KAZ OIL TERMINAL PROJECT

Environmental and Social Impact Assessment

On behalf of:
Waterway Trading & Petroleum Services LLC

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Contents

Acronyms and Abbreviations

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ACMs	Asbestos Containing Materials
BIOGH	Basra International Oil and Gas Hub
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CEMP	Construction Environmental Management Plan
cfu	Coliform Forming Units
CMP	Contractor Management Plan
CPA	Coalition Provisional Authority
CO	Carbon Monoxide
CSM	Conceptual Site Model
CSSF	Common Seawater Supply Facility
dB	Decibel
DWB	Deeper Water Berth
DETR	Department for the Environment, Transport and the Regions
DO	Dissolved Oxygen
DoE	Department of Environment
DWT	Deadweight Tonnage
EA	Environment Agency (UK)
EAME	Earth & Marine Environmental Consultants
EIA	Environmental Impact Assessment
EC	European Community
ECC	Environmental Compliance Certificate
EHS	Environment, Health and Safety
EPC	Engineering, Procurement and Construction
EQ	Equator Principles
EQS	Environmental Quality Standards
ERW	Explosive Remnants of War
ES	Environmental Statement

ESIA	Environmental and Social Impact Assessment
ESMS	Environmental and Social Management System
ESMMP	Environmental and Social Management and Monitoring Plan
EU	European Union
FEED	Front End Engineering Design
GCPI	General Company Ports of Iraq
GDP	Gross Domestic Product
Ha	Hectares
HAZID	Hazard Identification
HAZOP	Hazard and Operability Study
H_2S	Hydrogen Sulphide
HGV	Heavy Goods Vehicles
HSSE	Health, Safety, Security and Environment
Hz	Frequency
HSSE	Health, Safety, Security and Environment
IBA	Important Bird Area
IDCF	Iraqi Defence Coastal Force
IEEM	Institute of Ecology and Environmental Management
IEMA	Institute of Environmental Management and Assessment
IFC	International Finance Corporation
IFC EHS	IFC Environmental Health and Safety General Guidelines
IFC PS	IFC Performance Standards
IGRS	Iraqi Geospatial Reference System
IPA	Iraqi Port Authority
IUCN	International Union for Conservation of Nature
IS	Islamic State
KAZ	Khor Al-Zubair
km	Kilometres
km^2	Square Kilometres

KPI	Key Performance Indicators
KZP	Khor Al-Zubair Port
IS	Islamic State
LER	Local Equipment Rooms
LPG	Liquefied Petroleum Gas
LNG	Liquefied Natural Gas
m	Metres
m^3	Cubic Metres
MDM	Multi-buoy Mooring
MCERTS	Monitoring Certification Scheme
mg/m_3	milligram per cubic metre
mg/l	milligram per litre
MoC	Ministry of Culture
MoE	Ministry of Environment
MoF	Ministry of Finance
MoH	Ministry of Health
MoO	Ministry of Oil
MoT	Ministry of Transport
MoWR	Ministry of Water Resources
Mt	Metric tonnes
NEPC	National Environmental Protection Council (Australia)
NGO	Non-governmental Organisation
NORM	Naturally Occurring Radioactive Material
NOx	Nitrogen oxides
NTS	Non-Technical Summary
OSERP	Oil Spill Emergency Response Plan
ORP	Oxygen Reduction Potential
PAHs	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyls

PID	Photo-Ionisation Detector
PM10	Particulate Matter up to 10 micrometres in size
PM2.5	Particulate Matter up to 2.5 micrometres in size
PM1	Particulate Matter up to 1.0 micrometres in size
ppm	Parts per million
PPM	Planned Preventative Maintenance
ppmv	Parts per million by volume
ROPME	Regional Organisation for Protecting the Marine Environment
SKA	SKA International Group
SO_2	Sulphur Dioxide
SO_4	Sulphate
SOP	Standard Operating Procedures
SRFO	Straight Run Fuel Oil
SVOCs	Semi-Volatile Organic Compounds
SWMP	Site Waste Management Plan
TDS	Total Dissolved Solids
ToC	Total Organic Carbon
ToR	Terms of Reference
TPH	Total Petroleum Hydrocarbons
TSP	Total Suspended Particulates
UAE	United Arab Emirates
µg/l	microgram per litre
UK	United Kingdom
UKAS	United Kingdom Accreditation Service
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
USACE	United States Army Corps of Engineers
US EPA	United States Environmental Protection Agency

UXO	Unexploded Ordnance
VOCs	Volatile Organic Compounds
VR	Vacuum Residue
WHO	World Health Organisation
WP	WorleyParsons
WTPS	Waterway Trading & Petroleum Services LLC

Chapter 1 - Introduction

Contents

1 Introduction

1.1 General

This document reports the findings of an Environmental and Social Impact Assessment (ESIA) that has been undertaken to assess the potential adverse and beneficial impacts and associated mitigation and management measures for the Khor Al-Zubair (KAZ) Oil Terminal Project in Southern Iraq. This is a development by Waterway Trading & Petroleum Services (WTPS) who have commissioned this study.

This ESIA has been prepared in-line with requirements outlined within Protection and Improvement of the Environment (Law No. 27, 2009) and in accordance with Iraqi National guidelines (where available), internal BP performance recommendations and International Finance Corporation (IFC) Performance Standards (PS) and Environmental Health and Safety (EHS) Guidelines.

The ESIA has been undertaken by Earth & Marine Environmental Consultants (EAME), a multi-disciplinary environmental consultancy practice that has competence and specialises in such studies and which has extensive experience of and operational bases and teams in Iraq.

1.2 Background to the Iraq Oil Terminal Project

WTPS intends to construct a new marine terminal for the import (and eventually export) of refined petroleum products.

As a result of armed conflicts, trade sanctions and isolation from the international community for decades, Iraq does not presently have the resources to provide refined petroleum products at a sufficient rate to meet demand. As such, the import of these products is required to facilitate the reconstruction of Iraq and growth of its economy and the proposed terminal will be a major contributor to this.

Furthermore, Iraq has a distinct lack of suitable export facilities for refined products. Therefore, when the country’s refining capability has reached levels that it is able to export refined products, the proposed terminal will help to meet these future export ambitions.

The proposed development is located on the western bank of the Khor Al-Zubair channel, adjacent to the Khor Al-Zubair Port (KZP) and the KZP Freezone.

Figure 1.1: *Location of the Khor Al-Zubair (KAZ) Iraq Oil Terminal Project*

United States Central Intelligence Agency (2004), 1:6,000,000 Map of Iraq

The Terminal will provide berthing facilities, storage infrastructure, truck loading/unloading facilities and all associated utility and support systems. The Terminal will provide multiple berths capable of discharging vessels up to 47,000 deadweight tonnage (DWT). The construction of the Terminal will be phased: the first phase being a single Deeper Water Berth (DWB) and associated pipeline connection to the existing SKA bulk storage terminal within the Freezone; subsequent additional phases will include storage tanks and associated utilities, with the potential to accommodate storage capacity up to 300,000m^3. The Terminal will be constructed to the appropriate international industry standards using reliable and proven technology and will be operated in accordance with standards and practices generally prevailing in the petroleum marine terminal and storage industry. A fuller description of the development is provided in *Chapter 3*.

Although there are existing operating facilities/berths within a few hundred metres of the proposed site, the Terminal is effectively located on a 'Greenfield site'.

1.3 ESIA Process

1.3.1 Aims

The principal aim of the ESIA process is to protect the environment and the quality of life by ensuring that a project which may have significant environmental effects, is subject to a formal assessment before permission is granted and/or the Project is implemented. It also provides an opportunity for consultation with potentially affected stakeholders.

1.3.2 Objectives

The overall objective of the ESIA process is to identify and, wherever possible, eliminate or minimise adverse environmental or socio-economic impacts arising from activities associated with the Terminal and to incorporate appropriate mitigation into the design, construction and operation. The purpose of the ESIA process is to:

- identify and assess the anticipated positive and negative environmental and socio-economic impacts of the Project;
- identify and analyse alternatives to the Project;
- recommend mitigation measures for significant negative impacts and enhancement measures for positive impacts to be implemented during the construction and operation of the Terminal;
- verify compliance with Iraqi environmental regulations and policies, World Bank Safeguard Policies, and industry best practice and standards;
- generate baseline data for monitoring and evaluation of executed mitigation measures (if any) during the operation of the Terminal;

- seek the views of relevant stakeholders (including the public); and
- prepare an ESIA Report compliant with recognised national and International standards.

1.3.3 Scope

This ESIA covers all activities that are located within the defined Project boundaries during the construction and operational phases of the development and addresses all aspects of the natural, physical and social environment that could be impacted by the development, *i.e:*

- Socio-economic context;
- Soils, Geology and Hydrogeology;
- Surface Water and Sediment Quality;
- Air quality;
- Noise;
- Marine, Intertidal and Terrestrial ecology;
- Cultural Heritage and Archaeology; and
- Waste Management.

In each case the assessment involves defining the baseline conditions, assessing the potential impacts of the development (i.e. how those baseline conditions may be altered and how significantly), definition of mitigation measures to address significant adverse effects and an account of the residual impacts.

1.3.4 ESIA Stages

The ESIA process is outlined below:

- **Environmental and Social Screening** – This involved the early identification of environmental and social impacts in order to develop an understanding of the key environmental and social issues and the potential impacts related to the project.
- **Project Definition** – This involved the evaluation of alternatives with regard to the Project concept, location, technical approaches and mitigation options.

- **Scoping** – This activity has involved a number of components including stakeholder identification and preliminary consultation, the development of an environmental and socio-economic baseline for the Project and identification of potential impacts destined for detailed assessment.

- **Stakeholder Consultation** – This has included both the distribution of Project information to key stakeholders (*e.g.* local communities and authorities, non-governmental organisations (NGOs)) and further identification of potential impacts through face-to-face meetings. It is recognised that consultation and dialogue are important activities and that engagement will also continue throughout construction and operational phases.

- **Baseline Environmental and Socio-economic Data Collection** – This involved the identification of environmental and socio-economic baseline conditions through review of existing data and undertaking of appropriate environmental and social surveys.

- **Environmental and Social Assessment** – This involved the identification and assessment of potential construction and operational impacts including an appraisal of their significance. Furthermore, it has included the investigation and development of measures to mitigate potentially significant negative impacts and enhance benefits associated with the proposed development.

- **Public Disclosure** – Public disclosure has been initiated via the publication of a range of draft disclosure materials, such as the non-technical summary (which will also be provided in Arabic).

Whilst this ESIA report presents the findings and recommendations of the ESIA process prior to project implementation, the inclusion of an Environmental and Social Management and Monitoring Plan (ESMMP) will focus of on-going management activity as the development progresses beyond construction and into operation.

The management and monitoring plan provides the technical basis for development and implementation of a focused Environmental and Social Management System (ESMS) to manage all relevant activities during both the construction and operational phases of the Project. As such, the intention is that the management and monitoring plans will evolve and be further developed as the implementation of the Project is progressed with a view to achieving continual improvement of performance against Project Key Performance Indicators (KPIs).

1.4 Project Team

EAME were appointed by WTPS in June 2014 to undertake the ESIA for the Project. The specific ESIA team members are outlined below:

- **Project Director: Steve Rowan** – The Project Director for the project will be Steve Rowan, who is a Chartered Chemist with over 25 years' experience as an environmental specialist. He has worked on sampling and analysis programmes for almost every industrial sector and is an expert on international environmental regulations, protocols and best practice and has worked on large scale projects in Southern Iraq for a number of years.

- **Project Manager: David Wells** – David has extensive experience of designing; managing and executing both onshore and offshore field work in Iraq and is experienced in a range of environmental consultancy projects, particularly environmental baseline surveys, auditing, and site characterisation, auditing and monitoring.

- **Social Impact Assessment Specialist: Zainab Al-Ribhawi** – Zainab is EAME's in-country Iraqi Project Manager who is able to speak both Arabic and English. She is an experienced Project Manager, Project Coordinator and trainer, plus has been a team leader, observer and Liaison Officer for various UN agencies in Iraq. She has specific training in Security with NCA, women rights with (NIRAS) AIHR, human rights with mercy hands humanitarian society, proposal writing and project cycle management with mercy hands humanitarian society, conflict resolution with mercy hands humanitarian society, accounting by NDI, negation and mediation (Baghdad University Social Centre), various biochemistry and water analysis courses, radio operator training with International Medical Corps and collection of information from IDPs and Refugees camps. In addition she is an experienced environmental scientist and chemist and has worked on all of EAME's field campaigns over the last 4 years.

- **Terrestrial Ecological Specialist: Josh Smithson** – Josh has over 8 year's ecological experience working in the UAE, Qatar, Algeria, Kazakhstan, Australia and the UK. During this time he has designed, coordinated and led field surveys varying from three days to six weeks. Josh is trained in the safe handling of animals, inclusive of reptiles, and regularly undertakes surveys for IUCN Red List Species. Josh is responsible for the compilation and implementation of Health and Safety protocols for all ecological field work. With many surveys taking place in Oil and Gas Concession Areas, he is trained in H2S awareness and the appropriate use of Breathing Apparatus. Josh's relevant skill base includes: international Ecological Impact Assessments, environmental management plans, biodiversity assessments, protected species licensing and mitigation plans, land rehabilitation and habitat management, invasive fauna and species control and mitigation plans.

- **Marine Ecological Specialist: Steven Atkinson** – Steven has experience of undertaking marine ecological sampling and monitoring in Iraqi territorial waters including the mouth of the Khor Al-Zubair and Khor Abdullah. This includes collecting phytoplankton, zooplankton and benthic organisms whilst complying with CEFAS SOPs as well as recording the appearance of marine mammals and seabird. Steven is currently studying for an MSc in Marine Planning and Management and is a certified Marine Mammal Observer (JNCC accredited), Gulf of Mexico Protected Species Observer (BOEM and BSEE accredited) and qualified open water, advanced open water and rescue diver. In addition, Steven holds BOSIET and MIST, Norwegian Escape Chute Training and current UK and Norwegian Offshore Medical accreditation.

- **Noise and Vibration Specialist: Steve Butler** – Steve Butler is an environmental consultant who has in excess of 15 years industrial and corporate experience. He holds a Post Graduate Diploma in Acoustics, Vibration and Noise Control and has extensive experience in noise monitoring and impacts assessments. Steve also has a broader range of experience in environmental auditing, having undertaken due diligence audits on behalf of EBRD in Eastern Europe, Russia and Turkey and has worked on noise and air quality monitoring projects in Iraq for Environmental Baseline Surveys.

- **In-country Environmental Specialist: Abbas Balasem** – Abbas is a former regional Director of the Iraqi Ministry of Environment and has extensive knowledge and contacts within governmental departments and has worked for EAME on numerous projects in Iraq.

- **Project Health and Safety Manager: Michael Sylvester** – Michael is a Technical Manager and has over fifteen years consultancy experience in EHS projects and two years industrial experience. Michael is an experienced auditor and is well versed in H&S legislation, EHS management systems, environmental permit applications and undertaking EHS and environmental audits. Michael holds a NEBOSH National Diploma in Occupational Health and Safety (Level 6) (DipNEBOSH) and is a Graduate Member of the Institution of Occupational Safety and Health (Grad IOSH).

- **Field Scientist: Asaad Hameed** – Biology graduate and a former employee at the Ministry of Health, Asaad is a field scientist with attention to detail and a high level of accuracy in preparing and entering information. In addition, Asaad is highly skilled in NGO management and administration as he has been involved with such organisations as the International Research and Exchange Board, International Organisation of Migration, United Nations Office for Project Services and USAID/NDI since 2005.

- **Field Scientist: Aqeel Ahmed** – Aqeel is a bilingual field scientist experienced in soil, sediment, groundwater and surface water sampling and lives in Basra.

1.5 ESIA Structure

The ESIA document is presented in a series of chapters and supporting appendices as outlined in *Table 1.1*.

Table 1.1: Structure of the ESIA Report

Volume/Report Section	Description
VOLUME I – NON TECHNICAL SUMMARY	
Non-Technical Summary	A summary of the ESIA report using non-technical language. This has been produced in both English and Arabic and summarises every aspect of the ESIA in a way that is understandable to the non-expert reader.
VOLUME II – ESIA REPORT	
Acronyms and Abbreviations	A glossary of common abbreviations and acronyms used.
Chapter 1 – Introduction	A general introduction to the Project, a brief outline of the objectives of the assessment, and the report structure of the ESIA.
Chapter 2 – Approach and Methodology	A description of the methods used to conduct the ESIA assessment.
Chapter 3 – Project Description	A detailed description of the Project.
Chapter 4 – Policy, Legal and Administrative Framework	A summary of relevant environmental and social standards and guidelines and BP HSE policy, environmental and social standards and expectations.
Chapter 5 – Air	A description of the baseline conditions for air, noise and climate and how these may be impacted by the development (and to what level of significance) and a discussion of mitigation measures for significant impacts and summary assessment of the residual impacts.

Table 1.1: Structure of the ESIA Report	
Chapter 6 – Land	A description of the baseline conditions for geology, soils, sediment and waste and how these may be impacted by the development (and to what level of significance) and a discussion of mitigation measures for significant impacts and summary assessment of the residual impacts.
Chapter 7 – Water	A description of the baseline conditions for surface water and groundwater and how these may be impacted by the development (and to what level of significance) and a discussion of mitigation measures for significant impacts and summary assessment of the residual impacts.
Chapter 8 – Ecology	A description of the baseline conditions for terrestrial, inter-tidal and marine ecology and how these may be impacted by the development (and to what level of significance) and a discussion of mitigation measures for significant impacts and summary assessment of the residual impacts.
Chapter 9 – Social-economic Conditions	A description of the baseline conditions for socio economic conditions, marine and land traffic, cultural heritage and archaeology and how these may be impacted by the development (and to what level of significance) and a discussion of mitigation measures for significant impacts and summary assessment of the residual impacts.
Chapter 10 – Hazard Analysis and Risk Assessment (Unplanned Events)	An assessment of the potential environmental and socioeconomic impacts associated with unplanned events associated with the Project.
Chapter 11 – Summary & Conclusions	A high-level summary of residual impacts associated with the Project and a summary matrix of all impacts and mitigation measures.
VOLUME III – TECHNICAL APPENDICES	
Appendix A - Contributors	Details of the participants, contributors and local institutes involved in the production of the ESIA.
Appendix B – Constraint Maps	Maps of environmental, cultural heritage and social constraints surrounding the Project site.

Table 1.1: Structure of the ESIA Report	
Appendix C – Public Consultation and Disclosure	Results from the public consultation and disclosure process.
Appendix D – Environmental and Social Management and Monitoring Plan	Overarching ESMMP including individual topic management plans.
Annex E – Commitments Register	The register of all commitments made in the ESIA.

The ESIA has been presented in English and the Non-Technical Summary in Arabic and English. All efforts have been made to ensure that the Arabic translation of this ESIA is an accurate and true reflection of the intent and meaning the English original.

Chapter 2 – Approach and Methodology

Contents

2 ESIA Approach and Methodology

2.1 Introduction

This chapter describes the process undertaken to complete the Environmental and Social Impact Assessment (ESIA) that is the subject of this report. This chapter presents in particular, the methodology and rationale used to assess the significance of impacts that may result from the Project and identifies the potential impact scenarios that were considered.

The results of the baseline surveys, impact assessment, assignment of mitigation measures and discussion of residual impacts for each media considered are presented in subsequent chapters of this report.

2.2 ESIA Process

The principles of ESIA are now widely established both nationally and internationally. *Figure 2.1* illustrates the key stages in the general approach.

All major projects will cause some changes to the environment. In the past the ESIA process mainly identified what these changes would be and, after proposing mitigation, reported them to the decision maker. As ESIA has evolved, the emphasis has moved on to the reduction of potential adverse impacts and maximising potential benefits through appropriate design measures. Designing out the significant effects of a project is the central tenet of the approach.

As can be seen from *Figure 2.1* an iterative assessment process is shown in the central box of the diagram. The aim of the process is to design out or minimise potential impacts and to do so in a way that prioritises those that are potentially most significant.

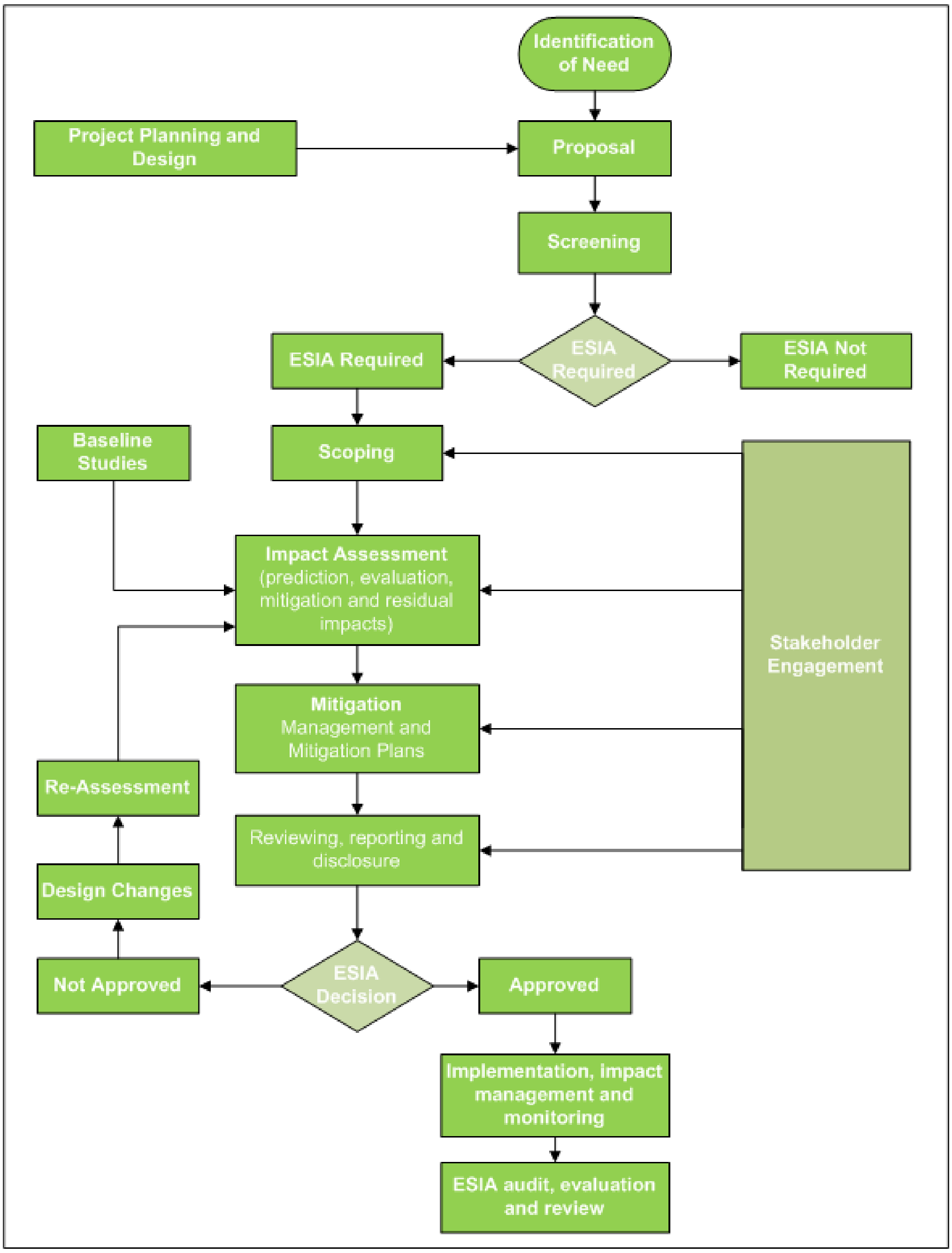


Figure 2.1: *ESIA process stages*

The assessment process constitutes a systematic approach to the evaluation of the proposed project in the context of the natural, regulatory and socio-economic environments in which development is proposed. Each of the steps in the ESIA process will be described in turn in the following sections. All of the potential impacts arising from this Project have been identified, and either standard, recognised industry-practice mitigation measures or impact-specific, feasible and cost-effective mitigation measures have been applied. Any potential impacts that remain after the application of mitigation measures are referred to as residual impacts.

The methodology takes account of potential impacts on a wide range of receptors including:

- the physical environment (*e.g.* climate, air quality, soil and groundwater quality);
- the biological environment (*e.g.* plants, animals, birds and their food chains); and
- the human environment (e.g. communities, social groups and individuals, employment generation, changes in per capita incomes, threats to vulnerable groups and exposure to health and safety risks).

The ESIA process at its core fundamentally seeks to answer a series of questions as follows:

Project Definition

What is the project, where is it located and what will be its likely area of influence both in what it could affect and who it could affect?

↓

Baseline Assessment

What are the key attributes and characteristics of the physical, biological and human environment that the project could interact with?

↓

Impact Assessment and Mitigation

How will the project construction and operation alter those baseline conditions, positively and negatively, and how will significant negative impacts be mitigated such that the residual impacts are environmentally and socially acceptable?

All residual environmental and social impacts are assigned a level of impact of low, medium, high or beneficial and are managed in the long-term by the application of a project specific Environmental and Social Management and Monitoring Plan (ESMMP).

2.3 Stakeholder Consultation and Disclosure

2.3.1 Overview

The process of stakeholder consultation and disclosure is an ongoing requirement that applies throughout the entire ESIA process. Consultation is important in gaining understanding of the key environmental and social issues relating to the site's proposed development and addressing the concerns of stakeholders as well as helping to develop mitigation strategies, if required.

2.3.2 Stakeholder Identification

Using EAME's particular knowledge and experience of Southern Iraq, the key stakeholders were identified and approached as part of the project. This was to ensure that the people who may be affected or who may have an interest in the proposed Terminal had an opportunity to obtain information about the Terminal and to express their opinions and concerns.

2.4 Screening Assessment

Screening is undertaken at the early stages of the project development process to identify potentially significant impacts and to determine whether an ESIA is necessary. Early identification of these potential impacts enables an early understanding of the key environmental and social issues and the potential project impacts. It results in a list of prioritised potential impacts that are likely to require either further detailed assessment and/or management throughout the life cycle of the project. The output from screening informs the scoping assessment.

Screening for the Iraq Terminal project was undertaken by Waterway Trading & Petroleum Services LLC (WTPS), in the UK on 22nd April 2013 in conformance with internal policies on Environmental and social Requirements for New Access Projects, Major Projects, International Protected Area Projects and Acquisition Negotiations".

The screening process determined that an ESIA would be necessary for this project given its scale and location.

2.5 Scoping Assessment

An important stage in the ESIA process is the scoping of key environmental and social issues that need to be evaluated more thoroughly. An ESIA is a multidisciplinary study and its success in connection with any given project depends largely on the ability to identify at an early stage the key environmental and socio-economic issues that should be addressed. Scoping is the process of determining which issues are likely to be important and defining the ESIA Terms of Reference (ToR). The Scoping exercise is also an opportunity for initial consultation with potential stakeholders and feedback from them on the approach being applied. A successful scoping exercise should:

- Describe the project sufficiently that stakeholders understand the nature and scale of the proposals and where they will be implemented;
- identify the impacts to be assessed and how they will be assessed; and
- Invite input from stakeholders as to the adequacy of what is being proposed and whether or not they hold additional information that might be available and relevant to the study.

The outcome of the scoping assessment should also identify where uncertainty remains (i.e. further information is required in order to conduct a robust assessment).

2.6 Evaluation of Alternatives

The ESIA should also seek to evaluate alternatives to the proposed project in terms of scale, site location, methods of delivering the project objectives and including a "do nothing" option (i.e. seeking to address the need for the development).

A discussion of the alternative options that were assessed and/or discounted during the Project development process and ESIA is provided in *Chapter 3*, including the social and environmental implications of a 'no development option'.

2.7 Legislative Review

The legal, policy and administrative framework review for this Project is described in *Chapter 4*. This review addresses social and environmental requirements and policies relevant to the Project at the following levels:

- Iraqi government laws and agreements;
- International conventions that Iraq has ratified;
- World Bank Standards;
- UK standards and practices;

- other national legislation and policies; and
- WTPS policy and management systems.

A detailed review of the legal and policy framework ensures that the Project has been assessed (as far as is reasonable practicable) against relevant existing environmental and social regulations and guidelines as well as WTPS's environmental, social, ethical and business policies and standards.

2.8 Baseline Assessment

The results of the scoping study indicated that there were certain key issues requiring detailed additional study for the Project area, and that certain existing baseline data for the Project were either insufficient or out of date and required supplementary information. The detailed baseline surveys therefore conducted for the ESIA addressed the following aspects:

AIR	▪ **Air Quality** (chemicals and particulates)
	▪ **Climate** (weather and seasons)
	▪ **Noise** (ambient noise levels and sources)
LAND	▪ **Soil** (chemical and physical attributes)
	▪ **Geology** (geological units and strata)
	▪ **Sediment** (chemical and physical attributes)
WATER	▪ **Surface Water** (chemical quality and dynamics)
	▪ **Groundwater** (chemical quality and dynamics)
ECOLOGY	▪ **Terrestrial** (habitat and biodiversity)
	▪ **Inter-tidal** (habitat and diversity)
	▪ **Marine** (habitat and diversity)
SOCIAL	▪ **Traffic** (land and marine)
	▪ **Socio-economic** (employment, land-use and recreation)

- **Culture** (heritage, archaeology and religious sites)
- **Demographics** (population, ethnicity and religion)

2.9 Impact Assessment

Once the baseline conditions have been established it is possible to begin the process of assessing the potential impacts of the project proposals, in other words, how the project proposals may change those baseline conditions.

A logical and systematic approach is taken to identify all potential impacts and screen out those that are deemed to be insignificant using robust and consistent risk ranking and evaluation criteria. This includes making sure that all indirect and cumulative effects are considered in addition to direct effects and of course considering positive as well as negative impacts.

The assessment of impacts considers both the short and the long-term impacts and includes all phases of the development (*i.e.* construction, production, decommissioning and post decommissioning), in accordance with industry norms.

Characteristics of the Potential Impacts

All of the potential effects of the development will be considered in detail according to the following characteristics:

- nature (positive, negative, direct, indirect, cumulative);
- magnitude (severe, moderate, low);
- extent/location (area/volume covered, distribution);
- timing (during construction, operation, decommissioning, immediate, delayed, rate of change);
- duration (short term, long term, intermittent, continuous);
- reversibility/irreversibility (temporary vs. permanent);
- likelihood (probability, uncertainty or confidence in the prediction); and
- significance (local, regional, global).

Evaluation of Potential Impacts

Once potential impacts are determined then the level of impact, in terms of its relative value, can be assessed. The key elements for evaluating impact include:

- level of stakeholder concern;
- professional and scientific judgment;
- disturbance/disruption of ecosystems;
- accord with relevant legislation and regulation; and
- degree of negative impact on social values and quality of life.

The purpose of impact evaluation is to assign relative significance to the predicted impacts associated with the development and then to determine the priority in which impacts are to be avoided, mitigated or compensated. This ranking is obtained from the determined importance of the environmental impact and to the concerned communities.

All impacts identified and their relative significance are presented in a detailed impact assessment matrix in this ESIA report. This allows risk ranking of the identified impacts and identifies all impacts that have been screened out as being insignificant with an appropriate justification for why these have been screened out.

Preventing, Mitigating and Monitoring

Once all of the significant impacts have been identified, these should be mitigated or reduced to an acceptable level of significance where possible. Wherever possible, unacceptable impacts should be avoided by altering the project design or construction.

Monitoring programmes generally arise from the findings of the assessment, and are based on the identified potential impacts and sensitive areas environment, including communities and natural resources.

Socio-economic Impacts

Impacts on local populations and communities may disrupt current local lifestyles and livelihoods; however, there may also be positive impacts by providing employment in an otherwise depressed area. Current resource use, such as agriculture, wildlife harvesting, fishing, and tourism are important and cultural issues must also be considered.

Social impacts can be divided into four main types:

- *demographic impacts* such as changes in population numbers and characteristics (such as sex ratio, age structure, in-and-out migration rates and resultant demand for social services, hospital beds, school places, housing *etc*);
- *cultural impacts* including changes to shared customs, traditions and value systems (*e.g.* language, dress, religious beliefs and rituals) archaeological, historical and cultural artefacts and to structures and environmental features with religious or ritual significance;
- *community impacts* including changes in social structures, organisations and relationships and their accompanying effect on cohesion, stability, identity and provision of services; and
- *socio-psychological impacts* including changes to individual quality of life and well-being, sense of security or belonging and perceptions of amenity or hazard.

Residual Impacts

All the residual negative impacts found to have a medium or high significance and any the impacts that are found to be significantly beneficial shall be reported and appropriately mapped.

Chapter 3 – Project Desciption

Contents

3 Project Description

3.1 Introduction

This chapter of the ESIA describes the planned activities and operations that the Project will entail in relation to construction, commissioning, operation, maintenance and decommissioning of the Terminal and related infrastructure. It should be noted that at this stage, the descriptions relate to the current base case for the proposed Project design and implementation. This base case is subject to refinement and potential change during the detailed engineering phase, although any changes are expected to be of a localised nature relating to operational detail and construction and operation practicalities. A fundamental change in scale, form, location or concept for the development is not anticipated.

3.2 Overview

Waterway Trading & Petroleum Services LLC (WTPS) intends to construct a new marine terminal on the Khor Al-Zubair River, close to the Khor Al-Zubair Port (KZP) in Southern Iraq. The Project is required to help accommodate Iraq's current and future import and export requirements for refined petroleum products.

The Terminal will provide berthing facilities, storage infrastructure, truck loading/unloading facilities and all associated utility and support systems. The Terminal will provide multiple berths capable of discharging vessels up to 47,000 deadweight tonnage (DWT). The construction of the Terminal will be phased, with a final storage capacity currently anticipated to be in the region of 300,000m^3. Ultimately facilitating the import of up to 900,000m^3 per month of distillate products.

The Terminal will feature truck racks enabling discharging and loading which will expand the site's flexibility and allow for the import and export of products from the same facilities. Pumps and heating facilities will be provided to allow for the handling of a variety of petroleum products and modern firefighting and security systems as well as emergency response equipment will be installed to ensure that the site will be operated to international Health, Safety, Security and Environment (HSSE) standards.

In summary, the Terminal will allow for the following:

- *Increased cargo sizes:* The river frontage allows the construction of dedicated purpose-built deeper water oil berths allowing increased cargo sizes and improved freight economics;

- *Provision of Storage Tanks:* Import into tankage (rather than direct into trucks) will further improve economics by providing buffer storage between vessel discharge and truck loading, thereby, shortening ship discharge times and reducing demurrage costs; and

- *Truck Loading Racks:* Installation of truck loading racks will enable high storage turnover rates and facilitate high terminal throughputs.

3.3 Project Location

The proposed development is located on the western bank of the Khor Al-Zubair river, adjacent to (to (south of) the KZP and the KZP Freezone. Umm Qasr Port is 14km south of the site, Basra City Centre is 37km to the north and the border crossing into Kuwait at Safwan is located 19km to the south-west of the site see (*Figure 3.1* and *Figure 3.2*).

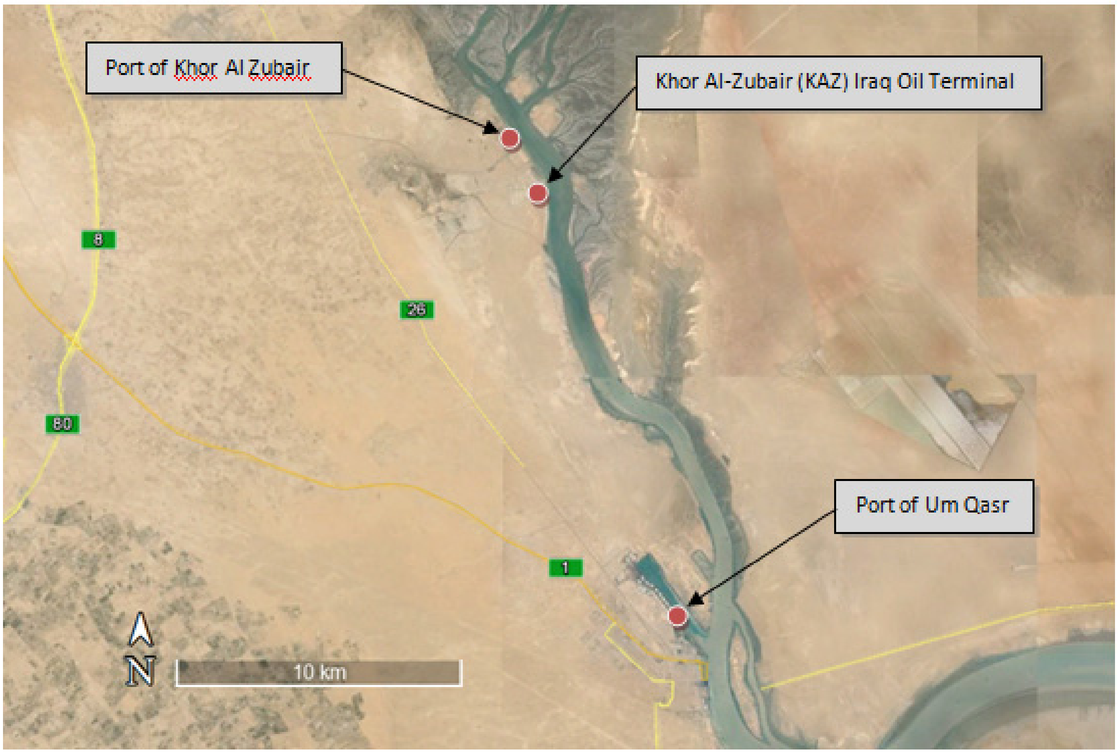


Figure 3.1: *Location of the proposed Terminal development*

Google Earth Pro Imaging with the permission of Google Licensed to Earth and Marine Environmental Consultants Ltd

Figure 3.2: *Proposed site outline*

Google Earth Pro Imaging with the permission of Google Licensed to Earth and Marine Environmental Consultants Ltd

3.4 Site Description

The site outwith the port curtilage is presently unoccupied and unfenced (although access to the site from the port is via a locked gate). The site can be characterised as a partially (sparsely) vegetated sabhka environment with a corresponding foreshore of intertidal mudflats subject to daily tidal inundation.

There is presently no built development on the site and no infrastructure of any kind (other than around Berth 1 which is part of the Port). Furthermore, there is nothing to demarcate the site from the surrounding land in terms of visible boundaries or fencing (other than at the Port boundary). There is no discernible difference between the site and surrounding land, which stretches for many kilometres with little change in relief or features. Other than a narrow strip of intertidal vegetation that is exposed at low tide (approximately 20m wide) and patches of sabhka vegetation, the site is featureless and characterised by dry silty sand with salt encrustation. There is evidence of disturbance of some of the soils by heavy plant and some accumulations of earth mounds from earthworks activities. Also there is an earth bank road running along the site parallel to the shoreline with two smaller earth bank roads extending to the water line. Typical views of the site are presented in the photographs overleaf:

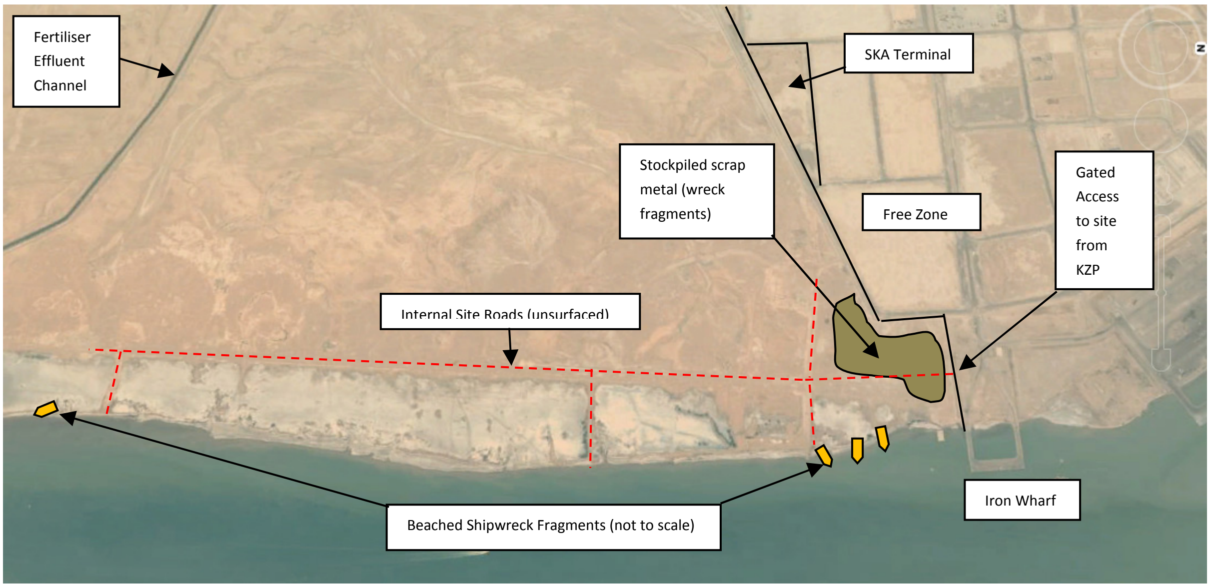


Figure 3.3: *Notable site features*

Photograph 3.1: *Aerial photograph of the site and surrounding area*

Photograph 3.2: *Distant view of site from the SKA terminal (note wreck fragments on shoreline)*

Photograph 3.3: *Shipwreck scrap fragments deposited on-site*

Photograph 3.4: *View across the site from southern boundary*

Photograph 3.5: *View along foreshore towards LPG Terminal at low tide*

Photograph 3.6: *View along foreshore towards KZP at low tide*

Photograph 3.7: *View to the project site from KZP Berth 1*

Photograph 3.8: *View of the site from Khor Al-Zubair at low tide*

Photograph 3.9: *Shipwreck debris on the shoreline on the Project site*

3.5 Project Rationale

Over the coming years and in particular the near to mid-term (next 5 – 10 years), Iraq is expected to become increasingly short of refined petroleum products due to the lag between oil production capacity and installed modern refining capacity. These shortfalls will eventually be met by the construction of new refineries and the expansion and upgrade of existing refineries, to the extent that the expectation is that Iraq will eventually become a net exporter of refined products. In the meantime, however, there is a demonstrable import need to assist in the reconstruction effort and economic growth of Iraq and associated improvements in living standards. At present, there are no suitable import/export oil product storage facilities in Southern Iraq, with KZP acting in such a capacity at present but with limited equipment, resources and capacity (and no holding capacity). As such, the Terminal will allow for the poorly maintained and inefficient infrastructure at KZP to be abandoned and the berths returned to their original design purpose of dry cargo import and export. Furthermore, once Iraq has developed its refinery infrastructure to an extent that a surplus is generated and can be exported, the Terminal will become a strategic export hub for Iraq.

The development of an import/export facility with direct sea access is also Iraq's only way of importing and exporting such products without having to go through neighbouring states (or now the highly unstable and insecure Islamic State (IS) region). In this respect it is a nationally strategic asset for a nation that derives over 90% of its Gross Domestic Product (GDP) from oil (and eventually oil products).

The National Development Plan 2013 - 2017, published in January 2013, has stipulated the following relevant goals with regards to development:

- Boost crude oil exports from the level of 2.6 million barrels per day in 2012 to 6 million barrels per day in 2017;
- Gradually increase crude oil storage capacity in export warehouse form 10,987 million barrels to 30.357 million barrels in 2017;
- Increase current refinery capacity of 600 thousand barrels per day in 2012 to 950 thousand barrels per day in 2017;
- Boost storage capacity for oil products to secure storage equivalent to 40 days consumption each for gasoline, gas oil, and liquid gas and 100 days consumption for white oil;

- Improving ports and building new ports meeting all environmental and health requirements with a sustainable capacity sufficient to absorb planned export quantities; and

- Protect the environmental and pollution and treatment environmental problems resulting from the oil and gas industry.

In summary, as a result of armed conflicts, trade sanctions and isolation from the international community, Iraq does not presently have the resources to provide refined petroleum products at a sufficient rate to meet demand (and fuel growth and modernisation). As such the import of these products is required and the proposed terminal will enable this. Furthermore, Iraq has a distinct lack of suitable export facilities for refined products. Therefore, when the country's refining capability has reached levels that it is able to export refined products, the proposed terminal will help to meet these future export ambitions.

3.6 No Development Alternative

If the project does not go ahead, there will evidently be no environmental and socio-economic impacts from construction or operation of such a facility, however, the potential positive benefits would also be lost, including:

- Loss of dedicated import and export facilities for refined petroleum products;

- The continued use of inefficient and poorly maintained infrastructure at KZP which prevent its reversion to its original design use of dry cargo (for which there is also a pressing requirement); and

- Loss of the social benefits of the employment opportunities and economic stimulus that the Project would generate.

Other than for the storage of large fragments of shipwreck scrap, the site is unused and unoccupied and alternate potentially beneficial uses are not presently proposed. The most likely use of the site would be as similar port/logistics related facilities with similar attributes and impacts as those proposed for the current project.

3.7 Location Alternatives

Prior to identifying and agreeing the location of the proposed Terminal site, other alternatives were actively assessed (including consideration of the potential environmental and social impacts). However, it is important to appreciate the location specific constraints represented by the Iraqi coastline (*i.e*. only 58km in length) and the presence of only two navigable rivers suitable for the location of a terminal project.

The proposed site is ideal for this project as adjacent to it is the SKA Terminal, an existing small capacity, newly built terminal located inside the KZP Freezone. A joint arrangement has been made with SKA to provide WTPS with access to the existing gasoil storage facilities and associated trucking loading racks. The SKA Terminal may potentially meet the short term gasoil demand without the immediate requirement for storage and truck loading facilities on the proposed site. However, the SKA Terminal will not be able to entirely fulfil the long term requirements particularly as there is little room for expansion. It does, however, allow for considerable operational benefits, but must necessarily have the berth terminals located close to it.

Furthermore, from early bathymetric studies of the area, it seems that the channel maintains a natural scoured minimum depth of 12m in this location, which means it forms a natural deeper water location for a loading berth, with minimal dredging requirements. It is also close (with direct access to) the port distributor roads which in turn connect to the main highway to Basra and the various development zones of the Southern Region.

The opposite bank of the Khor Al-Zubair is largely undeveloped and has no established transport infrastructure, so the construction project and logistics would be considerably larger than a development on the west side of the channel (as might the related impacts).

The alternate channel which could receive relatively large ships is the Shatt Al-Arab Waterway, however, there is a sandbar on the entrance to the channel that dries on certain tides (limiting accessibility times) and the channel has been neglected for many years in terms of maintenance dredging so is only around 8 – 10m in depth. Furthermore, there are many shipwrecks in the channel. Consequently, the Shatt Al-Arab Waterway would not be suitable for such a development, even if there was surrounding infrastructure to support it.

Considering the Khor Al-Zubair, therefore, the only logical option for such a berth, the only zone that is reachable from the navigable channel and accessible to transport infrastructure is the west bank. The area between KZP and the Liquefied Petroleum Gas (LPG) Terminal is the most suitable area for such a development and within that zone, the tie in with the existing and useful SKA Terminal determines that the facility should be close to this, which is also advantageous from a natural draught perspective.

Bearing the above discussion in mind, the selected site is the most practical site strategically and offers the opportunity for development with less construction, logistics, natural, environmental and social constraints than other locations.

3.8 Feasibility Studies

WorleyParsons (WP) have undertaken a feasibility study for the development of the proposed Terminal, the primary focus of which was on the alternative options for the marine facilities including:

- Upgrade of the existing Berth 1; and
- Development of a new Deeper Water Berth (DWB) either as a new Multi-Buoy Mooring (MBM) facility or a new jetty (with a single or double berth).

The key recommendation from the study was to build a single DWB as part of the first phase of the project. This recommendation was the basis for the technical development of the onshore terminal options. As such WTPS, identified a basic concept requirement for a phased development up to approximately 300,000m^3 product storage with all associated truck loading/unloading facilities and all other required utility and safety systems and supporting terminal infrastructure. The final Terminal development should be able to handle a product throughput of approximately 900,000m^3 per month utilising two berths.

3.9 Project Activities and Design

The onshore elements of the project includes:

- Tankage, of up to 300,000m^3, over three plots of land for the importation of gasoline and gasoil and the export of naphtha, Straight Run Fuel Oil (SRFO) and Vacuum Residue (VR);
- Associated process, pipelines, power generation, utilities, trucking facilities; and
- Civil and structural works such as earthworks, roads, flood protection, buildings and foundations.

The Terminal has been designed to handle up to five different products: gasoline, gasoil, naphtha, SRFO and VR. Gasoline and gasoil will be imported by marine tankers and offloaded into the tank farm before being exported via road tanks. Simultaneous truck loading and marine tanker unloading will be employed to increase the efficiency of the Terminal. Naphtha, SRFO and VR will be brought to the Terminal via road tankers and loaded onto marine tankers for export.

Gasoline, gasoil and naphtha will be stored in floating roof storage tanks while SRFO and VR will be stored in fixed roof storage tanks with a heating system and recirculation pumps to ensure a homogeneous temperature inside the tanks. Heat tracing will also be provided on all pipework which may contain VR. Road tank facilities will be sited in close proximity to the storage facilities, which will segregated into dedicated bays to prevent cross contamination.

The offshore elements of the project include:

- Jetty facility providing two berths of vessels ranging from 5,000 to 47,000 DWT;
- Access trestle to the jetty; and
- Topside elements to facilitate the import and export of products.

The jetty facilities will be designed to allow for unloading and loading of different products with from a maximum of two vessels at any one time.

3.10 Footprint and Land Requirements

The onshore proportion of the site covers a parcel of land approximately 1,500m by 500m, covering a total area of approximately 0.95km^2 (95 ha) with a perimeter of roughly 4,944m. It is understood that WTPS have secured a 25 year access/licence agreement with General Company for Ports of Iraq (GCPI) to develop the site.

When the Terminal is fully operational, it is envisaged that the site will comprise twenty-three buildings, six generic building types and in the region of thirty tanks totalling approximately 300,000m^3 of storage, as indicated in the layout below.

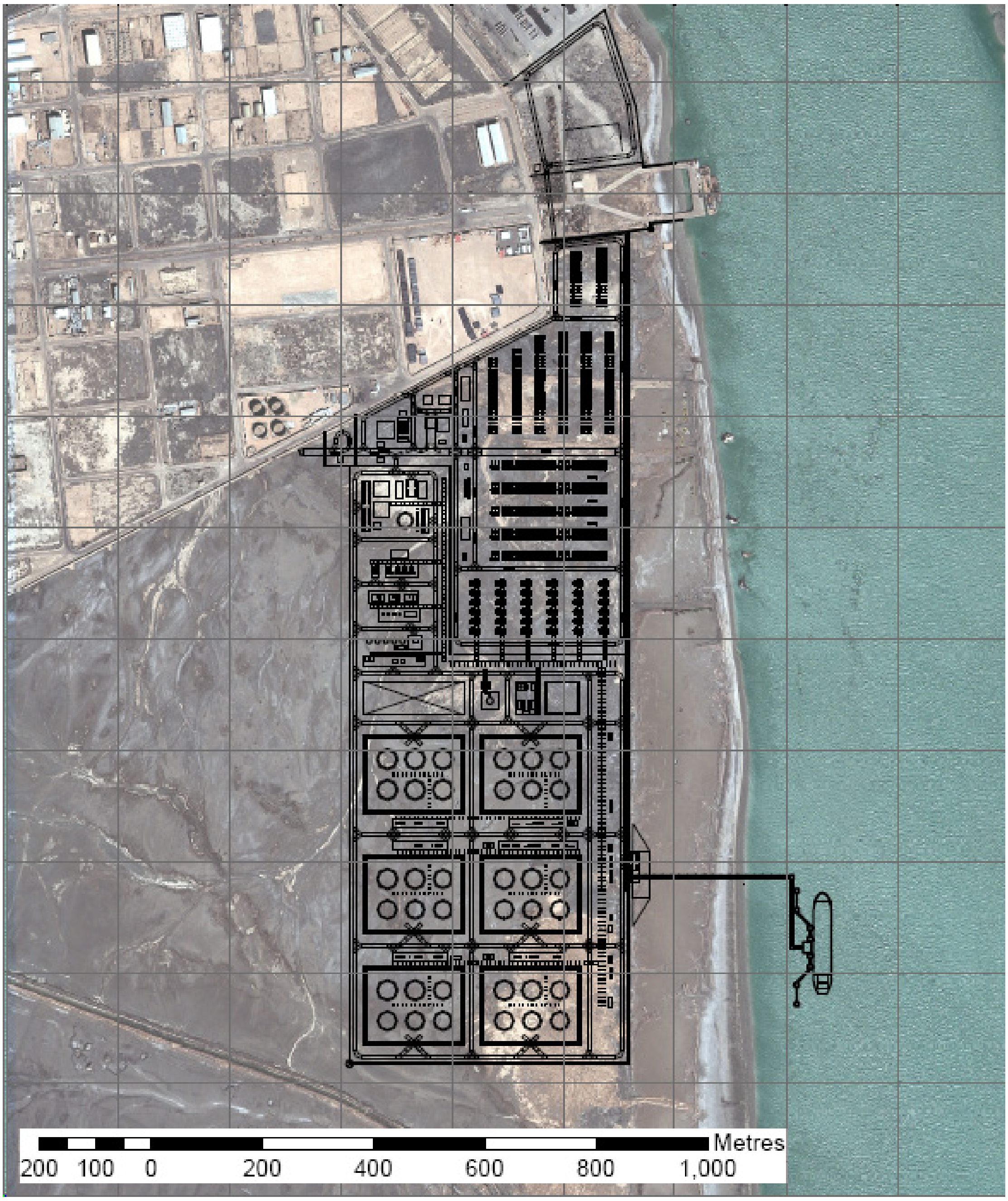


Figure 3.4: *Proposed final layout*

3.11 Construction Strategy

The Construction Strategy comprises the following elements:

- the facility will be built and commissioned in phases;

- It is anticipated that the facility would be stick built, utilising modularisation and Vendor Skids/Packages where it is deemed practical and beneficial to the project;
- Assessments will be utilised throughout the project to ensure construction risks are removed wherever possible; and
- The plant design will ensure that any impact on on-going operations is minimised during future expansion phases of the facilities.

To ensure minimal impacts to site operations during further expansion phases, some pre-investment will be undertaken so that subsequent phases can be completed efficiently. This will include:

- Early installation of tie-in isolation valves between the different phases of the facilities;
- A modular construction approach will be reviewed for the piperacks and construction of the jetty;
- Standardisation of design;
- Civil engineering works will be split between site preparation and bulk earthworks, followed by main civil works;
- Civil works will be planned to be completed ahead of the main mechanical and engineering and installation works;
- Construction of temporary facilities will be planned to be substantially complete prior to the start of the main construction activities;
- Dedicated project temporary facilities; and
- Dedicated residential and transport to be arranged for the construction workforce.

3.11.1 Phase 1

The project will be completed in a phased approach, Phase 1 will comprise the construction of the DWB, 1.5km tie-in 20” pipeline and rack to the SKA Terminal.

3.11.2 Subsequent Phases

Subsequent phases will include:

- Extension of the DWB;

- Full Site preparation, levelling and compaction;
- More extensive piling of the site for tank foundations;
- Installation of a network of roads;
- Construction of equipment, tank and pipe sleeper/pipe rack concrete foundations, sumps etc. for the storage tanks and associated pumping facilities;
- Fabrication/installation of structural and support steelwork;
- Construction/installation of all building for the project;
- Fabrication/installation/corrosion protection and thermal insulation/hydro testing of above and below ground piping;
- Expansion of utilities/plant/equipment including vendor skids/packages;
- Expansion of passive fire protection to equipment and steelwork;
- Installation/testing of all electrical equipment and cabling;
- Installation/calibration of instrumentation devices and cabling (including testing of loops); and
- Pre-commissioning and commissioning of the final phase of the expanded facility.

3.12 Temporary Facilities

Temporary facilities will be required in order to support the construction of the Terminal. At present the land to the west of the site, owned by the Ministry of Finance, is likely to be used for such a purpose. It is envisaged that the construction camp will be approximately 0.3km^2 in size and accommodate 2,000 workers. The indicative arrangements are shown below.

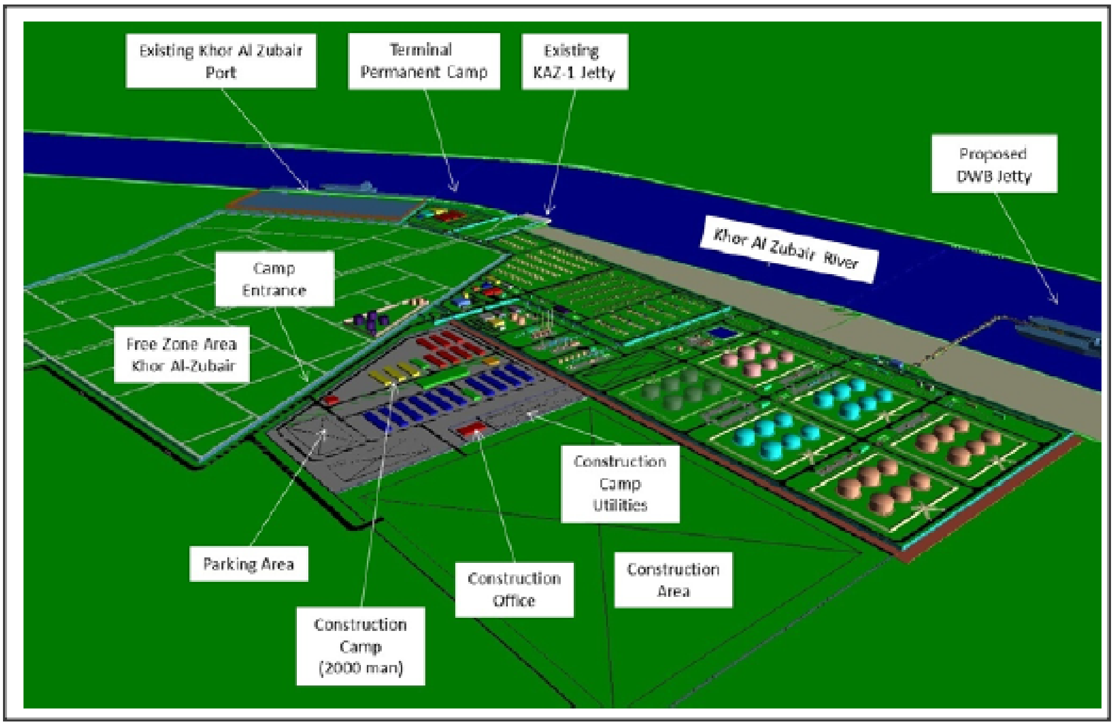


Figure 3.5: *Concept design for the temporary facilities*

The temporary facilities are likely to include:

- Fully functional temporary construction offices;
- IT and communications;
- HSE Induction and training centre;
- First Aid and emergency response centre
- Effluent water treatment and disposal;
- Temporary warehousing facilities;
- Material storage/laydown areas;
- Temporary fabrication shops and construction facilities;
- Pre-assembly area;
- Site parking lots for vehicles and plant;

- Temporary power generation and distribution to all facilities;
- Potable water system;
- Construction water system;
- Oxygen/acetylene supply/storage;
- Concrete batch plant (if required);
- Security gatehouse and guard posts;
- Security fencing;
- Construction accommodation with utilities and recreational facilities; and
- Construction offices.

3.13 Schedule

A phased construction approach will be adopted for this project and the construction schedule shall be part of the overall project schedule. The construction schedule will follow a Work Break Down Structure/Work Pack philosophy.

Construction milestones shall be included within the Construction Schedule, the milestones will be used to demonstrate and monitor that the project target completion dates are being achieved.

The precise schedule has not been specified at this stage as political disruption in Baghdad associated with the IS insurgency and change of government has places some uncertainty on the anticipated date of approvals to start, but construction works for Phase 1 are expected to commence in 2015.

3.14 Logistics Alternatives

Equipment will be imported into Iraq via ship. Ship is a safer and more efficient mode of freight transport than road haulage as it can transport substantially greater volumes of material per transit, involves less interaction with other users, is more fuel efficient, has lower emissions and causes less noise (due to distances from receptors) and less general nuisance.

Aggregates and general construction equipment sourced within Iraq will be transported within by road. There is rail infrastructure close to the site but this been damaged and inactive for many years and will not be serviceable within the timescale of the project.

Transport of materials and equipment by air has been discounted with the exception for emergency response and rapid evacuation personnel movements and small items of specialist equipment.

3.15 Commissioning

The equipment that will have been installed at the facilities, in most cases, will have undergone rigorous testing for certification by the manufacturer before it is delivered to the site.

After confirming that all systems and sub-systems have been built, aligned and documented in accordance with the design specification, drawings, codes, safety standards and statutory requirements, a dedicated commissioning team will undertake a commissioning programme that aims to prove that the facility functions as expected. The commissioning programme also provides an opportunity for the operational staff to become familiar with the operation of the new equipment.

3.16 Operation and Maintenance

The facility will be operated under international standard operating protocols and associated Health, Safety and Environmental Management Systems. An Environmental and Social Management and Monitoring Plan (ESMMP) has also been developed as part of the ESIA process that will be applied and audited periodically during the site operations.

The developer has substantial experience of designing, commissioning and operating such facilities over many years and has well developed training, management, monitoring, audit and review systems as well as sophisticated and detailed operational manuals and standard operating procedures. These are all subjected to external auditing programmes and monitoring systems.

Nonetheless, there is always the potential for accidental releases and malicious damage so the operator will also have in place Emergency Response Plans and Resources to deal with any such incidents. These are discussed in more detail under potential impacts later in this report.

3.17 Decommissioning

The Terminal is expected to operate for at least 25 years. Upon definitive cessation of operations, however, (which may also occur in phases or partially), a decommissioning plan will be implemented. This will set out the measures, techniques and resource requirements for de-polluting any storage and conveyance systems prior to their dismantling and will also set out measures for dealing with contamination that may have arisen as a result of the project activities. Prior to decommissioning, an environmental risk assessment will be undertaken to identify the final contaminative status of the site, with the intention being to remediate the site back to the baseline conditions that existed at the time of commencement of operations.

The exact details of how the site will be decommissioned will be determined as and when required and it is not possible to determine at what techniques will be used. However, these will be in accordance with industry and international standards and in accordance with tried and tested established decommissioning protocols used by WTPS and its stakeholders at other similar facilities.

The overall objective of the decommissioning programme will be to leave the site in a condition whereby there is little or no risk of the plant and equipment causing contamination of the soil and groundwater on the site or presenting a risk of harm to the natural and human environment in terms of residual materials at the facility.

Chapter 4 – Policy, Legal and Administrative Framework

Contents

4 Policy, Legal and Administrative Systems

4.1 Introduction

Given the economic and security challenges that the Iraq has faced, and still continues to face, environmental management has been neglected, however, there has been noticeable focus on the development and introduction of environmental legislation in more recent years, and the control and management of polluting industries and activities are becoming increasingly regulated. However, there is limited enforcement at present and there is a need for further development of such legislation and the associated enforcement regimes.

The main issues in Iraq with respect to constraints on the implementation of effective environmental protection measures are:

- there is limited effective institutional or administrative infrastructure for management of environmental protection regimes or promotion of sustainable development;
- there is limited participation in regional and global environmental agreements and processes; and
- there is limited adequate legislation or enforcement of this legislation.

The establishment of the Ministry of Environment (MoE) in September 2003, which gradually replaced the environment department within the Ministry of Health (MoH), has allowed for a more focused approach to the environment, and the development of new environmental legislation.

For example, Law No. (27) of 2009 for Protection and Improvement of the Environment has established penalties for companies and individuals that breach environmental standards. This is considered, at the current time, the primary environmental legislative instrument in Iraq. It also upholds existing regulations which have established environmental standards. Additionally, in terms of redevelopment projects, an Environmental Compliance Certificate is required for certain projects. In order to obtain such a certificate, an Environmental Impact Assessment (EIA) must be produced for the development proposals, which must be submitted to the MoE. This legislation should ensure that there is pre-project environmental evaluation of major projects before they commence and provides opportunities for environmental management and protection systems to be incorporated into new developments at the design stage.

The process developers must adhere to in order to obtain an Environmental Compliance Certificate is outlined in *Figure 4.1*. A full overview of Law No. (27) of 2009 is provided below.

Figure 4.1: *Obtaining an Environmental Compliance Certificate (Modified from USAID Investor Guide to Iraq September 2009[1])*

The Environmental Compliance Certificate (ECC) and associated EIA are not explicitly connected to port related developments in Law 27 (which makes no reference to Ports). Furthermore, the principal objective of the ECC seems to be the appropriate zoning and location of developments with respect to sensitive environmental receptors. The regulation

[1] http://pdf.usaid.gov/pdf_docs/pnadx187.pdf

focus on the distance from residential habitation that a certain type of industry must be located rather than specific environmental protection measures or emission limit values (which are prescribed more generically elsewhere in the legislation). Notwithstanding the lack of specific application to port related projects, the developer has elected to comply with the requirements of Law 27 and to undertake an ESIA to internationally recognised standards, the findings of which are presented in this report.

4.2 National Legislation

In addition to the aforementioned principal environmental law (*i.e.* Law No. (27) of 2009), there are various laws and instructions which will assist in the undertaking of an EIA and IEE, which establish assessment criteria against which environmental baseline conditions should be compared. *Table 4.1* summarises the principal environmental and other relevant regulations and instructions currently in operation within Iraq as well as providing details of which are applicable to the project.

Table 4.1: Iraq – Register of Environmental Regulations and Instructions

Name	Reference	Date	Additional Notes	Status	Project Relevance
Cities land use	Law 64	1965	-	Current	No
Rangelands and their Protection	Law 106	1965	Measures to organise grazing and to improve Ranges outside the areas irrigated by rivers, prohibit tree or shrub cutting or hay making for commercial or agricultural purposes without a licence.	Current	No. Site is not used for agricultural purposes.
Noise Prevention	Law 21	1966	Prevention of excessive noise in public places.	Current	No. Lack of public places in vicinity of site
Preservation of Rivers and Public Water from Contamination	Regulation 25	1967	Protection of rivers and public water bodies from contamination Wastewater discharges.	Current Updated in 2001	Yes. The Terminal will be operated to industry standard pollution prevention procedures to help reduce the risk of contamination. The Terminal will either utilise a bespoke sewage treatment plant or wastewater will be removed off-site.
Wastewater Discharge Quality Requirements	Instruction 1	-	Wastewater discharge concentration limits.	Current	Yes. The Terminal will either utilise a bespoke sewage treatment plant or wastewater will be removed off-site.

Table 4.1: Iraq – Register of Environmental Regulations and Instructions

Name	Reference	Date	Additional Notes	Status	Project Relevance
The New Determinants for the Prevention of Pollution of Rivers	Instruction 25	1967	Physical, chemical and biological guidelines for water quality and wastewater discharges.	Current	Yes. The Terminal will be operated to industry standard pollution prevention procedures to help reduce the risk of contamination. The Terminal will either utilise a bespoke sewage treatment plant or wastewater will be removed off-site.
Regulating the Exploitation and Protection of Aquatic Life	Law 48	1976	Regulates fishing and aquaculture.	Current	No.
Protection of Wild Animals and Birds	Law 21	1979	Breeding of wild animals in protected areas and the creation of natural habitats for wild animals and birds.	Current	Unlikely due to the low ecological sensitivity of the site, however, the Khor Al-Zubair is an Important Bird Area (IBA).
National Clean Air Act		1979	Local air quality standard	Current	Yes. Due to the site's operational activities.
Protection Against Ionizing Radiation	Law 99	1980	Ionizing radiation sources.	Current	No. No sources of radiation to be present on-site.

Table 4.1: Iraq – Register of Environmental Regulations and Instructions

Name	Reference	Date	Additional Notes	Status	Project Relevance
Internal Regulation of the State Organization for Land Reclamation	-	1980	Prescribes the tasks and structure of a public agency entitled 'The State Organization For Land Reclamation'.	Current	No. No land reclamation to be undertaken.
Public Health Act	Law 89	1981	Wide-ranging Act includes the burial of waste, protection for workers from the effects of vibration.	Current	Yes. The site will generate wastes during construction and operation. Appropriate PPE will be provided to personnel.
Environmental Protection and Improvement	Law 76	1986	Repealed by Law No. 3 (1997) on Protection and Improving the Environment.	Repealed	N/A
Safe Storage and Handling of Chemicals	Instruction 4	1989	Safe storage and handling of chemicals.	Current	Yes, however, the Terminal will utilise industry-standard procedures to minimise the risk.
Environmental Criteria for Industrial, Agricultural, and Public Service Projects	-	1990	Environmental requirements of industrial, agricultural and public service developments.	Current	Yes. It is likely that the Terminal will come under (64) Fuel Depot.
Chief of the Environmental Protection Board Concerning the Cutting of Trees	Decision No. 1	1991	-	Current	No. No trees are located on-site.

Table 4.1: Iraq – Register of Environmental Regulations and Instructions

Name	Reference	Date	Additional Notes	Status	Project Relevance
Noise emitted from sound equipment	Instruction 2	1993	Applicable to tourist facilities, concert venues etc.	Current	No
Establishing the Ministry of Irrigation	Law 8	1993	Resolution No. 68 of 1993 Promulgating Law No. 8 of 1993.	Current	Unlikely. Although, the Ministry's remit include planning of water resources and control of water flow, this is likely to be regarding irrigation rather than infrastructure developments.
Planning	Law 24	1994	-	Current	No
Maintenance of networks of irrigation and drainage	Law 12	1995	Provides for the management and maintenance of irrigation and drainage networks.	Current	Unlikely, however, it does provide for the management and maintenance of natural rivers.
Law Concerning Ports	Law 27	1995	Ports and the prevention of water pollution.	Current	Yes, however, the Terminal will be run using industry-standard procedures to help minimise the risk of pollution.

Table 4.1: Iraq – Register of Environmental Regulations and Instructions

Name	Reference	Date	Additional Notes	Status	Project Relevance
Protection and Improving the Environment	Law 3	1997	Revoked by Protection and Improvement of the Environment (Law No. 27, 2009). Regulations and instructions issued in accordance with the 1997 law shall remain in full force in a way not to contradict with the 2009 Law until replaced or cancelled. 1st amendment No.73 of 2001.	Revoked	N/A
Maintenance of Rivers and Public Water from Contamination	Regulation 25	1997		Current	Yes, however, the Terminal will be run using industry-standard procedures to help minimise the risk of pollution.
Preservation of Water Resources	Regulation 2	2001	-	Current	Yes. The Terminal will utilise water preservation techniques wherever possible.
Drinking Water Standards	Specification 417	2001	Drinking water standards.	Current	Yes.
The Law of Antiquities and Heritage	Law 55	2002	-	Current	No sites of cultural heritage located on or in the vicinity of the Terminal.

Table 4.1: Iraq – Register of Environmental Regulations and Instructions

Name	Reference	Date	Additional Notes	Status	Project Relevance
Arabian memorandum of understanding in cooperation in marine transportation	Law 6	2007	-	Current	No
RAMSAR Convention for the wetlands	Law 7	2007	-	Current	No. The nearest Ramsar site is located in the Mesopotamian Marshlands.
Vienna convention and Montreal protocol to protect the Ozone layer	Law 42	2007	-	Current	Yes. Equipment used on-site will not consume ozone depleting substances.
Climate Change Convention and Kyoto protocol	Law 7	2008	-	Current	No
UNESCO Convention to protect the cultural intangible heritage	Law 12	2008	-	Current	No
Convention for Biological Diversity	Law 31	2008	-	Current	No

Table 4.1: Iraq – Register of Environmental Regulations and Instructions

Name	Reference	Date	Additional Notes	Status	Project Relevance
The Ministry of Environment	Law 37	2008	The MoE structure, goals and the means of implementing them. MoE was previously the Council of Protection and Improvement of Environment. Formerly CPA Order 44 (2003).	Current	Yes. ESIA to be submitted to the MoE.
Iraq signing up to Basel Convention	Law 3	2009	-	Current	No. Site is unlikely to produce hazardous wastes.
Protection and Improvement of the Environment	Law 27	2009	General environmental protection including EIA for major developments. Section 2 - Protection of water resources Section 3 – Air pollution and noise reduction Section 4 – Protection of land Section 5 – Protection of biodiversity Section 6 - Management of hazardous materials and wastes Section 7 - Protection of the environment from pollution resulting from the exploration and the extraction of oil and natural gas	Current	Yes. Including details of the EIA requirements. Other sections directly relate to the Terminal's operations.
Regulate the regions for the collecting debris to landfills	Law 29	2009	Updates Regulation No. 67 (1986).	Current	Yes. Wastes will be produced on-site.

Table 4.1: Iraq – Register of Environmental Regulations and Instructions

Name	Reference	Date	Additional Notes	Status	Project Relevance
Law of Forests and nurseries	Law 30	2009	Formerly Law 75 (1955). Notification No. 5 of 1967 prohibits the cutting of trees and charcoal making.	Current	No. No trees are present on-site.
Law on the protection of wild animals and birds	Law 17	2010	Formerly Law No. 21 (1979).	Current	Possibly due to the presence of the IBA.
Law of categorisation and siting of Industrial facilities.	Instruction 3	2012	This lists a wide range of potentially polluting industries and activities into three classes (A, B & C) and sets out how far certain industrial activities in each class can be located from municipal and urban areas (creating buffer zones in effect). It does not relate to Ports.	Current	No

4.2.1 General Environmental Legislation

Protection and Improvement of the Environment (Law No. 27, 2009)

This law, which replaces and repeals Environment Protection and Improvement Law No. (3), 1997 (note that regulations and instructions issued pursuant to the 1997 law shall remain in full force in a way not to contradict with the provisions of the 2009 law, until replaced or cancelled), aims to protect and improve the environment and natural resources, preserve public health, biodiversity and cultural and natural heritage, to ensure sustainable development and international and regional cooperation in this area. Specifically this law details the requirements for an EIA for major developments.

The law defines, amongst other things:

- Environmental contaminants as being any solid material, liquid or gas, noise, vibration, radiation, heat or flare, or the like, or ecological factors that lead directly or indirectly to the pollution of the environment.
- Environmental determinants (*i.e.* the permissible limits of concentration of each pollutant that are allowed to be put to into the environment under national standards).
- Hazardous waste (waste that causes or is likely to cause as a result of the contents of the material, serious harm to humans or the environment).
- Waste (unusable or non-recyclable solid, liquid or gaseous wastes from various types of activities).
- Dangerous materials (materials that are harmful to human health when abused or adversely affect the environment, such as pathogens, toxic substances, explosive or flammable substances, ionizing radiation, or magnetic materials).
- Land degradation (the loss of some chemical, morphological, physical, fertility or microbiology properties).

Article 3 establishes under this Law the Environment Protection and Improvement Council, associated with the MoE, to protect and improve the environment. In accordance with Article 4 this Council is to include representatives from each of the following:

- Ministry of Municipalities and Public Works.
- Ministry of Planning and Development Cooperation.
- Ministry of Higher Education and Scientific Research.

- Ministry of Interior.
- Ministry of Agriculture.
- MoH.
- Ministry of Industry and Minerals.
- Ministry of Science and Technology.
- Ministry of Electricity.
- Ministry of Water Resources.
- The Ministry of Oil.
- Ministry of Transport.
- Ministry of State for Tourism and Antiquities.
- Ministry of Foreign Affairs.
- Ministry of Education.
- Ministry of Commerce.
- Ministry of Labour and Social Affairs.
- Ministry of Culture.
- The Ministry of Construction and Housing.
- Municipality of Baghdad.
- The Iraqi commission for the control of sources of radioactivity.
- Ministry of Defence.

The objectives of the Council, as defined in Article 6, are to:

- Provide advice on environmental matters.
- Review and comment on the environmental aspects of plans, projects and national programs prepared by the ministries and stakeholders before approval, and monitor implementation.

- Co-ordinate with relevant ministries and authorities in the preparation of local programs for the protection of the environment and to follow-up the implementation of these programmes.
- Express an opinion in Arab and international relations with respect to environmental affairs.
- Comment on national and ministry emergency and environmental disaster plans.
- Co-ordinate between the activities of ministries and agencies with respect to environmental protection, and evaluate their work.
- Comment on legislation related to the environment or projects.
- Implement projects to protect and improve the environment in the provinces.
- Co-operate with ministries and stakeholders in the preparation of a list of sites of natural and cultural heritage and those nominated for World Heritage designation.
- Prepare an annual report of the environmental situation in the Republic of Iraq for submission to the Council of Ministers.

Article 7 relates to the establishment of a council in each governorate, to be known as the Environment Protection and Improvement Council. The Article states that every Council be chaired by the governor, and that the chairman of the Council determines the associated functions and operation of the Council. The Council to protect and improve the environment in the governorate has the right to consult specialists or representatives from the public, private, mixed and cooperative sectors, with respect to environmental matters related to the authority, but these representatives have no voting rights.

Article 8 requires planning authorities to introduce considerations for protection of the environment and for pollution control, consumption of natural resources and for sustainable development in applications for development projects.

Article 9 relates to polluting activities, with respect to:

- The use of environmentally clean technology to address pollution, and for efficient operation.
- The monitoring and recording of pollutants.
- Building an information base on environmental protection, to include concentrations and levels of pollutants resulting from polluting activities.

- Work on the use of renewable energy technologies to reduce pollution.

Article 10 relates to the need for an environmental impact assessment (EIA) prior to the commencement of a project. According to Article 10, an EIA must include the following:

- Determine the positive and negative impacts of the project on the environment and the impact on the surrounding environment;
- Detail the proposed methods to avoid and treat the causes of pollution in order to achieve compliance with environmental regulations and instructions;
- Propose contingencies for pollution emergencies and potential precautions;
- Detail possible alternative technology that is less harmful to the environment and the rational use of resources;
- Detail provisions to reduce and recycle waste, where possible; and
- Provide an assessment of the environmental feasibility of the project and an estimate of the cost of pollution relative to production.

The EIA must assess the environmental feasibility of the project and estimate the cost of pollution relative to production.

Article 11 relates to preventing the operation of activities which can adversely affect the environment for which approval of the Ministry has to be obtained.

Article 12 relates to the extension/expansion of existing facilities or the renovation of such facilities with respect to the provisions detailed in Articles (9), (10) and (11) of this Law.

Article 13 addresses the need for the introduction of educational institutes specialising in environmental science to provide education and training in coordination with the Ministry of Environment, and for the promotion of environmental awareness programs (public and private programs), and for the authorities to prepare cultural programs, books, publications and bulletins, which aims to develop environmental education.

<u>Section II Protection of water resources from pollution</u>

Article 14 relates to the prevention of:

- The discharge of effluents (domestic, industrial, agricultural) to inland water resources, groundwater or surface waters, or Iraqi maritime waters, without treatment to ensure compliance with the specifications set out in national environmental legislation and international conventions.

- With respect to residential dwellings and industry, connecting or discharging of sewage, effluents from industry and other activities, to rain water drainage systems.
- The disposal of solid waste, animal waste and corpses, or scrap material into water resources.
- The use of toxic substances and explosives to catch fish, birds and aquatic animals.
- The discharge from oil tankers of waste oil, wastewaters or fuel to surface water or territorial waters of the Iraqi navy.
- Any act that may lead to the pollution of surface water resources as a result of the exploitation of the river, unless approved by the concerned authorities.
- Any acts that lead to pollution of the marine area as a result of exploration or exploitation of the seabed of the territorial sea and its subsoil and the continental shelf, including pollution emergencies which result in damage to the marine environment, to ensure compliance with national legislation and the principles and provisions of international law.

Section III Air pollution and noise reduction

Article 15 prevents:

- Emissions of fumes or gases or vapours resulting from production processes or burning fuel, in breach of national environmental legislation.
- The use of engines or vehicles which produce exhaust emissions in excess of the permissible limits as stated in national environmental legislation.
- The burning of solid waste unless in designated areas and in an environmentally safe manner.
- Exploration, drilling, construction or demolition activities that use raw materials and produce wastes and dust, unless necessary precautions are taken to prevent pollution.
- Working with activities emitting non-ionizing electromagnetic radiation emitted from the major broadcasters, towers and antennas for mobile phones and other, in excess of the limits established by the Ministry for this purpose.

Article 16 relates to the prevention of high levels of noise above permissible limits in the operation of machinery, equipment, horns and loudspeakers.

Section IV Protection of land

Article 17 relates to the prevention of the following:

- Any activity that directly or indirectly results in soil degradation or soil pollution.
- Non-compliance with the design for urban areas, thus protecting land from urban sprawl.
- Any activity that would result in desertification, or would impact the natural environment unless approved by the relevant authorities.
- The demolition or damage to designated areas of natural and cultural heritage.
- Disposal of solid waste unless in places allocated for such disposal.

Section V Protection of biodiversity

Article 18 prevents the following:

- Damage to biota in their habitats.
- Fishing, hunting or trafficking of threatened and endangered species.
- The hunting, killing, keeping, or transfer of protected species (birds, wildlife and aquatic species) as identified by the authorities.
- Damage to plants and rare medicinal and aromatic plants used for scientific, medical, industrial, or trade purposes, or its seeds, in according with the requirements of the authorities.
- Cutting of perennial trees (*i.e.* trees over 30 years of age) in public areas within the city, unless permitted.
- Logging in the forest unless approved by the regulatory authorities.
- The introduction of plants and animals into the environment, unless permitted by the regulatory authorities.
- Genetic engineering research which may be detrimental to the environment.

Section VI Management of hazardous materials and wastes

Article 19 requires that the Ministry should, in cooperation with the relevant organisations, develop national registers for hazardous chemicals in use in the Republic of Iraq, and for hazardous wastes.

Article 20 relates to the following:

- Control in the use of pesticides or any other chemical compounds.
- The use of environmentally sound methods for the transportation, transfer, storage and disposal of hazardous waste, including radioactive materials, and obtaining regulatory approvals for such activities.
- Ensure that the production, transportation, import or storage of hazardous materials does not result in environmental damage and that the precautions stipulated in the laws and regulations are adhered to. The regulations require that the Ministry be notified of any environmental incident that occurs, and that necessary actions should be taken to minimise the risk of environmental damage as a result of the incident.
- Prohibits the introduction of hazardous and radioactive wastes from other countries to or through Iraqi land, sea or airspace unless regulatory approval has been obtained.
- Prohibits the treatment of hazardous waste without a license for such activities.

Section 7 Protection of the environment from pollution resulting from the exploration and the extraction of oil and natural gas

Article 21 stipulates the following:

- Measures should be in place to reduce the risk of environmental damage as a result of exploration and drilling activities for oil and gas and that necessary precautions and measures should be taken to protect the land, air, water and aquifers from pollution and destruction.
- Salt water associated with the extraction of crude oil should be disposed of in an environmentally safe manner.
- Prevention of oil spills to surface waters or into groundwater aquifers that are used for human and agricultural purposes.

- The Ministry should be informed of the causes of any fires and explosions, and leakage of crude oil and gas from wellheads and pipelines, and of the remedial actions taken during such events.

Chapter 5 Environmental Control, Article 22 relates to environmental monitoring for those activities which affect the environment.

Article 23 requires the operator of a facility which is subject to environmental control to maintain records of the releases to the environment in accordance with requirements issued by the Minister.

Article 24 relates to the implementation of this Law by the Ministry of the Environment.

Chapter 6 relates to The Environmental Protection Fund which is established by Article. 26.

Chapters 8 and 9 relate to penalties and penal provisions that have to be paid as a result of any damage caused. Article 33 states that polluters must pay "a fine of not less than 1 million dinars and not more than 10 million dinars repeated each month until the removal".

Article 34 states that if the pollution is not remedied this can result in imprisonment and further fines 'for a period of not less than three months or a fine of not less than 1 million dinars and not more than 20 million dinars, or both'. 'The penalty shall be doubled each time the violation is perpetrated'.

Article 25 states that the perpetrator 'shall be prone to imprisonment and bound to return the materials or the hazardous or radioactive wastes to its origin or dispose of them in a safe manner, together with compensation'.

Law, No. 8 of 2008 and Law No. 3 of 2010 are effectively a repeat of Law No. 27 of 2009 for Environmental Protection and Improvement but are specific to the Kurdish Region.

Environmental Criteria for Industrial, Agricultural, & Public Service Projects (1990)

These regulations, which were approved by the Council for Protection and Improvement of the Environment in its meeting numbered 14, 1990, establishes environmental criteria with respect to the location and environmental requirements of industrial, agricultural and public service developments.

The environmental instructions establish three project categories:

- **Environment Polluting Activities Category (A)** – This category is for intensive environmentally polluting activities, including major agricultural or industrial projects that could result in significant impacts on environment quality over large areas. Such activities should be located away from villages, towns, cities, *etc.*, including areas of cities, districts, sub-districts and villages, *etc.* nominated for development under a rural settlement plan. Suitable pollution controls/ abatement equipment should be provided to protect the environment.

- **Environment Polluting Activities Category (B)** – This category relates to those activities which have less potential to result in pollution than those in Category (A). Such activities include industrial, agricultural, or other activities which can result in site contamination which can be controlled. Such activities can therefore be established within city boundaries and within the development plots allocated for them, provided that pollution control equipment/treatment units are installed in accordance with relevant national regulations and instructions.

- **Environment Polluting Activities Category (C)** – This category relates to activities which cause minor levels of pollution that can be treated *i.e.* industrial factories that do not result in significant contamination, and small-scale agriculture and residential complexes, hotels, and hospitals, which generate pollution with mainly organic content that can be treated easily using pollution control equipment/treatment units. Such activities can thus be established within and outside of city borders, without any limitation, in accordance with these instructions. This also allows farm owners to set up environmentally non-polluting industries within their farms.

In cases where it is not possible to control all pollution (for example odour), the activity should be located outside of the city boundaries, and in accordance with the determinants for that activity as detailed in these instructions.

The regulations then go on to list various activities, establishing the environmental classification category for that activity, and the various site location restrictions and environmental requirements. The most relevant to the project is fuel depot (see *Table 4.2*).

Table 4.2: Example Activity and Associated Environmental Controls

Name	Category	Scope
(64) Fuel Depot (*i.e.* places were all kinds of oil products are stored).	C	**Site Restrictions:** • They are to be established within public service areas in a way that ensures they are greater than 250m from the boundaries of residential areas, hospitals, kindergartens and schools; • They are to be within 250 m of a public road. **Environmental Requirements:**

Table 4.2: Example Activity and Associated Environmental Controls		
Name	**Category**	**Scope**
		• Establish a fence which is not less than 2m height; • Provide a collection system to ensure the collection of leaked/spilt fuel, which may occur during the loading process, into special tanks; • Provide safety requirements with respect to the control of fire and emergencies which could cause environmental pollution of neighbouring areas.

4.2.2 Drinking Water

Drinking Water & Standard Methods for Testing and Analysis (Specification No. 417)

Current drinking water standards are outlined within *Table 4.3*.

Table 4.3: Drinking Water Standards	
Analyte	**Limit (mg/l)**
Acrylamide	0.0005
Arsenic	0.01
Barium	0.7
Cadmium	0.003
Chromium	0.05
Copper	1.0
Cyanide	0.02
Fluoride	1.0
Lead	0.01
Mercury	0.001
Nickel	0.02
Zinc	3.0
Nitrate (as NO_3^-)	50
Nitrite (as NO_2^-)	3.0
Selenium	0.01

Table 4.3: Drinking Water Standards	
Analyte	**Limit (mg/l)**

4.2.3 Ionizing Radiation Sources

Protection against Ionizing Radiation (Law No. 99, 1980)

This Law, which repeals Law No. 80, 1971, prohibits the acquisition, use, manufacture, storage, loan, transportation, sale, purchase, import, export or possession of ionizing radiation sources, unless licensed.

The Law establishes a Radiation Control Agency under the Environmental Protection Board, the role of which includes:

- defining radiation control policies;
- developing and supervising the implementation of plans and programmes in this area;
- coordinating and supervising radiation control activities; and
- approving plans for radiation-emitting installations and for installations who store radioactive substances (Section 4).

Section 5 provides for the establishment of a Radiation Control Centre responsible for:

- monitoring all peaceful uses of ionizing radiations;
- ensuring protection against exposure to radiation and from pollution caused by radiation sources;
- identifying radiation sources which require licensing; and
- issuing of licences (Section 6).

The Agency is responsible for granting licences and for establishing licensing procedures (Section 7), and for establishing protective measures such as maximum permitted exposure levels, and maximum permitted concentration levels of radioactive substances in air and water, in accordance with the recommendations of the International Atomic Energy Agency and other competent international organizations (Section 8).

The transport of ionizing radiation sources is subject to the requirements of the Agency (Section 9). The Agency shall establish instructions with respect to the prevention of accidents and the elimination of their consequences (Section 10).

The duties of the owners of ionizing radiation sources are provided in Sections 12 and 13.

The Regulations provide for the establishment of a medical committee under the Radiation Protection Centre (Section 18), the aims of which include:

- determining the occurrence of radiation accidents and the level of exposure of radiation; and
- reporting on the diagnosis and on medical treatments in connection with such incidents.

4.2.4 Wildlife and Habitats

Protection of Wild Animals and Birds (Law No. 21, 1979)

This Law is composed of 5 parts and 24 articles. Implementation and monitoring will be entrusted to the "Special Administration" as detailed in Article 2, and the breeding of wild animals in protected areas and the creation of natural habitats for wild animals and birds in Article 3. The rules on protection are contained in Part II.

The Minister of Agriculture and Land Reclamation shall issue in the Official Gazette a list of protected species of animals and birds, prohibited zones, hunting seasons and hunting gears and methods (Article 5). The Law prohibits the collective hunting of wild animals and birds, hunting of wild animals with cars or aeroplanes and using automatic guns or machine guns (Article 6). The hunting of wild animals must be authorised by the Minister of Agriculture and Land Reclamation (Article 8).

Breaches of the Law may result in a fine of 500 dinars or three years imprisonment, or both (Article 19).

Decision No. 1 of 1991 of the Chief of the Environmental Protection Board Concerning the Cutting of Trees, 1991

This Decision prohibits the cutting of trees from "natural forests and pavements of town streets, areas with young trees and green belts". Breach of this Decision shall be punished in accordance with the provisions of Articles 16 and 17 of Law No. 76 of 1986 concerning the protection and improvement of the environment.

Ranges and their Protection (Law No. 106, 1965)

This Law, which is composed of 14 Articles, declares that the preservation and improvement of ranges is a public benefit. Land may be declared as a Range by the Minister. The Minister may take further measures to organise grazing and to improve Ranges outside the areas irrigated by rivers, prohibit tree or shrub cutting or hay making for commercial or agricultural purposes without a license; prohibit grazing in certain areas in certain periods for preservation and improvement; and prohibit grazing in some areas of Ranges selected through studies for Range improvement.

The Minister of Agriculture is responsible for the identification of land that is to be considered as natural pastures (Article 2). The provisions of this Law apply to all natural pastures (Article 3).

The cutting trees of is to be subject to authorisation (Article 6).

Breach of this Law will be punished by imprisonment for a period of no more than six months and payment of a fine of no more than 200 dinars, or both (Article 10).

Forest Law (Law No. 30, 2009)

Forests are divided into three categories: State Forests; Wakif Forest (Endowed Forest); and Private Forest. The provisions of this Law, except those on technical and administrative supervision, shall apply to State Forests. Article 4 contains general provisions which apply to all forests. Article 5 provides for concessions in Reserved Forests. Article 6 specifies activities prohibited in Closed Forests and Reserved Forests. "Reserved Forest" and "Closed Forest" are protected areas defined by Article 1, and are placed under the control and administration of the Directorate General of Forests and Plantations. The remaining provisions of the Law deal in the main with enforcement, offences and penalties.

This Notification No. 5 of 1967 prohibits the cutting of trees and charcoal making, and the transportation of forest products for commercial purposes in specified natural forests (Article 1). Article 2 specifies the exceptions to this rule. Village inhabitants may for specified purposes cut wood and transport products within the forest region (Articles 3 and 4).

4.2.5 Ports

Law Concerning Ports (Law No. 27, 1995)

This law applies to all civil ports, the internal waters, and marine areas where ships anchor for a specific purpose such as waiting, loading and unloading or to carry out works (Section 2). The land and sea boundaries of each port shall be demarcated by resolution of the Council of Ministers.

The Director General of the Establishment is vested with powers to regulate navigation and port safety, the prevention of water pollution, the operation of importation and exportation agents, and the registration of ships.

4.2.6 Fishing

Regulating the Exploitation & Protection of Aquatic Life (Law No. 48 of 1976)

This Law consists of 7 chapters and 36 Articles. It regulates fishing and aquaculture including the following:

- breeding and protection of aquatic life;
- general rules for fishing activities;
- fishing gear;
- marketing and industrialisation of aquatic products;
- fees and licenses; and
- penalties.

Article 1 prohibits the use of methods such as chemicals, explosives, or electricity for the killing aquatic organisms, the use of gear which may harm eggs or fry, the pollution of waters which would harm aquatic life, and the use of fixed gear which blocks the flow of water.

Fish conservation measures may be proclaimed by the State Fisheries Company (Article 2). This Company is also responsible for undertaking fish breeding in public waters (Article 4) and for the importing and distribution of breeding fish and other aquatic species (Article 7). The Company is responsible for supervising trading in aquatic life (Article 16).

Fishing in the territorial waters of the Arab Gulf shall be governed by a regulation which is to be established within one year from the date the present Law (Article 9). Article 11 requires fishing licences to be issued to vessels, and Article 12 requires personal fishing licences for professional fishermen.

The Port Authority (GCPI) and river police, tolerate fishermen working close to the ports but they typically tend to congregate around the wrecks or string nets out across the channel at various locations, working from small vessels. Large vessels work out of Fao Port and head out to the Khor Abdullah to fish in marine waters.

4.2.7 Land Reclamation

Internal Regulation of the State Organization for Land Reclamation (1980)

This Regulation (made under Article 4 of the Law relative to the State Organisation for Land Reclamation (No. 83 of 1973), as amended) prescribes the tasks and structure of a public agency entitled 'The State Organization for Land Reclamation', which was established by Law No. 83 of 1973. The organization consists of a President and an assistant, an administrative council, a department for planning and implementation and a department for administrative and financial matters. It also prescribes various committees and institutes including:

- The Sand Dunes Committee;
- The Spring Line Committee;
- 'State Establishments' for land reclamation in specific parts of the country; and
- 'State Establishments' for the execution of land reclamation contracts, for cultivation and development of reclaimed lands, and for research, training and surveys.

4.2.8 Rivers and Public Water

Establishing the Ministry of Irrigation (Law No. 8, 1993) - Resolution No. 68 of 1993

The objectives of the Ministry include the planning of water resources, the construction of waterworks, the exploitation of surface water and groundwater, the maintenance of irrigation projects, the prevention of floods, and the control of water flows. The Minister of Irrigation is the supreme head of the Ministry (Article 2). The departments connected with the Ministry include The General Body of Dams and Reservoirs, the General Body of Surveys, and the General Body operating irrigation projects.

Article 4 also lists various companies involved in construction, irrigation and exploitation of water resources connected with the Ministry. Each Governorate shall have a Directorate of Irrigation, except in the Autonomous Regions where the Directorate shall be connected with the competent administration of the Region (Article 5).

Relative to Maintenance of Networks of Irrigation and Drainage (Law No. 12, 1995)

This law:

- qualifies irrigation networks;

- provides for the management and maintenance of irrigation and drainage networks, including natural rivers and water basins;
- provides for the establishment of a public body called the General Body for the Operation of Irrigation Projects; and
- defines duties of farmers in relation with the management and exploitation of agricultural land and the use of water.

The Irrigation Network shall consist of: main streams, branches and connecting channels, and secondary streams carrying water from branch streams to farm streams and arm streams.

The General Body for Irrigation is responsible for maintaining natural rivers, the main drainage, and main and branch streams, of at least 400 litres a second. Farmers shall be responsible for the maintenance of minor systems and the systems on their land.

Section 5 provides for the appointment of water observers who are responsible for the supervision of the distribution of water. Section 6 lists the various restrictions on the use of water by farmers.

Preservation of Rivers & Public Water from Contamination (Regulation No. 25, 1967)

This regulation is composed of 19 Articles and relates to the protection of rivers and public water bodies from contamination. The public water bodies to which the regulations apply (Article 2), include:

- All rivers in Iraq and their tributaries.
- Streams, canals and all their branches.
- Drainage channels and its branches.
- Lakes, marshes, ponds and swamps.
- Springs, wells and other groundwater.
- Ponds and other pools of water.

Article 3 states that no wastewater discharges should be discharged into public waters unless permitted by the Health Authority.

Article 5 states that the Health Authority will determine the volume and the quality of wastewater which may be discharged into a public water body, and will establish discharge consent limits for the wastewater discharge.

The standard consent limits for the discharge of wastewater into public water bodies are detailed Article 7:

- If oxygen uptake is exceeded, suspended solids or floating rates are to be determined by the health authority's instructions, but at all times should not exceed the upper limit of 60 ppm.
- The discharge must not contain hydrogen sulphide, toxic substances, harmful amounts of bacteria or harmful substances which may produce toxic substances when they interact with chemical agents that may be present in public water.
- The wastewater must not have a hydrogen ion concentration (pH) of less than 6 or more than 10.
- The temperature must not affect the receiving water.
- Any other wastewater discharge parameters may be decided by the Health Authority.

The disposal of carcasses, secretions or faeces, solid and liquid waste of any kind, or any other harmful substance, into any public waterway or on beaches is not permitted (Article 10). Article 11 prohibits the washing of animals, leather, wool, intestine and contaminated clothing, and any material that may result in harm to public health, in public waters, and prohibits the defecation and urination in such waters or on the shores.

Article 15 contains details of the penalties for breaching these regulations.

Wastewater Discharge Quality Requirements (Instruction No. 1)

This Instruction provides discharge concentration limits for a number of substances contained in wastewater (*Table 4.4*), in accordance with the provisions of Article (16) of Regulation 25 on the Maintenance of Rivers and Public Water from Contamination, 1967.

Table 4.4: Discharge Consent Limits for Wastewater

Analyte	Limit
Lead	0.1
Arsenic	0.05

Table 4.4: Discharge Consent Limits for Wastewater

Analyte	Limit
Copper	0.1
Nickel	0.1
Selenium	0.05
Mercury	0.005
Cadmium	0.1
Zinc (divalent)	5.0
Chromium	0.1
Cyanides	0.1
Hydrogen Sulphide	0.5
Carbon disulphide	1.0
Crude oil and its derivatives dissolved Hydrocarbons	0.1
Free chlorine	Trace
Sulphide	0.5
Carbon tetrachloride	5.0 (0.5?)
D.D.T.	0.2
Dinitronaphthalene	2.0
Cholorobenzene	2.0
Trinitrototoluene	0.5
Dinitrobenzene	0.5
Tetranitromethane	0.5
Fluorides	1.0

EAME understands that these consents have been expressed as a ratio (percentage) rather than an absolute concentration or maximum permissible concentration and this is the maximum percentage that each parameter is allowed to be present in wastewater discharges to natural waters.

Exceedence of these discharge consents is a direct breach of the provisions detailed of paragraph (2) of Article VII of the Maintenance System of Rivers and Public Water, 1967.

It is understood that these values may have been updated with new determinants that appear to be more stringent through the introduction of The New Determinants for the Prevention of Pollution of Rivers No. (25), 1967.

The New Determinants for the Prevention of Pollution of Rivers (No. 25, 1967)

These instructions provide physical, chemical and biological guidelines for water quality and wastewater discharges. The regulation defines Water Resources as:

- rivers and its tributaries and branches;
- streams, waterways, canals and branches of;
- lakes and ponds and other pools of water; and
- springs, wells and groundwater.

The regulations apply to wastewater from cities, industry, agriculture and other activities including:

- wastewater discharged to a public water source;
- wastewater discharged to public sewers;
- wastewater discharged to the sewage treatment works; and
- wastewater discharged to the marshes.

The regulations define discharge limits for discharges to both natural waters (water resources) and sewers (which generally have a higher permissible discharge limit). These allowable limits are outlined in the *Table 4.5*.

Table 4.5: Discharge Consent Parameters

Pollutants	Limits For Discharge to Water Resources	Limits For Discharge to Public Sewers
Colour	-	-
Temperature	Less than 35°C	45°C
Suspended solid	60	750
pH	6 - 9.5	6 – 9.5

Table 4.5: Discharge Consent Parameters		
Pollutants	**Limits For Discharge to Water Resources**	**Limits For Discharge to Public Sewers**
Dissolved Oxygen	-	-
BOD	Less than 40	1000
COD(Cr_2O_7 method)	Less than 100	-
Cyanide (CN-)	0.05	0.5
Fluoride (F-)	5.0	10
Free Chlorine (Cl_2)	Trace	100
Chloride (Cl-)	A. If the ratio of the amount of water discharged to the amount of source water is 1000:1 or less, the chloride concentration of the discharge is permitted at 1% of the concentration of the natural source before discharge. B. If the ratio of the amount of water discharged to the amount of source water is more than 1000:1 the wastewater discharge must not exceed a chloride concentration of greater than 600 mg/litre. C. If the concentration of fluoride in the source water is less than 200 mg/l then the permitted discharge limit must be established on a case by case basis.	600
Phenol	0.01 – 0.05	5 - 10

Table 4.5: Discharge Consent Parameters		
Pollutants	**Limits For Discharge to Water Resources**	**Limits For Discharge to Public Sewers**
Sulphate (SO_4=)	A - if the ratio of the amount of water discharged to the amount of source water is 1000:1 or less, the sulphate concentration of the discharge is permitted at 1% of the concentration of the natural source before discharge. B - If the percentage of the amount of wastewater discharged to the amount of source water is more than 1000:1, the wastewater discharge must not exceed a sulphate concentration of greater than 400mg/l. C - if the concentration of sulphate in the source water is less than 200mg/l then the permitted discharge limit must be established on a case by case basis.	300
Nitrate (NO_3-)	50	-
Phosphate (PO_4^{3-})	3	-
Ammonium (NH_4+)	-	-
DDT	Nil	-
Lead (Pb)	0.1	0.1
Arsenic (As)	0.05	0.05
Copper (Cu)	0.2	-
Nickel (Ni)	0.2	0.1
Selenium (Se)	0.05	-
Mercury (Hg)	0.005	0.001
Cadmium (Cd)	0.01	0.1
Zinc (Zn)	2.0	0.1
Chromium (Cr)	0.1	0.1
Aluminium (Al)	5.0	20
Barium (Ba)	4.0	0.1

Table 4.5: Discharge Consent Parameters

Pollutants	Limits For Discharge to Water Resources	Limits For Discharge to Public Sewers
Boron (B)	1.0	1.0
Cobalt (Co)	0.5	0.5
Iron (Fe)	2.0	15
Manganese (Mn)	0.5	-
Silver (Ag)	0.05	0.1
Total Hydrocarbons & Derivatives	Allows the discharge of total hydrocarbons to water sources and A -1 and A -2 according to the concentrations and limitations set forth in the tables below; the concentration of hydrocarbons must be measured discharging to the water source. Hydrocarbons shall not be discharged to water sources A3 and A4. For a river in continuous flow 10 mg/l according to the ratio of the amount of wastewater discharged to the amount of the water source should not be less than 1000:1. For a river in continuous flow 5 mg/l and in accordance the ratio of the amount of wastewater discharged to the amount of the water source should be 500:1 or less. For a river in a continuous flow 3 mg/l and in accordance with the ratio of the amount of wastewater discharged to the amount of the water source should be 300:1 or less.	-
Sulphide (S=)	Nil	3.0
Ammonia (NH_3)	Nil	10
Ammonia Gas (Free NH3)	Nil	6.0
Sulphur dioxide SO_2	Nil	7.0
Calcium carbide CaC	Nil	Not allowed
Organic solvents	Nil	Not allowed

Table 4.5: Discharge Consent Parameters		
Pollutants	**Limits For Discharge to Water Resources**	**Limits For Discharge to Public Sewers**
Benzene	Nil	0.5
Chlorobenzene	Nil	0.1
TNT	Nil	0.5
Bromine (Br_2)	Nil	1 – 3

EAME understands the references to A1, A2, A3 and A4 to refer to water quality classifications for natural water bodies as determined by the Iraq Authorities. The values presented in *Table 4.6* are believed to be the environmental quality standards which must not be exceeded by industrial wastewater discharges.

Table 4.6: Physical, chemical and biological determinants for public water bodies to classify them into Grades A1 – A4					
A-4	**A-3**	**A-2**	**A-1**	**Material**	
normal	normal	normal	normal	Colour	1
-	-	-	-	Heat	2
	-	-	-	Suspended solids	3
	6.5-8.5	6.5-8.5	6.5-8.5	Hydrogen ion concentration	4
-	More than 5	More than 5	More than 5	Dissolved oxygen	5
	Less than 3	Less than 3	Less than 5	B.O.D.5	6
-	-	-	-	CO.D.CR207	7
0.02	0.02	0.02	0.02	Cyanide	8
0.2 or more depending on the concentration in the natural source				Fluorine	9
Trace	Trace	Trace	Trace	Free Chlorine	10
200 Or more depending on the natural	200 Or more depending on the natural	200 Or more depending on the natural source	200 Or more depending on the natural source	Chlorides	11

Table 4.6: Physical, chemical and biological determinants for public water bodies to classify them into Grades A1 – A4

A-4	A-3	A-2	A-1	Material	
source	source				
0.005	0.005	0.005	0.005	Phenol	12
200 Or more depending on the natural source	200 Or more depending on the natural source	200 Or more depending on the natural source	200 Or more depending on the natural source	Sulphate	13
50	15	15	15	Nitrate	14
0.4	0.1	0.4	0.4	Phosphate	15
-	1.0	1.0	1.0	Ammonium	16
zero	zero	zero	zero	Pesticide DDT	17
0.05	0.05	0.05	0.05	Lead	18
0.05	0.05	0.05	0.05	Arsenic	19
0.01	0.05	0.05	0.05	Copper	20
0.1	0.1	0.1	0.1	Nickel	21
0.01	0.01	0.01	0.01	Selenium	22
0.001	0.001	0.001	0.001	Mercury	23
0.005	0.005	0.005	0.005	Cadmium	24
0.1	0.5	0.5	0.5	Zinc	25
0.05	0.05	0.05	0.05	Chromium	26
-	0.5	0.1	0.1	Aluminium	27
1.0	1.0	1.0	1.0	Barium	28
1.0	1.0	1.0	1.0	Boron	29
0.05	0.05	0.05	0.05	Cobalt	30
0.3	0.3	0.3	0.3	Iron	31
0.1	0.1	0.1	0.1	Manganese	32
0.01	0.01	0.01	0.01	Silver	33

Table 4.6: Physical, chemical and biological determinants for public water bodies to classify them into Grades A1 – A4

A-4	A-3	A-2	A-1	Material	
-	-	-	-	Total hydrocarbons and their derivatives	34
-	-	-	-	Sulphide	35
-	-	-	-	Ammonia	36
-	-	-	-	Ammonia gas	37
-	-	-	-	Sulphur dioxide	38
-	-	-	-	Alcohol-oil	39
-	-	-	-	Calcium carbide	40
-	-	-	-	Organic solvents	41
-	-	-	-	Petrol	42
-	-	-	-	Chlorobenzene	43
-	-	-	-	TNT	44
-	-	-	-	Bromine	45

Note: The allowable concentration can be increased in certain special cases based on the impact of the discharge to the water source.

Concentration in mg/l unless otherwise indicated.

4.2.9 Air Quality

National Clean Air Act 1979

Local air quality standards are defined by the Iraqi National Clean Air Act 1979. This act establishes long term, medium and short term ambient quality standards across a range of pollutant parameter.

Typically air quality objectives are medium-term policy based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the agreed WHO guideline limits, whereas others involve a margin of tolerance based on local industry activity i.e. allow a limited number of permitted exceedances of the standard over a given period. No stated exceedances are provided with the Iraqi standards.

These ambient standards are provided within *Table 4.7*.

Table 4.7: Air Quality Standards

Pollutant	Period	Ambient Air Standard (ppm)	Ambient Air Standard (µg/m³)
Sulphur Dioxide	1 hour 24 hours 1 year	0.1 0.04 0.018	None Stated
Carbon Monoxide	8 hrs 1 hr	10 35	None Stated
Nitrogen Dioxide	1 hr 24 hrs	0.05 0.04	None Stated
Ozone	1 hour	0.06	None Stated
PM10	24 hours	None Stated	150
PM2.5	24 hours 1 year	None Stated	65 15
Total Suspended Particulate	24 hours 1 year	None Stated	350 150
Dust	30 days	None Stated	10 ton/km²/month (residential) 20 ton/km²/month (Industrial)
Hydrocarbon	3 hours	0.24	160
Lead	24 hours 3 months 1 year	None Stated	2 1.5 1
Benzene	1 year	None Stated	0.003 (mg/m³)
Dioxin	1 year	None Stated	0.6 (Bg/m³)

The Iraq Ministry of Oil has issued air quality International Oil Companies (IOCs) with respect to air quality standards. These are outlined within *Table 4.8* alongside WHO guidelines.

Table 4.8: Iraq Ministry of Oil – Air Quality Standards

Pollutant	Averaging Period	Iraq Ministry of Oil Guidelines	WHO Guidelines (µg/m^3)
CO	8-hour	35 ppm	-
	1-hour	9 ppm	-
SO_2	10 minute	-	500 µg/m^3
	1 hour	0.1 ppm	-
	24 hour	0.04 ppm (105 µg/m^3)*	125 µg/m^3 (Interim target No.1) 50 µg/m^3 (Interim target No.2) 20 µg/m^3 (Guideline)
	1 year	0.018 ppm	-
NO_2	1-hour	-	200 µg/m^3
	24-hour	0.05 ppm	-
	1 year	0.04 ppm	40 µg/m^3
O_3	1-hour	0.06 ppm	-
	8-hour	0.075 ppm (147 µg/m^3)*	160 µg/m^3 (Interim target No.1) 100 µg/m^3 (Guideline)
PM_{10}	24-hour	150 µg/m^3	150 µg/m^3 (Interim target No.1) 100 µg/m^3 (Interim target No.2) 75 µg/m^3 (Interim target No.3) 50 µg/m^3 (Guideline)
	1 year	-	70 µg/m^3 (Interim target No.1) 50 µg/m^3 (Interim target No.2) 30 µg/m^3 (Interim target No.3) 20 µg/m^3 (Guideline)
$PM_{2.5}$	24-hour	35 µg/m^3	75 µg/m^3 (Interim target No.1) 50 µg/m^3 (Interim target No.2) 37.5 µg/m^3 (Interim target No.3) 25 µg/m^3 (Guideline)
	1 year	15 µg/m^3	35 µg/m^3 (Interim target No.1) 25 µg/m^3 (Interim target No.2) 15 µg/m^3 (Interim target No.3) 10 µg/m^3 (Guideline)

Table 4.8: Iraq Ministry of Oil – Air Quality Standards

Pollutant	Averaging Period	Iraq Ministry of Oil Guidelines	WHO Guidelines (µg/m^3)
TSP	24-hour	350 µg/m^3	-
	1 year	150 µg/m^3	-
Falling dust	30 days	10 t/km^2/month residential zone	-
	30 days	20 t/km^2/month industrial zone	-
Hydrocarbons	3-hour	0.24 ppm	-
Lead	24-hour	2 µg/m^3	-
	3-months	1.5 µg/m^3	-
Benzene	1 year	0.003 mg/m^3	-
Dioxin	1 year	0.6 pg/m^3	-

Notes:

* Converted when required for comparison between ppm/ppb and µg/m^3 (or mg/m^3) at 25°Celcius assuming ppm/ppb stated by volume.

Protection and Improvement of the Environment (Law No. 27, 2009)

The Law No. (27) of 2009 for Protection and Improvement of the Environment aims to control emissions to air from a variety of sources (including industrial (factories, power stations, incinerators, oil installations, *etc.*), non-industrial, and vehicles). It establishes emissions limits for the discharge of certain pollutants to air. The law details certain restrictions on activities in order to minimise harmful emissions to air.

Article 6 details various requirements/restrictions with respect to activities which burn hydrocarbon fuels;

Article 7 prevents the unauthorised disposal, processing and burning of municipal solid waste in or near to residential, agricultural, commercial and industrial areas. It goes on to state such waste can be burnt in incinerators but applies a number of restrictions and limitations with respect to the siting and operation of an incinerator.

Article 8 requires medical facilities to have their own incinerator to incinerate their medical wastes, and goes on to detail a number of conditions which must be met with respect to the operation of that incinerator, including those wastes that cannot be incinerated.

Article 9 relates to the incineration of hazardous wastes.

Article 10 details various conditions for the spraying of pesticides and other chemical compounds for agricultural usage and public health purposes.

Article 11 relates to exploration, excavation, demolition, construction, and waste transfer activities and the control of dust emissions from such activities.

Article 12 details the requirements that should be taken into account in the design of flues/stacks for the discharge of emissions to air, specifically:

- the chemical and physical properties of the substances emitted;
- the height above sea level;
- the height of facilities in the surrounding area;
- the outer diameter of the mouth of the stack;
- the inner diameter of the mouth of the stack;
- building materials used;
- the concentration, volume and velocity of emissions;
- temperature of the emission;
- the direction of prevailing winds; and
- the percentage of moisture in the ambient air.

Article 13 requires that all point sources of noise do not exceed national noise standards.

Article 14 requires the monitoring and recording of air emissions and the submission of periodic monitoring reports to the Ministry, competent authorities and stakeholders.

Article 15 requires the owner/operator of a facility to monitor and record emissions to air from the activity; monitoring records should be kept for a minimum of 5 years to enable the Ministry and designated observers from the competent authorities to access these records during inspections of a facility or activity.

Article 16 states that existing facilities have 4 years to comply with the requirements of this law.

The following limits are provided in the Annexes of this law.

Table 4.9: Maximum Allowable Emission Limits of Air Pollutants Emitted from Stationary Sources (Ref. Annex 1)			
Substance	**Symbol**	**Sources**	**Max. Allowable Emission Limits (mg/Nm^3)**
Visible Emissions		Combustion sources other sources	250 None
Opacity		All sources	20%
Carbon Monoxide	CO	All sources	500
Nitrogen Oxide (expressed as nitrogen dioxide)	NOx	Combustion sources material producing industries other sources	See Annex (2) 1000 1000
Sulphur dioxide	SO_2	Combustion sources material producing industries other sources	500 2000 1000
Sulphur trioxide Including Sulphuric Acid Mist (expressed as sulphur Trioxide)	SO_3	material producing industries other sources	150 50
Total Suspended particles	TSP	Combustion sources Cement industry: Exist new other sources	250 150 100 150
Ammonia and Ammonium compounds (expressed as ammonia)	NH_3	material producing industries other sources	50 10
Benzene	C_6H_6	All sources	5
Iron	Fe	Iron& steel foundries	100
Lead and its Compounds (expressed as lead)	Pb	All sources	5
Antimony and its Compounds (expressed as Antimony)	Sb	material producing industries other sources	5 1

Table 4.9: Maximum Allowable Emission Limits of Air Pollutants Emitted from Stationary Sources (Ref. Annex 1)

Substance	Symbol	Sources	Max. Allowable Emission Limits (mg/Nm^3)
Arsenic and its Compounds (expressed as arsenic)	As	All sources	1
Cadmium and its Compounds (expressed as cadmium)	Cd	All sources	1
Mercury and its Compounds (expressed as mercury)	Hg	All sources	0.5
Chrome	Cr	All sources	5
vanadium	V	All sources	5
Nickel and its compounds (expressed as nickel)	Ni	All sources	1
Copper and its compounds (expressed as cupper)	Cu	All sources	5
Hydrogen sulphide	H_2S	All sources Material producing industries	5 10
Chloride	Cl-	Chlorine works other sources	200 10
Hydrogen chloride	HCl	Chlorine works other sources	200 20
Hydrogen Fluoride	HF	All sources	2
Silicon fluoride	SiF_4	All sources	10
Fluoride and its compounds including HF & SiF_4 (expressed as fluoride)	F-	Aluminium smelters other sources	20 50
Formaldehyde	CH_2O	Material producing industries other sources	20 2
Carbon	C	Material producing industries Waste incineration	250 50

Table 4.9: Maximum Allowable Emission Limits of Air Pollutants Emitted from Stationary Sources (Ref. Annex 1)

Substance	Symbol	Sources	Max. Allowable Emission Limits (mg/Nm^3)
Total Volatile Organic Compounds (expressed as total organic carbon (TOC))	VOC	All sources	20
Dioxins & Furans		All sources	1 (ng TEQ/m3)

1. Combustion source relate to ovens, incinerators, boilers, oil and petrochemical industries, power plants and other industries, including the production of construction materials, production plants, laboratories and chemical plants, and other dyes.

2. The concentration of any substance specified in the first column emitted from any source specified in the third column shall not at any point before admixture with air smoke or other gases exceed the limits specified in the fourth column.

3. "mg" means milligram. "ng" means nanogram

4. "Nm^3"means normal cubic meter being that amount of gas which when dry occupies a cubic meter at a temperature of 25 degree centigrade and at an absolute pressure of 760 millimetres of mercury (1 atmosphere).

5. The limit of "Visible Emission" does not apply to emission of water vapour and a reasonable period for cold start-up, shutdown or emergency operation.

6. The measurement for "Total Suspended Particles (TSP)" emitted from combustion sources should be @ 12% reference CO2.

7. The total concentration of the heavy metals (Pb, Cd, Cr, Ni, Hg, Cu, As & Sb) must not exceed 5 mg/Nm^3.

8. VOC limits are for unburned hydrocarbons (uncontrolled).

9. The emission limits for all substances, excluding "Dioxins and Furans", are conducted as a daily average value.

10. "Dioxins and Furans" - Average values shall be measured over a sample period of a minimum of 6 hours and a maximum of 8 hours.

11. Adopted in measuring the concentration of any substance the first column the method adopted by EPA as a way of measuring a reference or equivalent methods of measurement of the global reference.

Table 4.10: Maximum Allowable Emission Limits of Air Pollutants Emitted from Hydrocarbon Fuel Combustion Sources (Ref. Annex 2)

Substance	Symbol	Sources	Max. Allowable Emission Limits (Mg/Nm^3)
Visible emissions		All sources	250
Nitrogen Oxides (expressed as nitrogen dioxide (NO_2))	NOx	Fuel combustion units: Gas fuel Liquid fuel	 350 500
Nitrogen Oxides (expressed as nitrogen dioxide (NO_2))	NOx	Turbine units: Gas fuel Liquid fuel	 70 150
Sulphur Dioxide	SO_2	All sources	500
Total Suspended Particles	TSP	All sources	250
Carbon Monoxide	CO	All sources	500

1. The concentration of any substance specified in the first column emitted from any source specified in the third column shall not at any point before admixture with air, smoke or other gases, exceed the limits specified in the fourth column.

2. "Nm^3" means normal cubic metre, being that amount of gas which when dry, occupies a cubic meter at a temperature of 25 degree centigrade and at an absolute pressure of 760 millimetres of mercury (1 atm).

3. The limit of “Visible Emission” does not apply to emission of water vapor and a reasonable period for cold start- up, shutdown or emergency operation.

4. The “NOx” emission limit of any existing turbine units operated by gas fuel, prior to the issuance and adoption of this regulation will be 125 mg/Nm3.

5. The measurement for “Total Suspended Particles (TSP)” emitted from combustion sources should be @ 12% reference CO_2.

6. Adopted in measuring the concentration of any substance the first column the method adopted by EPA as a way of measuring a reference or equivalent methods of measurement of the global reference.

Table 4.11: Maximum Allowable Emission Limits of Air Pollutants Emitted from Solid Waste Incinerators (Ref. Annex 3)

Substance	MAX. ALLOWBLE EMISSION LIMITS (mg/Nm^3) Incinerator capacity less than 3 ton/hour	MAX. ALLOWBLE EMISSION LIMITS (mg/Nm^3) Incinerator capacity 3 ton/hour or more
Total suspended particles (TSP)	100(daily average)	30(daily average)
Carbon Monoxide (CO)	100(daily average)	100(daily average)
Nitrogen Oxides (NOx) (expressed as nitrogen dioxide (NO_2))	350(daily average)	300(daily average)
Sulphur Dioxide (SO_2)	500(daily average)	300(daily average)
Hydrogen Chloride (HCl)	30(daily average)	20(daily average)
Hydrogen Fluoride (HF)	4(daily average)	2(daily average)
Total Volatile Organic Compounds (VOC) (expressed as total organic carbon (TOC))	20(daily average)	20(daily average)
Nickel (Ni) and its Compounds (expressed as Ni) Arsenic (As) and its Compounds (expressed as As)	Total (1) Total (1)	Total (1) Total (1)
Cadmium (Cd) and its Compounds (expressed as Cd) Mercury (Hg) and its Compounds (expressed as Hg)	Total (0.2) Total (0.2)	Total (0.1) Total (0.1)
Lead (Pb) and its Compounds (expressed as Pb) Chrome (Cr) and its Compounds (expressed as Cr) Copper (Cu) and its Compounds (expressed as Cu) Manganese (Mn) and its Compounds (expressed as Mn)	Total (5) Total (5) Total (5) Total (5)	Total (1) Total (1) Total (1) Total (1)
Dioxins and Furans	0.1 (ng TEQ/m^3)	0.1 (ng TEQ/m^3)

Table 4.11: Maximum Allowable Emission Limits of Air Pollutants Emitted from Solid Waste Incinerators (Ref. Annex 3)		
Substance	**MAX. ALLOWBLE EMISSION LIMITS (mg/Nm^3)** **Incinerator capacity less than 3 ton/hour**	**MAX. ALLOWBLE EMISSION LIMITS (mg/Nm^3)** **Incinerator capacity 3 ton/hour or more**
1. The concentration of any substance specified in the first column emitted from the incinerator shall not at any point before admixture with air, smoke or other gases, exceed the specified limits. 2. "Nm3" means normal cubic metre being that amount of gas which when dry, occupies a cubic meter at a temperature of 25 degree centigrade and at an absolute pressure of 760 millimetres of mercury (1 atm) 3. The Total concentration of the heavy metals (Cd, Hg, As, Cr, Cu, Pb, Mn, Ni, V) shall be measured over as ample period of minimum of 30 min and a maximum of 8 hours. 4. "Dioxins and Furans" Average value shall be measured over sample period of a minimum of 6 hours and a maximum of 8 hours. The emission limit value refers to the total concentration of dioxins and furans are calculated using the concept of toxic equivalence in accordance with Annex 5. Adopted in measuring the concentration of any substance the first column the method adopted by EPA as a way of measuring a reference or equivalent methods of measurement of the global reference.		

Table 4.12: Maximum Allowable Emission Limits of Air Pollutants Emitted from Hazardous and Medical Waste Incinerators (Ref. Annex 4)

Substance (Symbol)	MAX. ALLOWABLE EMISSION LIMITS (mg/Nm^3)
Total suspended particles (TSP)	10(daily average) 30 (half-hourly average)
Carbon Monoxide (CO)	50 (daily average) 100 (half-hourly average)
Nitrogen oxides (NOX) (expressed as nitrogen dioxide NO2)	200 (daily average) 400 (half-hourly average)
Sulphur dioxide (SO2)	50(daily average) 200 (half-hourly average)
Hydrogen Chloride (HCL)	10(daily average) 60 (half-hourly average)
Hydrogen Fluoride (HF)	1 (daily average) 4 (half-hourly average)
Total Volatile Organic Compounds (VOC) (expressed as total organic carbon (TOC)	10(daily average) 20(half-hourly average)
Cadmium (Cd) and Its Compounds (expressed as Cd) Thallium (Ti) and Its Compounds (expressed as Ti)	Total (0.1) Total (0.1)
Mercury (Hg) and Its Compounds (expressed as Hg)	0.1
Antimony (Sb) and Its Compounds (expressed as Sb) Arsenic(As) and Its Compounds (expressed as As) Chrome(Cr) and Its Compounds (expressed as Cr) Cobalt (Co) and Its Compounds (expressed as Co) Copper (Cu) and Its Compounds (expressed as Cu) Lead (Pb) and Its Compounds (expressed as Pb) Manganese (Mn) and Its Compounds (expressed as Mn) Nickel (Ni) and Its Compounds (expressed as Ni) Tin (Sn) and Its Compounds (expressed as Sn) Vanadium (V) and Its Compounds (expressed as V)	Total (1) Total (1) Total (1) Total (1) Total (1) Total (1) Total (1) Total (1) Total (1) Total (1)
Dioxins and Furans	0.1 (ng TEQ/M3)
1. The concentration of any substance specified in the first column emitted from the incinerator shall not at any point before admixture with air, smoke or other gases, exceed the specified limits.	

Table 4.12: Maximum Allowable Emission Limits of Air Pollutants Emitted from Hazardous and Medical Waste Incinerators (Ref. Annex 4)	
Substance (Symbol)	**MAX. ALLOWABLE EMISSION LIMITS (mg/Nm^3)**
2. "Nm^3" means normal cubic meter being that amount of gas which when dry, occupies a cubic meter at a temperature of 25 degree centigrade and at an absolute pressure of 760 millimeters of mercury (1 atm) 3. The Total concentration of the heavy metals (Cd, Hg, As, Cr, Cu, Pb, Mn, Ni, V) shall be measured over a sample period of a minimum of 30 min and a maximum of 8 hours. 4. "Dioxins and Furans" Average value shall be measured over a sample period of a minimum of 6 hours and a maximum of 8 hours. The emission limit value refers to the total concentration of dioxins and furans are calculated using the concept of toxic equivalence in accordance with Annex 5. Adopted in measuring the concentration of any substance the first column the method adopted by EPA as a way of measuring a reference or equivalent methods of measurement of the global reference.	

Table 4.13: Dioxins and Furans (Ref. Annex 5)	
Dioxin / Furan	**TEF**
2,3,7,8- Tetrachlorodibenzo-p-dioxin (TCDD)	1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (peCDD)	0.5
1,2,3,4,7,8-Hexachlrodibenzo-p-dioxin (HxCDD)	0.1
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	0.1
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin (HxCDD)	0.1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01
Octachlorodibenzo-p-dioxin (OCDD)	0.001
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	0.1
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	0.05
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	0.5
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	0.1
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	0.1
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	0.01
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	0.01
Octachlorodibenzofuran (OCDF)	0.001

1. “dioxins and furans” means polychlorinated dibenzo-p-dioxins (peCDD) and polychlorinated dibenzofurans (peCDF), being tricyclic and aromatic compounds formed by 2 benzene rings which are connected by 2 oxygen atoms in peCDD and by one oxygen atom in peCDF and the hydrogen atoms of which may be replaced by up to 8 chlorine atoms.

2. “TEF” means Toxic Equivalency Factor (Toxicology).

3. “TEQ” means Total Equivalent Quantity (Toxic Equivalent), being the sum total of the concentration of each of the dioxin and furan compounds specified in the first column of the table below multiplied by their corresponding TEF specified in the second column thereof: TEQ= Σ (TEF X Concentration) for each type of Dioxin or Furan

4.2.10 Waste

Public Health Act (Law No. 89, 1981)

Chapter V of Public Health Act (Law No. 89, 1981) sets 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.

As approved by the Presidency Office of the Presidency of the Republic in its letter No. m/5/4/5637, dated 05/05/1980, to adopt the following principles required for the burial of waste.

This Specification details the requirements for the establishment of sites for the burial of waste. Sites for the disposal of waste must be outside the boundaries of cities/towns and preferably in natural depressions, former quarries, or other such sites, or in the absence of such sites, land which is deemed unfit for cultivation. In the absence of depressions, trenches can be excavated to bury the waste. Such waste disposal sites should avoid locations where there is a high groundwater table, whenever possible. The Instruction details the methods to be used for the disposal of waste including the thickness of waste layers and the covering of the waste at the end of the working day to prevent odours and the breeding of insects, etc. Each waste disposal site must have staff dedicated to various tasks.

4.2.11 Noise

Noise Prevention (Law No. 21, 1966)

These regulations aim to prevent excessive noise in public places. They prevent broadcasting in public places that may disturb the peace but does allow for the use of speakers internally in public and private places if approved by the police, although the speakers cannot be used between the hours of 10pm and 8am. Applications for the use of such equipment should be made to the Police 3 days beforehand, except in urgent situations where a decision may be made on the same day as the application.

Article III details the need for obtaining approval for the use of such equipment.

The authorities have the right to supervise and control media broadcasts in public places, and to take legal action in the event of any violations (Article IV). Article V of the regulations details the violations and penalties should the regulations be breached.

Instructions (No. 2, 1993)

This Instruction details the conditions for determining the levels of noise emitted from sound equipment in tourist facilities. With respect to outdoor concerts, the Instructions state noise levels must not exceed 96db(A) at a distance of five (5) meters from the source of the sound. The power rating of the sound equipment must not exceed 100 watts.

With respect to indoor concerts full of sound insulation of the walls, ceilings and floors are required so noise levels do not exceed 38 db(A). The capacity of a single set of speakers must not exceed 100 watts.

Industrial and commercial operations have a maximum permissible noise limits of 70 dB(A) and residential activities of 55 dB(A).

The total capacity of the sound equipment must not exceed the limits as detailed in the *Table 4.14*.

Table 4.14: Noise Limits

The inside size of the hall/m^2	The electronic power of the loudspeaker/watt
10000	100
2000	180
3000	220
4000	280
5000	350
6000	400
7000	450
8000	500
9000	580
10000	600

4.2.12 Handling and Storage of Chemicals

Safe Storage and Handling of Chemicals (Instructions No. 4, 1989)

These Instructions detail the requirements for the safe storage and handling of chemicals, being issued in accordance to the provisions of the sixth and seventh paragraph of Article (3) and Article (105) of the Public Health Law No. 89, 1989.

These regulations apply to activities involving the manufacture, use, storage or handling of the following chemical types:

- Explosive;
- Flammable;
- Oxidizing;
- corrosive chemicals, radioactive chemicals and carcinogenic chemicals;
- chemical drugs;
- toxic chemicals and pesticides;
- chemical irritants; and
- inert chemicals.

Article 2 details the necessary precautions for the handling and storage of chemicals, and the need for suitable signage. The replacement of hazardous chemicals with less hazardous materials is required whenever possible, and the minimum possible quantity of such chemicals should be stored at facilities

Article 3 stipulates for chemical manufacturers the provision of suitable signage and labelling, security and safety, and for the adoption of the international system for the classification and written instructions for chemicals.

Article IV details the factors that should be considered when planning for the storage of chemicals including the properties of the materials to be stored, the systems needed to protect the chemicals from damage or exposure to fire, the transport of the chemical containers to and from the store, *etc.*

Article V goes on to detail specific requirements when constructing new chemical stores, and Article VI the rules for correct storage.

Articles VII to XIX detail the requirements for the safe storage and use of chemicals, for the disposal of waste chemical containers (Article XVIII), and actions to be taken in the event of the release of a chemical (Article XI); Article XIX details the need for personal protective equipment (PPE) for individuals working with such chemicals.

4.2.13 Vibration

Public Health (Law No. 89, 1981)

These regulations (Protection of Workers from Vibration Pursuant to Article III, paragraph VI and VII) relate to the protection of workers from sources of vibration. It details the requirements of the employer to provide medical examinations for employees whose jobs involve exposure to vibration; to provide vibration resistant gloves; and the need for rest periods during the day for workers exposed to sources of vibration.

It stipulates that the employer must minimise levels of equipment vibration, use low-vibration equipment; monitor levels of vibration in the workplace, and provide training to employees with respect to vibration in the workplace.

The permitted levels of exposure to vibration and the duration of exposure for hands and arms are detailed in the regulations.

Penalties for breaching these regulations are provided in Article 99 of the Public Health Law No. 89 1981.

However, it is recognised that currently within the country there remains limited effective institutional or administrative infrastructure to ensure implementation of this legislation. The enforcement of present legislation is weak and ad-hoc and is not effective at ensuring those environmental standards that do exist are being adhered to, but such an expectation would probably be unreasonable at this stage in the reconstruction of Iraq.

4.3 International Standards and Guidelines

4.3.1 International and Regional Conventions

The following United Nations (UN) treaties, agreements and protocols have been concluded and/or ratified by Iraq since Saddam Hussein and the Ba'ath Party were deposed from power in April 2003 (*Table 4.15*).

Table 4.15: UN Treaties Concluded and/or Ratified by Iraq (2003 – 2014)			
Name	**Signed**	**Additional Notes**	**Project Relevance**
Ramsar Convention on Wetlands	1971	The Convention on Wetlands of International Importance, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. It Convention entered into force in Iraq on 17/02/08. There is currently one Ramsar site (137,700 ha) in Iraq. Hawizeh Marsh (Haur Al-Hawizeh) is a transboundary wetland, part of the Mesopotamian marshlands complex centred at the confluence of the Tigris and Euphrates rivers, the marshes are ca.75-80% located in Iraq with the remaining area extending into the Islamic Republic of Iran.	Awareness
Vienna Convention for the Protection of the Ozone Layer	1985	The Montreal Protocol on Substances that Deplete the Ozone Layer (1987) was designed to reduce the production and consumption of ozone depleting substances in order to reduce their abundance in the atmosphere, and thereby protect the earth's fragile ozone Layer. Iraq was listed under Article 5 paragraph 1 of the Montreal Protocol as a developing country. On 25th June 2008 Iraq deposited the accession document for joining the Vienna Convention, the Montreal Protocol and its 4 Amendments. Three months later it became the 193 party to the Montreal Protocol.	Awareness

Table 4.15: UN Treaties Concluded and/or Ratified by Iraq (2003 – 2014)

Name	Signed	Additional Notes	Project Relevance
Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	1992	The overarching objective of the Basel Convention is to protect human health and the environment against the adverse effects of hazardous wastes. Its scope of application covers a wide range of wastes defined as "hazardous wastes" based on their origin and/or composition and their characteristics, as well as two types of wastes defined as "other wastes" - household waste and incinerator ash. The Convention aims to reduce hazardous waste generation and the promote environmentally sound management of hazardous wastes and restrict transboundary movements of hazardous wastes except where it is perceived to be in accordance with the principles of environmentally sound management. Iraq has signed the convention on 02/05/2011 (Accession) but, as of 2014, has yet to ratify it.	Awareness
Convention on Biological Diversity (CBD)	1992	National Biodiversity Strategies and Action Plans (NBSAPs) are the principal instruments for implementing the Convention at the national level as defined under Article 6. Under Article 26 of the Convention Parties prepare national reports on the status of implementation of the Convention. Iraq was party (accession) to Convention on 26/10/09.	Applicable
Convention to Combat Desertification	1994	Desertification, along with climate change and the loss of biodiversity were identified as the greatest challenges to sustainable development during the 1992 Rio Earth Summit. Established in 1994, UNCCD is the sole legally binding international agreement linking environment and development to sustainable land management. The Convention addresses specifically the arid, semi-arid and dry sub-humid areas, known as the drylands, where some of the most vulnerable ecosystems and peoples can be found. Iraq was party (accession) to Convention on 28/05/10.	Applicable

Table 4.15: UN Treaties Concluded and/or Ratified by Iraq (2003 – 2014)

Name	Signed	Additional Notes	Project Relevance
United Nations Framework Convention on Climate Change	1992	An international environmental treaty negotiated at the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit. The objective of the treaty is to stabilize greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Iraq accession of the Kyoto Protocol (1997) occurred on 28/07/09 whilst it entered in to force on 26/10/09. Under the Kyoto Protocol (1997) Iraq has been designated as a developing country without binding targets during the commitment period 2013-20.	Applicable
Agreement on International Roads in the Arab Mashreq	2001	The Agreement has the objective of forming the roads of the States of the United Nations Economic and Social Commission for Western Asia (ESCWA) region into a cohesive and homogeneous network capable of supporting and promoting intra-regional land trade and tourism. The agreement includes Route 8 between Basra and Safwan that is located 18 km west of the Project site. Iraq signed on 19/12/02 with full ratification on 17/03/08.	Awareness
United Nations Convention against Corruption (UNCAC)	2003	UNCAC requires that Parties implement several anti-corruption measures which may affect their laws, institutions and practices. These measures aim at preventing corruption, criminalizing certain conducts, strengthening international law enforcement and judicial cooperation, providing effective legal mechanisms for asset recovery, technical assistance and information exchange, and mechanisms for implementation of the Convention, including the Conference of the States Parties to the United Nations Convention against Corruption (CoSP). Iraq was party (accession) to Convention on 17/03/08.	Applicable

Table 4.15: UN Treaties Concluded and/or Ratified by Iraq (2003 – 2014)

Name	Signed	Additional Notes	Project Relevance
Convention for the Safeguarding of the Intangible Cultural Heritage	2003	The purposes of this Convention are to safeguard intangible cultural heritage, to ensure respect for the intangible cultural heritage of the communities, groups and individuals concerned and to raise awareness at the local, national and international levels of the importance of the intangible cultural heritage, and of ensuring mutual appreciation thereof. Iraq ratified the convention on 06/01/10.	Applicable

The following UN Treaties concluded and/or have been ratified by Iraq have been excluded from the table as they are not considered applicable to the Project.

- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) (1973)
- Convention on Hostages (1979)
- Convention on the Civil Aspects of International Child Abduction (1980)
- Convention for the Suppression of Unlawful Acts against the Safety of Maritime Navigation (1988)
- Convention on Terrorist Bombings (1988)
- Convention on the Marking of Plastic Explosives for the Purpose of Detection (1991)
- Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (1993)

- Comprehensive Nuclear-Test-Ban Treaty (CTBT) (1996)
- Ottawa Treaty (1997) often referred to as the Anti-Personnel Mine Ban Convention
- Convention on Terrorist Financing (2000)
- Convention against Transnational Organized Crime (2000) and associated protocols
- Optional Protocol to the Convention on the Rights of the Child on the Involvement of Children in Armed Conflict (2000)
- Optional Protocol on the Sale of Children, Child Prostitution and Child Pornography (2000)
- Cartagena Protocol on Biosafety (2000)
- World Health Organization Framework Convention on Tobacco Control (2003)
- UNESCO Convention on the Protection and Promotion of the Diversity of Cultural Expressions (2005)
- Convention against Doping in Sport (2005)
- Convention on Nuclear Terrorism (2005)
- Convention for the Protection of All Persons from Enforced Disappearance (ICCPED) (2006)
- Convention on the Rights of Persons with Disabilities (2007)
- Convention on Cluster Munitions (CCM) (2008)

4.4 Project Environmental Standards

The following project environmental standards have been identified:

4.4.1 World Bank/International Finance Corporation (IFC)

Operational Manual and Policies

The World Bank Operational Manual contains the operational policies (OPs), Policies, bank procedures (BPs), Directives, and interim instructions to staff (OpMemos) on the conduct of Bank operations. Ops of potential relevance include:

- OP 4.01 - Environmental Assessment (January 1999 revised April 2013)
- OP 4.02 - Environmental Action Plans (February 2000 revised in 2002)
- OP 4.03 - Performance Standards for Private Sector Activities (May 2013)
- OP 4.04 - Natural Habitats (June 2001 revised April 2013)
- OP 4.07 - Water Resources Management (February 2000)
- OP 4.10 - Indigenous Peoples (July 2005 revised April 2013)
- OP 4.11 - Physical Cultural Resources (July 2006 revised April 2013)

General Guidelines

The General EHS Guidelines contain information on cross-cutting environmental, health, and safety issues potentially applicable to all industry sectors. They are a technical reference document with general and industry-specific examples of Good International Industry Practice (GIIP). It should be used together with the relevant industry sector guideline(s).

- Environmental, Health, and Safety General Guidelines, April 30, 2007

Industry Sector Guidelines

The Industry Sector Guidelines contain information on cross-cutting environmental, health, and safety issues potentially applicable to specific industry sectors. Sixty-two industry sector guidelines have been produced by the IFC of which four have been assessed as potentially relevant to the proposed Project, they include:

- Onshore Oil and Gas Development (April 30, 2007)

- Ports, Harbours and Terminals (April 30, 2007)
- Shipping (April 30, 2007)
- Crude Oil and Petroleum Product Terminals (April 30, 2007)

In February 2013, the World Bank Group began a three-year process to review and update its Environmental, Health, and Safety (EHS) Guidelines (as referenced in *Table 6.15*). The current status of relevant EHS Sector Guidelines is as follows:

- Ports, Harbours, and Terminals EHS Guidelines – First consultation was undertaken between 15/10/13 – 15/11/13. The second consultation has yet to start.
- Onshore Oil and Gas Development EHS Guidelines – First consultation was undertaken between 15/10/13 – 15/11/13. The second consultation has yet to start.

Performance Standards

The IFC's Performance Standards (PS) define an internationally recognised way to manage environmental and social responsibilities associated with development.

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts (2012) including associated guidance note
- Performance Standard 2: Labour and Working Conditions (2012) including associated guidance note
- Performance Standard 3: Resource Efficiency and Pollution Prevention (2012) including associated guidance note
- Performance Standard 4: Community Health, Safety, and Security (2012) including associated guidance note
- Performance Standard 5: Land Acquisition and Involuntary Resettlement (2012) including associated guidance note
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources (2012) including associated guidance note
- Performance Standard 7: Indigenous Peoples (2012) including associated guidance note
- Performance Standard 8: Cultural Heritage (2012) including associated guidance note

Equator Principles

The Equator Principles (EPs) is a risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in projects and is primarily intended to provide a minimum standard for due diligence to support responsible risk decision-making. The Equator Principles was subject to review and re-issue in June 2013 (now referred to as Equator Principles III). There are ten statements of principle:

- Principle 1: Review and Categorisation
- Principle 2: Environmental and Social Assessment
- Principle 3: Applicable Environmental and Social Standards
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan
- Principle 5: Stakeholder Engagement
- Principle 6: Grievance Mechanism
- Principle 7: Independent Review
- Principle 8: Covenants
- Principle 9: Independent Monitoring and Reporting
- Principle 10: Reporting and Transparency

Chapter 5 - Air

Contents

5 Air

5.1 Introduction

This Chapter presents the summary of the assessment of air quality and noise conditions in the project area and considers the likely significant effects of the proposed Terminal in terms of noise, air quality and climate. Noise and Air Quality are described separately below.

5.2 Noise

5.2.1 Introduction

A noise assessment was undertaken that involved the measurement of background noise levels on the site to determine the ambient acoustic environment around the site. These are the baseline noise conditions against which the project impacts will be assessed.

In the context of this assessment, noise in terms of environmental impact is defined as unwanted or undesirable sound derived from sources that interfere with normal activities.

This chapter addresses:

- methodology adopted for this assessment;
- identification of receptors;
- the baseline conditions currently existing at the site;
- the likely significant environmental effect during the construction and operational phases of the proposed Terminal;
- the proposed mitigation measures (if required) which will prevent, reduce or offset any significant adverse effects; and
- likely residual effects after the mitigation measures have been implemented.

5.2.2 Basic Acoustic Terminology

Sound is produced by mechanical vibration of a surface, which sets up rapid pressure fluctuations in the surrounding air. Between the quietest audible sound and the loudest tolerable sound there is a million to one ratio in sound pressure level. It is because of this wide range that a logarithmic noise level scale is used in noise measurement studies. This is the decibel scale. Audibility of sound covers a range of about 0 to 140 decibels (dB) corresponding to the intensity of the sound pressure level. The ability to recognise a particular sound is dependent on the pitch or frequencies present in the source. Sound pressure measurements taken with a microphone cannot differentiate in the same way as the ear, consequently a correction is applied by the noise measuring instrument in order to correspond more closely to the frequency response of the ear which responds to sounds from 20 Hz to 20,000 Hz. This is known as 'A weighting' and written as dB(A). The use of this unit is internationally accepted and correlates well with subjective annoyance to noise.

The logarithmic basis of noise measurements means that when considering more than one noise source their addition must be undertaken in terms of logarithmic arithmetic. Thus, two noise sources each of 40 dB(A) acting together would not give rise to 40 + 40 = 80 dB(A) but rather 40 + 40 = 43 dB(A). This 3 dB(A) increase represents a doubling in sound energy but would be only just perceptible to a human ear. *Figure 5.1* gives typical noise levels in terms of dB(A) for common situations.

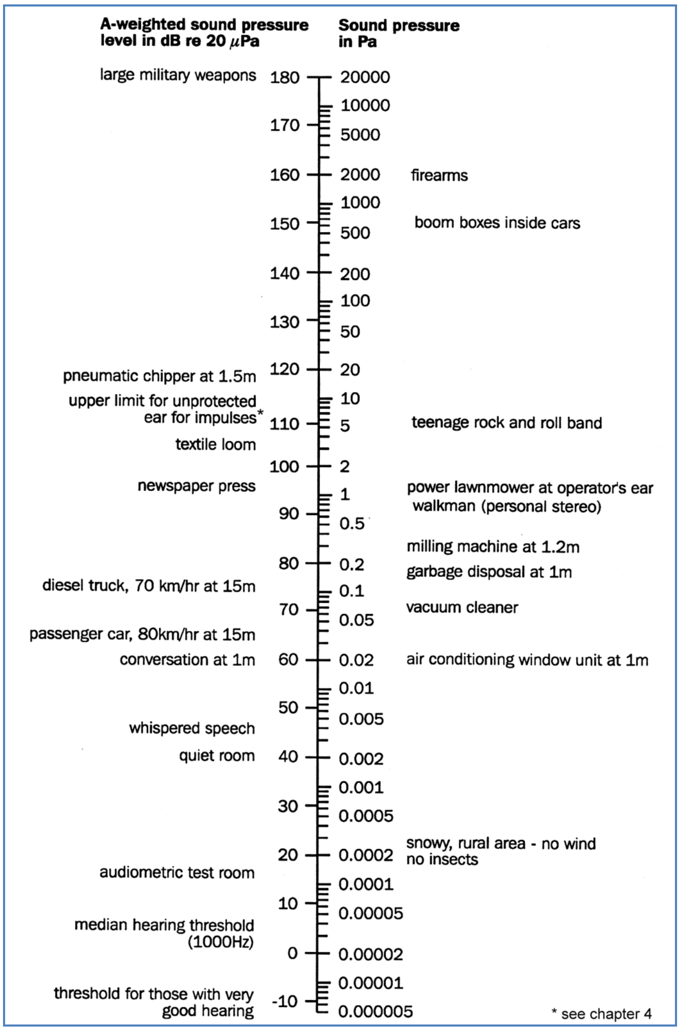


Figure 5.1: *Sound levels from typical noise sources*[1]

Table 5.1 summarises the subjective perception of noise level changes and shows that a reduction in sound energy of 50% results in a reduction of 3 dB and is just perceptible to the normal ear.

Table 5.1: Subjective Effect of Changes in Sound Pressure Level[1]

Change in sound level (dB)	Change in Power (decrease)	Change in Power (increase)	Change in apparent loudness
3	1/2	2	Just perceptible

[1] Occupational exposure to noise: evaluation, prevention and control, Chapter 1: Fundamentals of Acoustics, World Health Organization, p33, http://www.who.int/occupational_health/publications/occupnoise/en/index.html

Table 5.1: Subjective Effect of Changes in Sound Pressure Level[1]

Change in sound level (dB)	Change in Power (decrease)	Change in Power (increase)	Change in apparent loudness
5	1/3	3	Clearly noticeable
10	1/10	10	Half or twice as loud
20	1/100	100	Much quieter or louder

Noise levels can vary with time according to source activity and indices have been developed in order to be able to assign a value to represent a period of noise level variations and to correspond with subjective response.

The definition, in layman's terms, is given below for terminology used in the measurement and results obtained during the survey work.

- **Ambient noise:** The totally encompassing sound in a given situation at a given time usually composed of sound from many sources near and far.
- **Attenuation:** Noise reduction.
- **Background noise:** The general quiet periods of ambient noise when the noise source under investigation is not there.
- **Decibel (dB):** The unit of measurement for sound based on a logarithmic scale. 0dB is the threshold of normal hearing; 140dB is the threshold of pain. A change of 1dB is only detectable under controlled laboratory conditions.
- **dB(A) [decibel A weighted]:** Decibels measured on a sound level meter incorporating a frequency weighting (A weighting) serves to distinguish sounds of different frequency (or pitch) in a similar way to how the human ear responds. Measurements in dB(A) broadly agrees with an individual's assessment of loudness. A change of 3dB(A) is the minimum perceptible under normal everyday conditions, and a change of 10dB(A) corresponds roughly to doubling or halving the loudness of sound.
- **dB(C): [decibel C weighted]:** Frequency weighting which does not alter low frequency octave band levels by very much compared to `A' weighting. Similar to linear reading (i.e. linear does not alter frequency spectra at all).
- **Frequency (Hz):** The number of sound waves to pass a point in one second.

- **$L_{Aeq,T}$:** This is a noise index used to describe the "average" level of a noise that varies with time (T). It allows for the different sensitivities of the human ear to different frequencies (pitch), and averages fluctuating noise levels in a manner, which correlates well with human perceptions of loudness.

- **$L_{A10,T}$:** This noise index gives an indication of the upper limit or peak levels of the fluctuating noise. It is the "A-weighted" noise level exceeded for 10 per cent of the specified measurement period (T) *e.g.* if the measurement period was over 10 hours and the L_{A10} reading was say 60 dB, then this means that for 1 hour out of 10 the level went above 60 dB.

- **$L_{A90,T}$:** This noise index gives an indication of the lower limit or levels of the fluctuating noise. It is the "A-weighted" noise level exceeded for 90 per cent of the specified measurement period (T) *e.g.* if the measurement period was over 10 hours and the L_{A90} reading was say 50 dB, then this means that for 9 hours out of 10 the level went above 50 dB.

- **$L_{Amax,T}$:** This is the highest A-weighted noise level recorded during a noise measurement period (T).

5.2.3 Assessment Methodology

Baseline Noise Assessment

The noise assessment took place at five locations, determined after the initial site reconnaissance, in order to assess the representative baseline conditions. Each location was monitored for four 30 minute periods over two days. Although in general there was no anthropogenic noise source on the site (and no activity likely to give rise to any), there were occasional noises from passing ships and the nearby port operations. It was thus important to monitor the noise levels at different times of the day to try and capture some of these variations.

All noise measurements were undertaken in accordance with the principles of BS7445: 1991: Parts 1-3, *Description and Measurement of Environmental Noise* and following the guidance given in BS4142. The noise parameters of $L_{Aeq,T}$, $L_{A90,T}$ $L_{A10,T}$ and L_{AFmax} were recorded during the measurement period at each position.

All measurements were undertaken approximately 1.5m above local ground level, well away from any existing buildings, scrap debris or walls that could provide some form of shielding or attenuation or reflection of ambient noise (so called free-field conditions).

Photograph 5.1: *Noise monitoring at AN05*

All acoustic measurement equipment used during the noise surveys conformed to Type 1 specification of British Standard 61672: 2003: *Electroacoustics. Sound level meters*. Part 1 *Specifications.*

All meters were calibrated before and after the measurements period and no signal drift was found to have occurred during any of the monitoring periods. All equipment holds current manufacturers calibration certificates and conforms to relevant parts of IEC: 651:1979 (equivalent to BS5969:1981) for the requirements of Type 1 acoustic accuracy. Additionally the equipment conforms to specification contained within IEC 804:1985 (equivalent to BS6698:1986) for integrating Sound Level Meters. Fast meter response and free field settings were used for all measurements carried out during the survey.

Measurements were generally made in accordance with BS7445:1991 '*Description and measurement of environmental noise*' Part 2: 'acquisition of data pertinent to land use'. Environmental windshields were used at all times throughout the survey.

5.2.4 Noise Assessment Criteria

The criteria to be used to assess the noise environment considered the following requirements:

- Iraqi National Standards, Instructions No. 2, 1993;
- World Health Organisation (WHO) Guidelines for Community Noise, WHO, 1999; and
- International Finance Corporation (IFC) Noise Management Standard (April 2007).

A comparison of the standards is outlined below.

Iraqi National Standards, Instructions No. 2, 1993

The stated construction and operation noise level guidelines within residential locations is 55 dBA (daytime) and 45dBA (night-time) respectively (*Table 5.2*). It should be noted, however, that there are no residential locations in close proximity to the site. These quoted noise levels correlate with the Guidelines values stated by the Guidelines for Community Noise, WHO, 1999.

Table 5.2: Iraqi Noise Standard One Hour L_{Aeq}

Zone	Level L_{Aeq}(day time)	Level L_{Aeq} (night time)
Industrial	70	70
Commercial	70	70
Residential	55	45

WHO Guidelines for Community Noise

The WHO guideline values in *Table 5.3* are organized according to specific environments. When multiple adverse health effects are identified for a given environment, the guideline values are set at the level of the lowest adverse health effect (the critical health effect). An adverse health effect of noise refers to any temporary or long-term deterioration in physical, psychological or social functioning that is associated with noise exposure. The guideline values represent the sound pressure levels that affect the most exposed receiver in the listed environment.

The time base for L_{Aeq} for “daytime” and “night-time” is 16 hour and 8 hour, respectively. No separate time base is given for evenings alone, but typically, guideline value should be 5 –10 dB lower than for a 12 hour daytime period.

Table 5.3: WHO Guideline Values for Community Noise in Specific Environments

Specific Environment	Critical health effect(s)	L_{Aeq} (dB)	Time base (Hours)	L_{Amax}, fast (dB)
Outdoor living area	Serious annoyance, daytime and evening	55	16	-
Outdoor living area	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	-
Dwelling, indoors, inside bedrooms	Sleep disturbance, night-time	30	8	45
Industrial, commercial, shopping and traffic areas, indoors and outdoors	Hearing impairment	70	24	110

IFC Noise Management Standard

Under the requirements of the IFC standards ‘*Noise prevention and mitigation measures should be applied where predicted or measured noise impacts from a project facility or operations exceed the applicable noise level guideline at the most sensitive point of reception*’.

Table 5.4: IFC Noise Level Guidelines (One Hour L_{Aeq})		
Receptor	**Day time (07:00 – 22:00)**	**Night time (22:00 – 07:00)**
Residential, institutional and educational	55	45
Industrial and commercial	70	70

The IFC guidelines are in-line with the Guidelines for Community Noise, World Health Organization (WHO), 1999.

In addition, to comply with requirements routinely applied elsewhere in the world, an appreciation of the background noise conditions is required, against which to determine the impact of the proposed development at the nearby receptors. This is the basis for assessment under the British Standard BS4142:1997 *'Method for Rating Industrial Noise Affecting Mixed Residential and Industrial Areas'*.

5.2.5 Baseline Conditions

Receptor Identification

The site is irregular in shape and covers a total area of approximately 1km^2. The northern elevation of the site comprises KAZ Jetty No. 1 and areas of unsurfaced land with areas utilised for the storage of scrap metal, much of which appears to be marine-derived (wreck salvage). However, the majority of the site, approximately 95%, is undeveloped and there is no discernible difference between the site and surrounding land, which stretches for many kilometres with little change in relief or features. Other than a narrow strip of intertidal vegetation that is exposed at low tide (approximately 20m wide) and patches of Sabhka vegetation, the site is featureless and characterised by dry, silty sand with salt encrustation. There is evidence of disturbance of some of the soils by heavy plant and some accumulations of earth mounds from earthworks activities. Also there is an earth bank road running along the site parallel to the shoreline with two smaller earth bank roads extending to the water line.

The site surrounds are as follows:

- **North:** Khor Al-Zubair Port (KZP). Constructed between 1975 and 1980, the Port was designed to handle general cargo and specialised bulk materials such as fertilizer, phosphate, petrochemical and iron (scrap) exports together with iron ore imports. The Port's facilities extend beyond the quay side to include cranes and warehouses. The

Port covers an approximate area of 400 hectares (ha) and includes 12 berths giving approximately 3km of quay;

- **East:** Khor Al-Zubair River;
- **South:** Undeveloped land beyond which is the effluent channel from the fertiliser plant;
- **West:** Undeveloped land beyond which is Highway 26, approximately 5.5km distant at its closest point to the site; and
- **North-west**: KZP Freezone including the SKA Terminal which comprises tanked storage facilities, offices and worker accommodation.

Due to the very limited development of the site, the noise levels currently generated from the site itself are negligible. Although the northern boundary of the site is adjacent to KZP, the noise levels there are also minimal. No sensitive receptors have been identified in close proximity to the site. The nearest housing is located adjacent to the Highway 26, at least 5.5km distant. Consequently, the site is not in itself a significant contributor to the ambient noise levels and is similarly not subjected to significant noise from adjacent sources. The Freezone and the port are not especially busy in terms of plant and machinery operations, so there is little noise generated from these areas. The other larger industrial plants like the fertilizer plant and steelworks are some considerable distance from the project site so even strong noise sources on these sites would not be discernible at the project site.

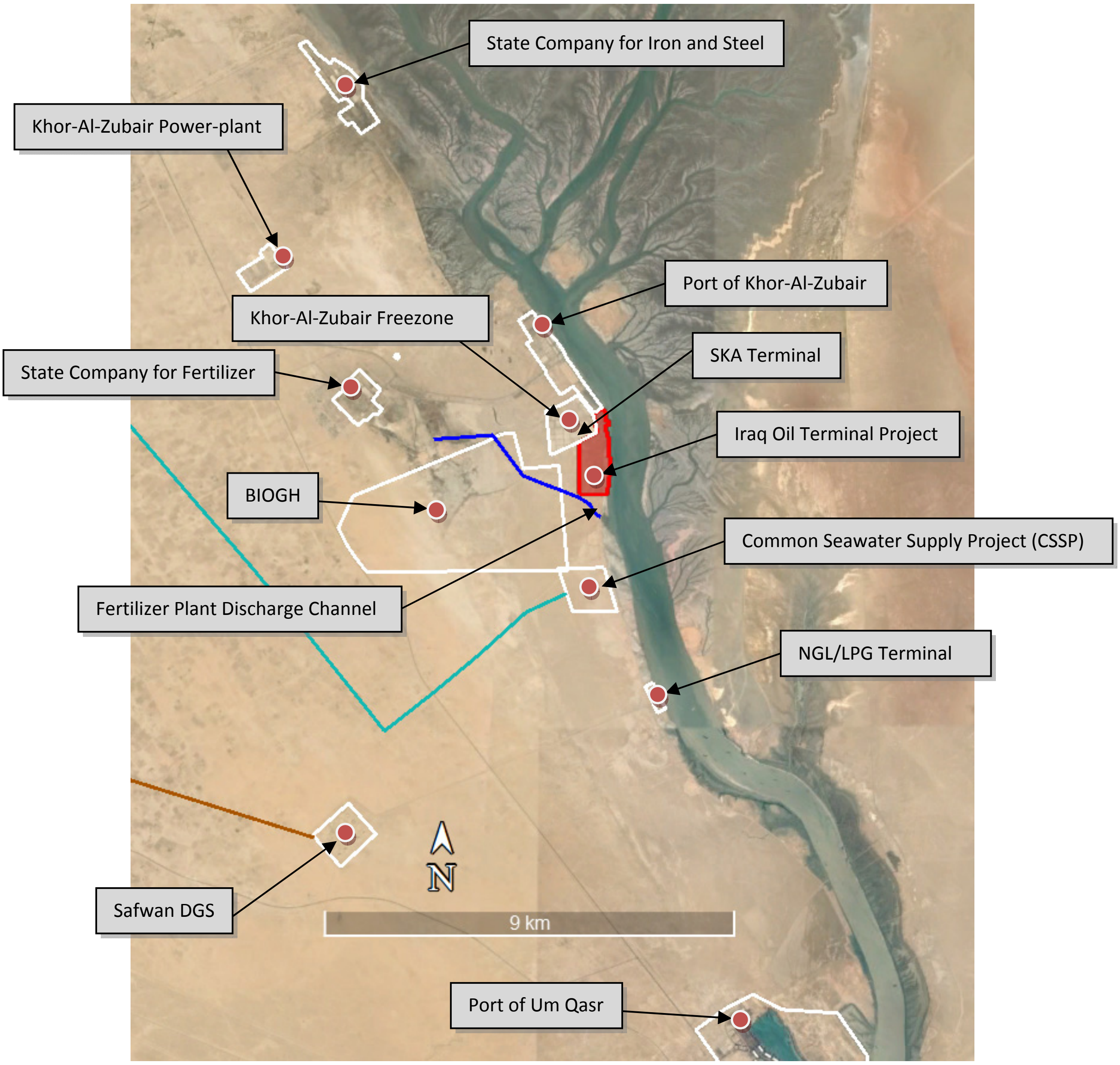


Figure 5.2: *Site and surrounding features*

Google Earth Pro Imaging with the permission of Google Licensed to Earth and Marine Environmental Consultants Ltd

Baseline Noise Measurements

A series of baseline environmental noise measurements were carried out at the site on 29th – 30th August 2014 in order to determine the prevailing noise levels at the proposed terminal. EAME deployed a Casella CEL-633 Class 1 noise meter at five locations for four 30 minutes periods over the two day campaign. The locations were determined following the site reconnaissance and are intended to provide spatial coverage of the baseline noise conditions at the site.

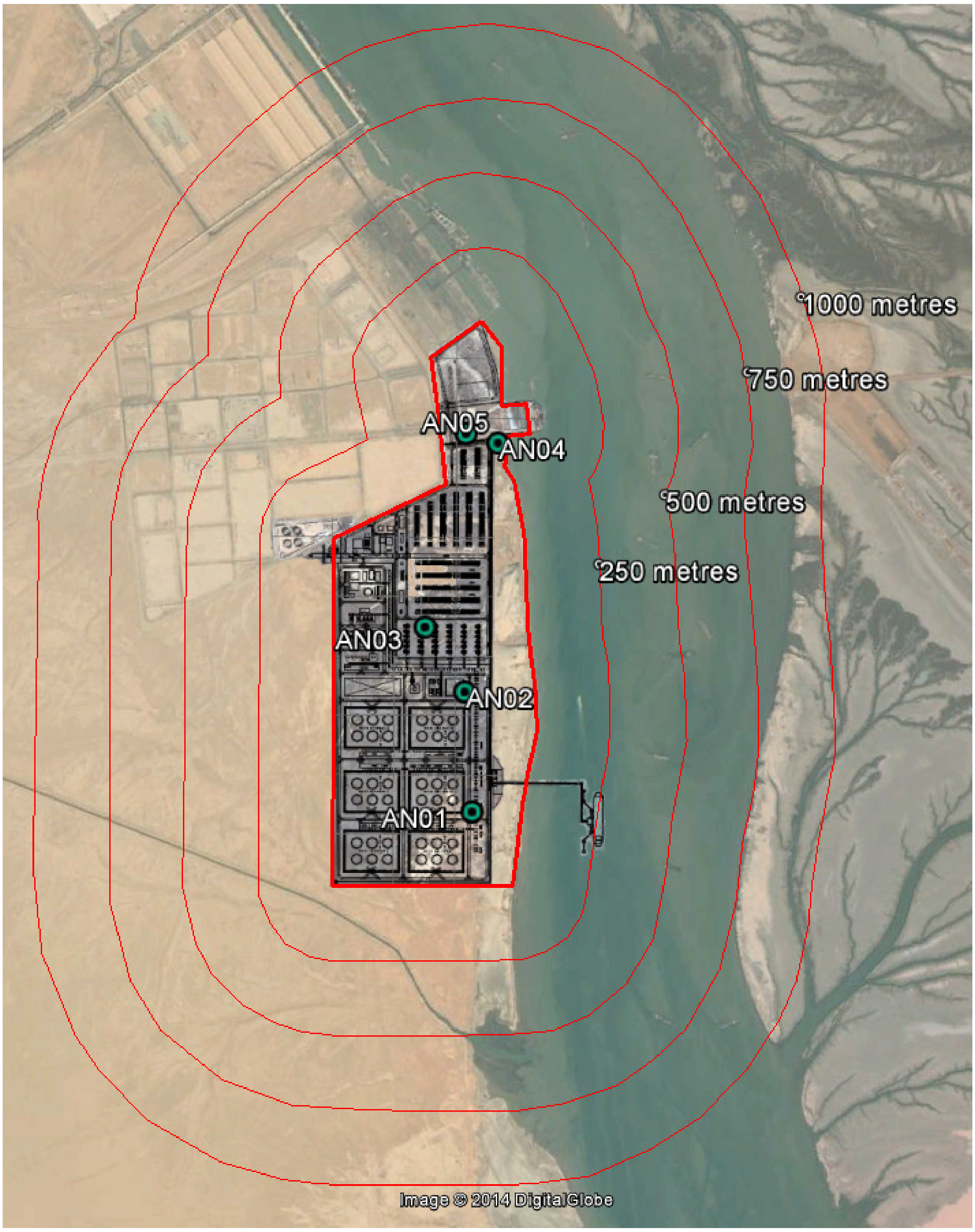


Figure 5.3: *Five noise measurement locations AN01 – AN05*

Google Earth Pro Imaging with the permission of Google Licensed to Earth and Marine Environmental Consultants Ltd

Table 5.5: Noise Monitoring Locations

Location	Latitude, Longitude
AN01	30°10'10.00"N, 47°53'31.00"E
AN02	30°10'23.00"N, 47°53'30.00"E
AN03	30°10'30.00"N, 47°53'25.00"E
AN04	30°10'50.00"N, 47°53'34.00"E
AN05	30°10'51.00"N, 47°53'30.00"E

The weather during the surveys was generally conducive to noise measurement with dry conditions, however, due to the exposed location of the site and the presence of the summer *Shamal*, the site was windy on occasion with periodic strong gusts. As such, in the instances where high wind fluctuations occurred during monitoring non-typical high background level (L_{A90}) readings may have been recorded.

Given the lack of receptors and a dominant noise climate in the immediate and wider environs of the site, the baseline noise measurements were undertaken on-site in order to derive a set of background noise statistics representative of the site. The results of the baseline environmental noise measurements at each of the locations are summarised in *Table 5.6* and presented in full in *Appendix F1*:

Table 5.6: Baseline Environmental Noise Measurements

Position	Period	Noise Level, dB			
		L_{Aeq}	L_{A90}	L_{A10}	L_{AFmax}
AN01	Maximum	56.5	48	56.5	78.6
	Mean	40.4	35.2	43.3	48.4
	Minimum	33.9	29.5	36.5	42.3
AN02	Maximum	53.0	48	56.5	61.1
	Mean	46.1	42.1	48.5	51.7
	Minimum	38.8	35.5	41.0	33.2

Table 5.6: Baseline Environmental Noise Measurements					
Position	**Period**	**Noise Level, dB**			
		L_{Aeq}	L_{A90}	L_{A10}	L_{AFmax}
AN03	Maximum	63.7	53.5	64.5	76.1
	Mean	45.1	40.6	47.4	53.5
	Minimum	34.2	30.0	35.0	37.7
AN04	Maximum	61.7	49.5	57.0	80.4
	Mean	42.3	39.0	44.0	48.5
	Minimum	34.4	32.5	36.0	38.7
AN05	Maximum	61.2	53.0	60.5	61.2
	Mean	43.5	39.5	45.7	43.5
	Minimum	38.4	36.5	38.5	38.8

During the monitoring period, the general noise levels were considered low with no discernible obtrusive tonal or noise impacts being observed. No significant differences were noted between the monitoring locations.

Using 1993 Iraqi Noise Standards, none of the maximum values or calculated means were found to be elevated above the 70 dB standard for industrial and commercial properties and overall the site can be considered to be a quiet low noise environment at present. The most dominant noise source on the site is the wind and occasional bird song from wading birds on the foreshore.

The observed noise levels and related guidance criteria are presented below.

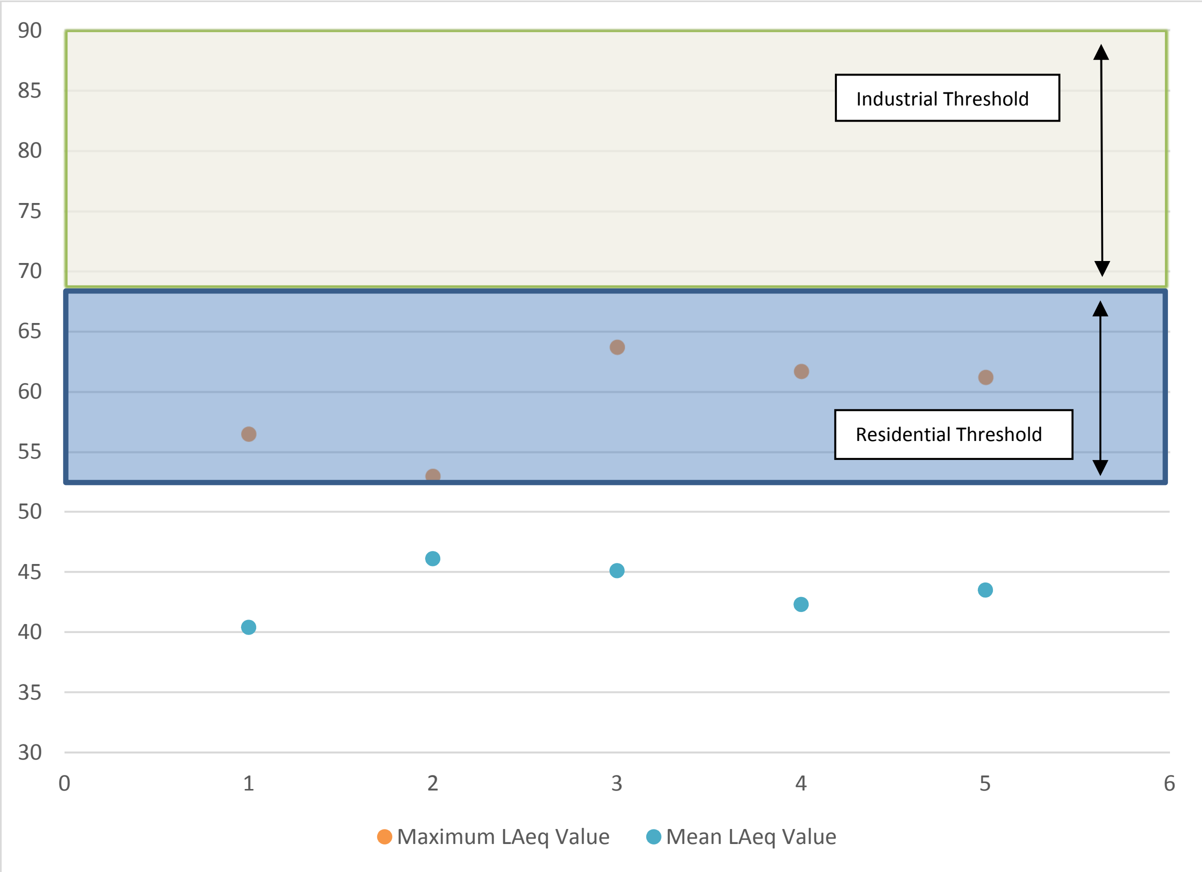


Figure 5.4: *Summarised noise monitoring vs reference criteria*

It can be seen from the figure above that none of the observed baseline noise levels exceed the threshold criteria for industrial environments (grey shaded area) and none of the mean values exceed the residential criteria (blue shaded area), but the peak levels for all locations (other than AN02) do exceed the residential criteria. As previously stated, however, the nearest residential property is over 5km away and this threshold is not directly applicable to the site environment.

5.2.6 Impact Assessment

Construction Impacts

It is inevitable with any major development that there will be some noise, particularly during the site clearance and construction phase when heavy plant and machinery is engaged. Typically, however, noise disruption due to construction is a localised phenomenon, temporary in nature by definition and only people living or working within a few hundred metres of the site boundary are likely to be impacted by construction noise. The table below illustrates the typical noise output levels that could be associated with construction plant and equipment.

Table 5.7: Typical Sound Power Levels Associated With Construction Activities		
Plant Type	**Possible Areas of Use**	**Activity Sound Power Levels, L_W (dB)**
Hand-held hammer	Demolition, general site activities	112
Pneumatic breaker	Demolition, site preparation, concreting operations	109
Tracked crane	Demolition, concreting operations	121
Compressor	Site preparation, concreting operations, general site activities	100
Dozer	Site preparation	113
Dump truck	Site preparation, general site activities	110
Grader	Site preparation	111
Lorry	Site preparation, general site activities	115
Tracked Excavator	Site preparation, concreting operations	102
Tractor	Site preparation	116
Trenching machine	Site preparation	105
Vibratory roller	Site preparation	106
Wheeled loader	Site preparation, concreting operations	108
Air hammer pile driver	Pilling	126
Auger crane mounted	Pilling	116
Drop hammer pile driver	Pilling	116
Pneumatic chipping hammer	Pilling	116
Tripod winch	Pilling	112
Batching plant	Concreting operations	106
Concrete mixer	Concreting operations	104

Table 5.7: Typical Sound Power Levels Associated With Construction Activities

Plant Type	Possible Areas of Use	Activity Sound Power Levels, L_W (dB)
Generator	Concreting operations, general site activities	122
Poker vibrator	Concreting operations	122
Truck mixer	Concreting operations	108
Circular saw	General site activities	110
Pneumatic circular saw	General site activities	103

In the case of the proposed development, all of the most noise-sensitive receptors (residential properties) are over 5km from the site. They are therefore, highly unlikely to experience any, let alone significant impacts, as a result of the proposed construction works on the site. There are thus no anticipated noise impacts on residential receptors from construction activities.

It is possible, however, that workers on the adjacent Freezone and port site would be able to receive noise impacts given their closer proximity to the works. The principal noise source will be from the engines of heavy plant and equipment during earthworks activities and the piling rigs. The noise levels will, however, be transient and will be masked to some extent by local activities within the port such as crane loading and ship engine running during berthing operations. There are no significant activities (that would involve personnel being present for prolonged periods of time) in the port and Freezone areas closest to the project site. Consequently, notwithstanding the natural attenuation of noise by buildings, the exposure time of personnel in zones likely to be affected would be very small.

A further consideration is that the local wind environment can substantially affect how far noise will travel. The ESIA work has been accompanied by a metocean study which has included 30 days of intensive meteorological monitoring on the KZP site. The wind rose for this study is presented in *Figure 5.5* overleaf.

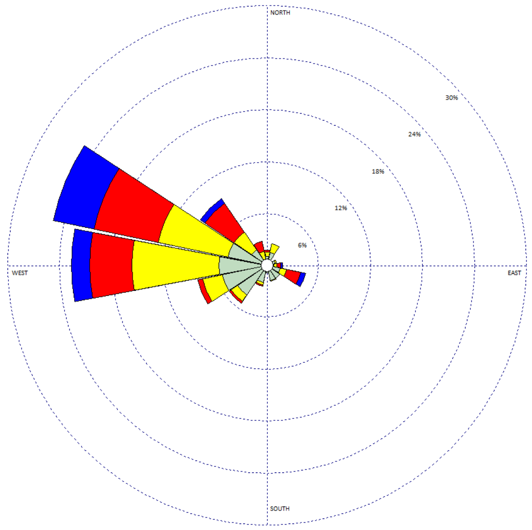


Figure 5.5: *Wind rose direction (blowing from) (hourly data points) between 10/09/14 – 10/10/14*

It can be seen that the predominant wind direction and the strongest winds are from the west and north-west. This accords with other studies in the area and is typical of the *Shamal* which blows for most of the year from the north and west. This means that on most occasions throughout the year the prevailing wind would carry noise from the project site out onto the Khor Al-Zubair and away from neighbouring land uses and residential areas.

Bearing the above discussion in mind there are not expected to be any significant noise impacts associated with the construction activities and the baseline noise conditions are not expected to change.

Operational Impacts

The other key consideration in terms of potential impacts is from the operational phase of the development. This could manifest itself in two ways in terms of the noise and air quality environment. These are the emissions and noise output associated with the fixed activities on the project site itself and those associated with marine and road traffic generated be the operations. Each of these are considered separately overleaf.

Operational Traffic Impacts - Road

The traffic impacts associated with the development proposals are discussed more fully in *Chapter 9 – Socio Economic Impacts*, however, in summary additional traffic associated with the development proposals could lead to additional traffic related impacts such as noise and air quality. The KZP site generates large amounts of Heavy Goods Vehicle (HGV) traffic primarily in the form of petrol tankers entering the port to load with petroleum products for redistribution into the local supply market. The tankers tend to queue on the main access road during the day and then load and travel through the night. The new berth will provide an alternate facility to the arrangements at KZP, so in that respect the operations will not generate new additional traffic, for these vehicles, it will provide an alternate facility. Increases in efficiency and capacity could, however, increase the numbers of vehicles (which can number several hundred per day).

The other main source of heavy traffic in the area is associated with the import of pipe for the oil and water infrastructure projects. Periodically large stock piles of pipes are built up in the Port, these are then transported to the oilfields by HGV's. There is thus the potential for additive impacts to arise if peak vehicle movements coincide.

The main impact of this in terms of noise could be HGV engines and road noise affecting residential receptors that the vehicles pass. There are, however, no noise-sensitive receptors (residential communities) along the main routes to and from the port. As such, even if HGV numbers increase substantially at times, it will not impact significantly on residential communities. Given the traffic volumes already generated within the port operations at KZP and Umm Qasr and the Safwan border crossing, noise related impacts from the additional traffic associated with the terminal are considered to be insignificant.

Operational Traffic Impacts – Marine

Marine traffic will inevitably increase as a result of the proposed terminal and the frequency of vessel transits will increase due to the increased turnaround efficiency of the new terminal. The vessels, however, will be approaching from the main channel (manoeuvred in to position by tugs), which has no sensitive land uses associated with the riparian lands and is a large open estuary. Consequently, any noise impacts associated with these vessels are likely to be insignificant.

Operational Impacts – Site Operations and Management

The main noise generating activities likely to be associated with the proposed development, (once operational) include generators, compressors, pumps, mechanical equipment (cranes, etc) and maintenance activities. Given the separation distance between the proposed operational areas and noise-sensitive receptors, it is considered that noise from the day to day site operations (and associated mechanical plant and equipment) is unlikely to be perceptible at those noise-sensitive receptor locations (such as the nearest residences which are over 5km away). It is likely that operational noise from the terminal will be audible in the Freezone and port area but the duration and level of exposure to operatives in those locations will be negligible.

It should also be borne in mind that the wind conditions are fairly consistent and predictable in Iraq with the predominant wind feature being the *Shamal* which blows from the west and north-west on most days. This would, on most occasions, carry any noise generated on the site out onto the open water of the Khor Al-Zubair, away from neighbouring land uses and distant residential properties.

It is reasonable to conclude therefore that the potential for significant noise impacts from the operational terminal is very low.

5.2.7 Mitigation

Given the lack of noise-sensitive receptors in close proximity to the site, and the low likelihood of significant noise generating activities on the site, no specific mitigation measures are considered to be necessary during the construction and operational phases. Notwithstanding that, in accordance with best practice (and to lessen potential occupational noise impacts for site workers) there should be some effort applied to reduce potential noise sources where possible. Techniques may include:

- Select low noise equipment or modes of operation that produces less noise (e.g. turn off engines rather than let them idle when not in use);
- keep stationary noisy plant such as generators and compressors, as far as possible from noise sensitive facades and sheltered by a properly built acoustic enclosures or screening;
- use noise control equipment such as jackets on pneumatic drills, and shrouds on piling rigs and cranes;
- use rotating or impacting machines on anti-vibration mountings; and
- ensure that audible warning systems, including reversing alarms, are switched to the minimum setting required to meet Health and Safety requirements. Also traffic routes that avoid reversing on site will minimise the impact.

5.2.8 Residual Impacts

Residual noise impacts are considered to be negligible and environmentally insignificant.

5.3 Air Quality

5.3.1 Introduction

The potential impacts of the proposed development on local air quality during construction, operational and decommissioning phases have been assessed. For these phases, the type, source and significance of potential impacts are identified and the measures that should be employed to minimise these impacts are described, where applicable.

5.3.2 Information from Desktop Study

The overall air quality in Basra Governorate has been deteriorating as development, population, traffic and industrial activity have increased in the region. Furthermore, the lack of state of the art controls over many of the gaseous discharges from the oil fields and open burning of domestic waste have also have had an effect on air quality. Also, given the lack of reliable power there is a growing use of diesel generators and associated emissions. There are also natural air quality issues in the form of fine dusts that are generated from the periodic and sometimes prolonged dust storms that affect the region. The population of Basra Governorate are in direct daily contact with the different gaseous pollutants that are caused by daily urban activities, mostly by increasing the use of fossil fuel combustion from electrical generators and motor vehicles, as well as exposing the population to industrial activities2.

The study area has a number of industrial activities and in particular the steel works, fertiliser plant and power plants (land based and ship based), which all lie north and north west of the site and hence upwind of the project site most of the time. In the immediate vicinity of the project site, however, there are few sources of air emissions.

Previous studies have indicated high concentrations of carbon monoxide, NOx and SOx within the industrial areas of Basra[2] and given that concentrations from these emissions are expected to increase, and could become hazardous to human health in places close to these sources or in urban areas.

Dust and sandstorms occur periodically in southern Iraq and are highly influential on both regional and local air quality. The area is susceptible to these storms because of the low topographic relief, scant vegetation cover, light-textured topsoil and recurring strong and turbulent winds[3].

[2] *Gaseous Pollutants in Basra City, Iraq,* Douabal *et al*., Air, Soil and Water Research 2013:6, 2013

[3] *Wind Regime of the Arabian Gulf*, Ali Hamid Ali, The Gulf War and the Environment, edited by Farouk El-Baz and R.M. Makharita, 1994, Gordon and Breach Science Publishers

Bearing all of the above in mind there are numerous potential sources of air pollutants in the wider area and region generally, but within the immediate locality of the site there are few.

5.3.3 Assessment Methodology

Air quality assessment was undertaken at the same five locations as the noise monitoring namely AN01 – AN05 (see *Figure 5.1*). The selection of monitoring sites was based in part on providing spatial spread across the site, but was also dictated by available structures of features to fit sampling tubes to. The parameters and periods of sampling are outlined in *Table 5.7*:

Table 5.7: Air Quality Sampling Parameters

Parameter	Sampling Method	Period
Nitrogen oxides (NOx),	Passive Static Sampling (Air diffusion tubes)	4 weeks continuous
Oxides of Sulphur (SOx)	Passive Static Sampling (Air diffusion tubes)	4 weeks continuous
Carbon Monoxide (CO)	Static Sampling through use of Gresham pump set	Once
Particulates (PM_{10} and $PM_{2.5}$)	Static Sampling and Monitoring Equipment through the use of Turnkey Instruments DustMate dust monitor	4 x 30 minute sampling periods per station over 2 days
Volatile Organic Compounds (VOC) methane and ethane	Passive Static Sampling (TENAX tubes or similar)	4 weeks continuous

Passive Diffusion Tubes

Passive diffusion tubes were installed within dedicated monitoring fixed to poles or perimeter fencing around the site. The passive diffusion tubes were used for SOx, NOx and VOC sampling. During the installation process, the following conditions were considered:

- that the tubes open end was exposed to the free circulation of air;
- the immediate area around the sampler location was open, allowing free circulation of air;
- the tubes were installed at breathing height;

- no tubes were directly attached to surfaces which may act as absorbers for NO_2;
- no tubes were installed in any form of recess;
- areas of high turbulence (*i.e.* corners of buildings) were avoided;
- sites were open to the sky with no overhanging vegetation or buildings; and
- sources of localised pollution (*i.e.* heater flues, air conditioning outlets, extractor vents, underground ventilation shafts *etc.*) were avoided.

Photograph 5.2: *Passive Tube Monitoring Shelter*

Gresham Tubes

Gresham tubes are used for collecting pressurised samples of air for laboratory analysis. Using the gas sampling pump, the air at each location is pumped into a 55ml stainless steel sample cylinder which becomes pressurised with the sample. The cylinders are then despatched to the laboratory for analysis. The Gresham tubes were used for CO sampling and analysis.

Laboratory Analysis

All laboratory analytical work was undertaken by SAL Laboratories located in the United Kingdom. The laboratory is both United Kingdom Accreditation Service (UKAS) and the Environment Agency's (UK regulatory body) Monitoring Certification Scheme (MCERTS) certified. UKAS is the sole accreditation body recognised by government to assess, against internationally recognised standards, organisations that provide certification, testing, inspection and calibration services.

Particulate Monitoring

The methodology used for each of the particulate surveys was relatively simple in that a dedicated tripod mounted particulate monitor was used in the fixed sample locations and was attended by an EAME field scientist who switched the device on and downloaded the data periodically to a laptop.   Sampling took place for 30 minutes at a time, on four separate occasions (spread over 2 days) at each of the sampling locations.

Photograph 5.3: *Particulate Monitoring*

All sampling and laboratory analysis was undertaken with reference to appropriate guidance and accreditation.

The air quality assessment also recorded climatic conditions and the presence of any identified or potentially significant pollutant sources that were evident at the time of sampling.

5.3.4 Air Quality Standards

World Bank and International Finance Standards

In order to try and put the findings of the air quality survey results into perspective, EAME considered the air quality standards and pollution concerns of the World Bank and International Finance Corporation (IFC), as well as Iraqi standards. According to these sources the main air emissions (continuous or non-continuous) associated with oil and gas activities include:

- combustion sources from power and heat generation, and the use of compressors, pumps, and reciprocating engines (boilers, turbines, and other engines);
- emissions resulting from flaring and venting of hydrocarbons; and
- fugitive emissions.

Principal pollutants from these sources include nitrogen oxides, sulphur oxides, carbon monoxide, and particulates. Additional pollutants can include: hydrogen sulphide (H_2S); volatile organic compounds (VOCs), methane and ethane; benzene, ethyl benzene, toluene, and xylenes (BTEX); glycols; and polycyclic aromatic hydrocarbons (PAHs).

The IFC Standard establishes limits for a number of air quality standards which in turn have been based on recommendations made by the World Health Organization (WHO)[4]. The relevant parameters of these standards are provided within *Table 5.8*.

The air quality standards are long-term benchmarks for ambient pollutant concentrations which represent negligible or zero risk to health, based on medical and scientific evidence reviewed by the WHO. These are general concentration limits, above which sensitive members of the public (*e.g.* children, the elderly and the unwell) might experience adverse health effects.

[4] IFC Environmental, Health, and Safety (EHS) Guidelines (April 30, 2007)

For some pollutants there is both a long-term (annual mean) standard and a short-term standard. In the case of NO_2, the short-term standard is for a 1-hour averaging period, whereas for PM_{10} it is for a 24-hour averaging period. These periods reflect the varying impacts on health of differing exposures to pollutants (*e.g.* temporary exposure on the pavement adjacent to a busy road, compared with the exposure of residential properties adjacent to a road).

Table 5.8: IFC Stated Ambient Air Quality Guidelines

Parameter	Averaging Period	Guideline Value in µg/m³	Guideline Value in ppm
Sulphur dioxide (SO_2)	24-hour 10 minute	20 (guideline) 500 (guideline)	0.007 ppm 0.187 ppm
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)	0.021 ppm 0.104 ppm
Particulate Matter PM_{10}	1-year 24-hour	20 (guideline) 50 (guideline)	-
Particulate Matter $PM_{2.5}$	1-year 24-hour	10 (guideline) 25 (guideline)	-

Notes:
Sulphur dioxide conversion factor 1 ppm = 2,860 µg/m³
Nitrogen dioxide conversion factor 1 ppm = 1,880 µg/m³

Local Regulatory Standards

Local air quality standards are defined by the Iraqi *National Clean Air Act 1979*. This act establishes long term, medium and short term ambient quality standards across a range of pollutant parameters.

Typically air quality objectives are medium-term policy based targets set by the Government which take into account economic efficiency, practicability, technical feasibility and timescale. Some objectives are equal to the agreed WHO guideline limits, whereas others involve a margin of tolerance based on local industry activity i.e. allow a limited number of permitted exceedances of the standard over a given period. No stated exceedances are provided with the Iraqi standards.

These ambient standards are provided within *Table 5.9*.

Table 5.9: Iraqi Air Quality Standards			
Pollutant	**Period**	**Ambient Air Standard (ppm)**	**Ambient Air Standard (µg/m^3)**
Sulphur Dioxide	1 hour 24 hours 1 year	0.1 0.04 0.018	None Stated
Carbon Monoxide	8 hrs 1 hr	10 35	None Stated
Nitrogen Dioxide	1 hr 24 hrs	0.05 0.04	None Stated
PM_{10}	24 hours	None Stated	150
$PM_{2.5}$	24 hours 1 year	None Stated	65 15
Total Suspended Particulate	24 hours 1 year	None Stated	350 150
Benzene	1 year	None Stated	0.003 (mg/m^3)

The composition of individual substances within the VOC group may differ considerably where characterisation of VOCs has not been undertaken. In this case it is best to adopt a precautionary approach and assume that the composition is 100% benzene.

5.3.5 Baseline Data

Passive air tubes were installed and the Gresham Tubes were filled on the 11th August 2014 and the particulate monitoring was undertaken on between the 29th and 30th August 2014. The passive air tubes installed on the 11th August 2014 and collected in on the 18th September, an exposure of 31 days.

All laboratory analytical certificates are presented in *Appendix F2.* For the purposes of discussion, the results are summarized in *Table 5.10* overleaf.

Carbon Monoxide

Table 5.10: Carbon Monoxide Analytical Results		
Location	**Iraqi National Standard**	**Observed Concentration (ppm)**
ANO1	8 hrs 10 ppm 1hr 35 ppm	0.31
ANO2		3.1
ANO3		5.3
ANO4		0.25
ANO5		5.3

The main man-made source of carbon monoxide is petrol vehicles which are not fitted with a catalytic converter, however, small amounts are also released from the burning of fossil fuels in power stations and waste incinerators where combustion is incomplete.

The levels of CO within the ambient air at all monitoring sites were below the Iraqi standards for CO over an 8 hour (10 ppm, 11.45 mg/m^3) and a 1 hour (35 ppm, 40.08 mg/m^3) averaging periods. As such, all monitored levels are below the stated environmental benchmark and significant pollution by this contaminant has not been observed.

NO_2

Table 5.11: Nitrogen Dioxide Analytical Results					
Location	**Iraqi National Standard**	**IFC Standard**	**Observed Concentration**		
			µg	**ppm**	**µg/m^3**
ANO1	1 hr 0.05 ppm 24 hrs 0.04 ppm	1 hr 0.104 ppm 1 yr 0.021 ppm	0.27	0.027	5.1
ANO2			1.4	0.014	27
ANO3			1.3	0.013	25
ANO4			1.6	0.016	31
ANO5			1.5	0.015	28

The current WHO guideline value of 0.021 ppm (40 µg/m^3 (annual mean)) is set to protect the public from the health effects of gaseous NO_2. The WHO identifies that, as an air pollutant, NO_2 has several correlated activities. At short-term concentrations exceeding 200 µg/m^3, it is a toxic gas which causes significant inflammation of the airways. NO_2 is also the main source of nitrate aerosols, which form an important fraction of $PM_{2.5}$ and, in the presence of ultraviolet light, of ozone. The major sources of anthropogenic emissions of NO_2 are combustion processes (*i.e.* heating, power generation, and internal combustion engines in cars).

None of the NO_2 concentrations were found to be above the Iraqi air quality or the IFC standards. As such, all monitored levels are below the stated environmental benchmarks and environmentally insignificant.

Table 5.12: Nitrogen Oxide Analytical Results

Location	Observed Concentration		
	µg	ppb	µg/m^3
ANO1	0.06	0.64	1.2
ANO2	<0.03	ND	ND
ANO3	<0.03	ND	ND
ANO4	<0.03	ND	ND
ANO5	<0.03	ND	ND

There are no Nitrogen Oxide guideline values, however, this parameter was not detected in four of the five samples and present in low concentrations in sample AN01.

The ambient levels of NO in the project area are not considered to be representative of poor air quality.

Sulphur Dioxide

Table 5.13: Sulphur Dioxide Analytical Results

Location	Iraqi National Standard	IFC Standard	Observed Concentration		
			µg	ppm	µg/m³
ANO1	1 hr 0.1 ppm 24 hrs 0.04 ppm 1 yr 0.018 ppm	24 hrs 0.007 ppm 10 mins 0.187 ppm	1.1	0.021	56
ANO2			3.6	0.068	180
ANO3			0.99	0.019	50
ANO4			0.6	0.011	30
ANO5			0.98	0.018	49

The current WHO guideline value of 0.187 ppm (500 µg/m^3) should not be exceeded over average periods of 10 minutes duration. Studies indicate that a proportion of people with asthma experience changes in pulmonary function and respiratory symptoms after periods of exposure to SO_2 as short as 10 minutes. SO_2 is a colourless gas with a sharp odour. It is produced from the burning of fossil fuels (coal and oil) and the smelting of mineral ores that contain sulphur. The main anthropogenic source of SO_2 is the burning of sulphur-containing fossil fuels for domestic heating, power generation and motor vehicles.

All of the samples were found to be below both the IFC 10 minute and Iraqi 1 hour air quality standards and do not indicate poor air quality on the project site.

Total Volatile Organic Compounds

Table 5.14: VOCs Analytical Results

Location	Observed Concentration		
	µg	ppb	µg/m³
ANO1	1.1	21	56
ANO2	3.6	68	180
ANO3	0.99	19	50
ANO4	0.6	11	30
ANO5	0.98	18	49

The term VOCs covers a range of chemical classes, including aliphatic, aromatic and chlorinated hydrocarbons; aldehydes; ketones; esters; ethers; acids; and alcohols. The compounds contribute directly or indirectly to a number of important environmental issues and concerns, but the nature and extent of their contributions depend on the chemical structure of each individual compound. The source of VOCs includes solvent use, road vehicles, equipment emissions, industrial processes, fires, waste disposal *etc.* The main issues of concern are:

- harmful effects on human health and on natural ecosystems through toxicity,
- carcinogenicity and other adverse physiological effects;
- damage to materials;
- tropospheric photochemical oxidant formation;
- stratospheric ozone depletion;
- global climate change; and
- odour.

There are currently no Iraqi or IFC standards for VOCs. The UK Environment Agency states that the composition of individual substances within the VOC group may differ considerably where characterisation of VOCs has not been undertaken[5]. In this case it is best to adopt a precautionary approach and assume that the composition is 100% benzene (a particularly pernicious VOC in terms of potential health impacts). As a result the monitoring results have been compared to the EC Air Quality Framework Directive & Daughter Directives[6] where Benzene has an annual mean threshold value of 5 $\mu g/m^3$.

All five samples were found to have VOC levels considerably in excess of the EU Benzene air quality limit (annual mean). It is important to note, however, that that the EU standard relates to an annual mean and the project samples are based on a one month average and the VOCs observed on site will be a range of chemical compounds of which benzene is likely to be a small component. So whilst the results do not necessarily indicate that the air is polluted to the extent that it is harmful to health it does indicate that there is a notable presence of VOC's in the ambient air. In theory, in clean air, there should be no discernible VOC's present, so the results indicate that anthropogenic activities are having an impact on air quality.

[5] http://publications.environment-agency.gov.uk/PDF/GEHO0410BSIL-E-E.pdf
[6] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:32008L0050:EN:NOT

Particulates

The monitoring programme measured Total Particulate (*i.e.* Total Suspended Particulates (TSP)), PM_{10} (*i.e.* inhalable coarse particles which have an aerodynamic smaller than 10 micrometers and larger than 2.5 micrometers), $PM_{2.5}$ (*i.e.* fine particles 2.5 micrometers in diameter and smaller) and PM_1 (*i.e.* ultra-fine particulate matter with diameter less than 1 micrometers) at all monitoring locations.

Particulates are released into the air from combustion processes like burning of hydrocarbons, vehicle engines, waste incineration and other industrial processes and by natural phenomena such as forest fires, volcanoes and dust storms.

The IFC guideline standard for PM_{10} is 20 µg/m^3 (annual mean) and 50 µg/m^3 (24-hour mean). In comparison the Iraqi standard is 150 µg/m^3 (24-hour mean). The IFC guideline standard for $PM_{2.5}$ is 10 µg/m^3 (annual mean) and 25 µg/m^3 (24-hour mean). In comparison the Iraqi standard is 65 µg/m^3 (24-hour mean) and 15 µg/m^3 (annual mean). The Iraqi standard for Total Suspended Particulates (TSP) is 350 µg/m^3 (24-hour mean) and 150 µg/m^3 (annual mean).

Table 5.15: Observed Particulate Data

Location	TSP	PM_{10}	$PM_{2.5}$	PM_1
AN01	311.0	181.4	27.1	4.8
AN02	318.6	187.1	26.9	5.4
AN03	413.5	233.4	34.6	9.7
AN04	357.9	212.2	31.5	6.5
ANO5	419.6	243.5	38.9	10.4

The ambient air quality of the site is affected (with regards to particulate matter) by occasional sand storms, which are a frequent phenomenon in this region. These sandstorms mobilise large volumes of fine dust into the atmosphere and can last from several hours to several days. The measured high levels of total particulate and respirable (below 10 microns) particulate matter observed during the survey period are most likely attributable to these windblown dusts and sands, rather than from industrial sources. Consequently, this will remain a dominant influence on the local air quality regardless of any construction works associated with the Project or other built development.

5.3.6 Impact Assessment

Construction Related Impacts

During the site preparation and construction phase of development, emissions to atmosphere are mainly expected to be particulate matter created by movements of construction vehicles and machinery over unsurfaced ground and the engine exhaust emissions. In particular impacts could arise from:

- coarse and fine dust from construction activities including excavation, earthmoving, materials storage and movement of construction vehicles; and
- construction plant, both mobile and stationary (e.g. cranes and generators), which emit a mixture of exhaust gases, in particular PM_{10}.

During construction of the proposed development dust emissions may arise from the following activities:

- demolition of existing structures;
- earth moving and major excavation works;
- moving and stockpiling of materials;
- movement of vehicles over unpaved or soiled surfaces causing re-suspension of dust particles;
- windblown dust emissions from stockpiles and soiled surfaces; and
- fitting out and finishing activities such as cutting and grinding of stone or bricks.

Disruption due to construction is typically a localised phenomenon and is temporary in nature. In general only people living or working within 100 metres of construction activities are likely to be impacted by nuisance dust. Dust arising from the majority of construction activities tends to be of a coarse nature and unable to travel great distances when airborne.

The ability of dust particles to remain suspended in the air depends on its shape, size and density. Coarse particles (>30µm), tend to be deposited within 100m of source[7]. Finer particles, between 10-30µm, are generally deposited within 200 to 500m of source, while very fine particles (<10µm), which remain suspended for longer, can travel up to 1km from

[7] Office of the Deputy Prime Minister (2000) MPG11: Controlling Environment Effects of Minerals Extraction, Annex 1 – The Control and Mitigation of dust at Mineral and Related Workings

source. The greatest proportion of construction dust is made up of coarse particles, thus the majority of dust emissions are deposited within 100m of source.

Only a small proportion of dust generated by construction activities would be of a fine nature (PM_{10}), but that is the proportion that can enter the human respiratory system and result in adverse health effects. The nearest residential properties are over 5km way and up-gradient of the prevailing wind and well beyond the 1km that such dusts may be expected to travel.

It should also be borne in mind that the whole area is subjected to periodic dust storms which raise the dust levels in the atmosphere across the whole area, sometimes for days.

The other potential air pollutants measured (SOx, NOx, CO) are well below concentrations that would be considered harmful to health and the temporary use of plant and machinery associated with the construction works do not have the potential to significantly alter the conditions from those observed. Localised traffic congestion caused by construction vehicles could lead to short term temporary increases in such parameters, however, the construction management programme will seek to ensure smooth traffic flows and avoid congestion as this will impact upon the programme so must be avoided. This in turn should help to minimise any short-term local effects caused by traffic congestion. The greatest potential for stationery vehicles (which is when the potential for exhaust emissions to deteriorate air quality is the highest) will be within the construction zone and working areas rather than on the approaches to the project area close to receptors. The vehicles are unlikely to travel through residential areas as there are none along the main highways leading to the site.

Operational Impacts

The following operational activities of the project have the potential to alter the baseline air quality conditions observed during this ESIA:

- Venting from tanks, (onshore and vessels);
- Emissions from vehicles visiting the site and loading/unloading; and
- Engine emissions from vessels visiting the terminal.

These activities have the potential to give rise to localised increases in the air pollutants that have been monitored for as part of the baseline activities, but the sources of these emissions will be localised and the periods of emission limited. Given this, the general absence of sensitive receptors and the predominant prevailing wind direction blowing towards the open water, the potential for significant impacts in relation to operational air emissions is considered to be very low.

5.3.7 Mitigation

Construction Activities

It is considered that with an appropriate Construction and Environmental Management Plan (CEMP) the potential for dust during construction to give rise to a nuisance will be minimal.

When preparing the Environmental Management Plan consideration will be given to inclusion of the following measures for the control of dust and emissions from construction and demolition:

- all plant and equipment to be maintained in accordance with appropriate legislation or manufacturers recommendations to ensure emissions to atmosphere are minimised;
- engines of plant and machinery and lorries to be turned off at all times when not in use;
- no burning of material to take place on site;
- ensure adequate water supply on site for damping down dust;
- wheel washing at the exits from construction areas where there is a potential for dust and mud to be carried on to the highway;
- regular visual monitoring of construction activities to identify any significant dust sources;
- water suppression in dry conditions to reduce dust emissions (use mobile bowsers or fixed sprayers as appropriate);
- appropriate speed limit applied to all construction vehicles working on the construction site;
- minimising heights for any stockpiles and tipping operations;
- avoid double handling of excavated material wherever practicable;
- seal or re-vegetate completed earthworks as soon as reasonably practicable after completion;
- sheeting of loads during transport of dusty/friable material; and
- ensure deliveries of bulk cement and other similar powder materials are in enclosed tankers and stored in suitable silos with emission control systems to prevent escape of

material and overfilling during delivery.

It is considered that with appropriate mitigation the significance of impact during construction is slight.

Operational Activities

It should be noted that the site is located in a dusty environment, however, when operational, the dust generation will reduce due to more hardstanding areas and surfaced site roads. As such, wind-blown dust originating from the site should decrease.

The road tankers which currently load and unload at KZP will utilise the proposed terminal and, as previously mentioned, the site will be operated to international industry standards, thereby, reducing the overall level of vehicle emissions.

At present, petroleum products are loaded and unloaded directly into tankers, the proposed port will utilise bulk tank storage, thereby, reducing ship discharge times and associated emissions.

Closure and Decommissioning

When the time comes to eventually close the terminal facility and decommission (and possibly demolish) it, there may again be impacts associated with this. The activities that would typically be involved in the closure and decommissioning of such a facility would be similar to those during construction, involving plant and machinery, earthworks, materials movement and management. Likewise, therefore, the impacts would be similar. It is unlikely that a site such as this would be returned to the status of the present undeveloped site. Whilst potentially polluting materials and valuable or recyclable infrastructure (tanks, pipes, scrap metal, machinery, plant, etc.) will be removed, the major structures (concrete, berths, drainage systems, walls, fences, etc.) would be unlikely to be removed. In all likelihood the site would probably be re-used for alternative uses or redeveloped. As such the extent of the works and associated traffic and construction type activities (machinery, earthworks, etc.) associated with closure of the facility, whilst similar in nature to the construction activities, are expected to be lesser in scale and duration, as would be the associated impact. It is considered therefore that the impact of closure and decommissioning activities upon the air quality environment will be negligible.

5.3.8 Residual Impacts

With appropriate measures for the control of dust during construction activities and VOC emissions during operation, it is expected that there will be no significant residual impacts on air quality associated with the project.

Chapter 6 – Land

Contents

6 Land

6.1 Introduction

This chapter of the ESIA report discusses the historical and current use of the site with respect to land quality, sediment quality and waste management. It details the objectives, methodology and findings of these assessments and also considers the potential impacts of the proposed Terminal construction and operational activities on the land quality conditions at the site. Note that this chapter deals with physical and chemical impacts, ecological impacts associated with land take and earthworks are dealt with in *Chapter 8 - Ecology*.

6.2 Land Quality

This section describes the underlying geology, geomorphology and soil conditions as well as establishes the present nature, extent and significance of contamination that already exists on the site such that a baseline is established against which project impacts can be evaluated. The contamination assessment also considered groundwater beneath the site but the discussion of this is presented in *Chapter 7 – Water Quality*.

6.2.1 Assessment Methodology

Baseline Conditions

This study involved a combination of desk-based studies, consultations with stakeholders, review of previous investigation reports and soil sampling and testing and associated analysis and risk assessment.

EAME undertook a comprehensive desk study[1] of the proposed Terminal covering a large number of relevant topics. The information obtained during this study enabled EAME to design a sampling programme to provide additional information on the baseline conditions of the area and supplement data obtained from previous investigations.

This assessment has been undertaken in accordance with current guidance on EIA[2] and has involved a review of the following sources of baseline data:

- Site walkovers undertaken in August and September 2014 to provide an assessment of current site activities and the site's environmental setting;
- Desk-based research;

[1] WTPS Iraq Oil Terminal Desk Study, Earth & Marine Environmental Consultants, August 2014, REF: 014-1287 REV00
[2] Environmental Impact Assessment – A Guide to Procedures, DETR, November 2000

- Review of a previous geotechnical site investigation report; and

- Conversations with port staff and local communities.

Based upon the desk based risk assessment, an environmental site investigation, undertaken in August 2014, was designed to provide additional data in order to develop a conceptual site model and allow sufficient characterisation of the site to adequately identify contamination risks, establish baseline conditions against which impacts could be assessed and develop appropriate mitigation measures. This study comprised the following elements:

- The drilling and installation of seven sentinel boreholes to 6m below ground level (bgl) to enable an assessment of the prevailing soil conditions (shallow soils and underlying natural strata) and groundwater conditions. All drilling works were conducted using clean drilling methods *i.e.* no oils or other contaminative fluids were used or added during drilling. Each borehole was installed to facilitate follow-on groundwater monitoring;

- Soil samples were collected from within the top 1.0m, a change in strata and at any depth where visual or olfactory evidence of contamination was identified or there were obvious changes in strata. Nitrile gloves were worn during the sampling itself and were changed regularly to further prevent any anomalies in the data *via* contaminant transfer. The samples were examined by an experienced EAME field scientist and inspected for visual and olfactory evidence of contamination;

- Soil arisings from the exploratory hole locations were examined visually and unusual odours (if any) were also noted. The soils encountered were logged broadly in accordance with BS EN ISO 14688-1:2002 and BS EN ISO 14688-2:2004, which has partially superseded BS 5930:1999, however, this standard does not cover descriptions of manmade or reworked materials and was written principally for engineering purposes. There are no equivalent Iraqi standards;

- In addition, EAME collected twenty surface soil samples; this is on the basis that this is a baseline study rather than a campaign to identify the spatial extent of suspected contamination from previous installations (which would require a greater level of sampling). The surface sampling was undertaken using a stainless steel trowel which was decontaminated between locations so as to prevent any cross-contamination;

- Selected samples were tested by dynamic headspace analysis, for the presence of volatile organic compounds using a Photo-Ionisation Detector (PID). Dynamic headspace analysis refers to the manual agitation of a bagged soil sample to facilitate the volatilisation of organic compounds present in the soil into the headspace above (*i.e.* soil gas) which is then analysed using the PID. The PID screens for a wide range of volatile organic compounds including hydrocarbon compounds and certain chlorinated solvents, but does not indicate a specific compound. The measurements obtained by the instrument in parts per million by volume (ppmv) provide a semi-quantitative indication of the concentration of hydrocarbon vapours that are present in the soil pore spaces;

- Submission of soil samples to an accredited independent laboratory. A total of thirty-four soil samples were submitted to the laboratory for analysis including metals and metalloids, asbestos, pH, Sulphate, Chloride, Phosphate, Monohydric Phenols, Cyanide, Speciated Polycyclic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (TPH) (C_{10} – C_{40}), Volatile Organic Compounds (VOCs) and Semi Volatile Organic Compounds (SVOCs); and

- Furthermore, EAME recommended that the possible discharge and accumulation of radioactive nuclides in the landscape should be assessed as part of the project to monitor possible radioactive contamination of the landscape. All surface soil samples sent to the laboratory were screened for radioactivity, the purpose of which was to measure levels of NORM across the study area. Measurements were collected using an energy-compensated pulse rate "micro-R" meter that provides a scaled reading in microroentgen per hour (μR/hr).

Following the desk study and environmental site investigation, a review of the findings was undertaken in the context of current guidance (and in the absence of any specific Iraqi legislation), to identify potential impacts and enable an assessment of potential impacts and define mitigation measures where necessary.

Photograph 6.1: *Drilling Rig Operating BH02*

Assessment Criteria

There are presently no soil contamination standards or land quality regulations in Iraq. In the absence of country specific standards, it is normal (best) practice for the assessment of contaminated soils to adopt a risk-based approach which is structured in a tiered manner. As well as having a systematic approach to collecting the data it is also necessary to adopt recognised techniques and standards in assessing them and particularly with regard to environmental risk assessment.

Table 6.1: Tiered Assessment	
Tier 1 Assessment	Comparison of site contaminant concentrations against generic standards and compliance criteria including an assessment of risk using the source pathway target model.
Tier 2 Assessment	Derivation of site specific risk assessment criteria and calculation of site specific clean up goals where Tier 1 values are exceeded.

The information gathered during the desk-based review and site investigation was utilised to develop a conceptual site model based on the risk assessment principle of identifying significant Pollutant Linkages. In other words where there is a pollution source and a sensitive receptor that could suffer harm from that source if a suitable pathway connects them, then there is a significant pollutant linkage and thus an unacceptable risk that requires mitigation.

The Ministry of Oil ((MoO), in the absence of any promulgated national standards has adopted the internationally recognised Dutch Intervention Guidelines indicator values (2000) for determining 'significant' level of impact in relation to impairing multi-functional land uses; however, such guidelines are not wholly appropriate in the context of this project and values do not exist for all contaminants. Such an approach is outdated and runs contrary to widely adopted risk-based approach applied in most jurisdictions now.

As such, EAME have utilised the following multiple screening criteria to try and provide a benchmark for assessing whether or not the chemical species levels found in the site soils should be regarded as significant contamination for environment assessment purposes:

- Dutch Intervention Guidelines (Department of Soil Protection, 2000) for 'significant' level of impact likely to impair multi-functional end-uses[3];
- US EPA (2010) Regional screening values for chemical contamination of industrial soil, Region 9[4]; and
- Australian National Environmental Protection Council (NEPC), Guidelines for Investigating Contaminated Soil and Groundwater, Health-based Investigation Level (HIL) - F – Commercial/Industrial (NEPC, 1999)[5].

Whilst these guidelines are not directly applicable, they do provide a useful range of indicator values in the absence of Iraqi promulgated standards and help to put the levels observed in context.

Identification of Impacts

The effects on ground likely to arise from the construction and operational phases of the proposed development are principally the following:

- the potential movement and dispersion of material in the various media during the construction phase from earthmoving and general construction works;
- potential for piling and dewatering of excavations to enable cross contamination of the ground strata;
- Introduction of new contaminants in the form of spilled oils, fuels and construction related wastes; and

[3] http://www.esdat.net/Environmental%20Standards/Dutch/annexS_I2000Dutch%20Environmental%20Standards.pdf
[4] http://www.epa.gov/region9/superfund/prg/
[5] Schedule B1 - Guideline on Investigation Level for Soil and Groundwater, National Environmental Protection Council, Federal Register of Legislative Instruments, F2013C00288, 1999

- mobilisation of contaminants and leaching through the sub strata to impact identified controlled waters, such as surface watercourses and groundwater bodies by the creation of new pathways.

Assessment and Evaluation of Effects

The assessment of effects has involved the following general approach:

- the identification and assessment of potential sources, pathways and receptors in relation to the proposed end use of the site during and following development;
- the sensitivity of receptors has been established on the basis of their nature, proximity to the site, existing quality or resource value and consideration of potential pathways;
- evaluation of the significance of the potential changes in ground levels, earth moving activities and assessment of the sensitivity of the resource to the predicted changes;
- the potential effects have been classified, prior to mitigation, as minor, moderate or major (either positive or negative); and
- where the predicted effects are considered to be significant, mitigation measures have been recommended to eliminate or reduce the impacts to an acceptable level. The residual effects (post mitigation) are discussed in the final subsection of this chapter.

6.2.2 Baseline Conditions – Desk-based Research and Site Walkover

This section provides a summary of relevant information arising from the desk study which preceded the intrusive site investigation works.

Site Walkover

The site is irregular in shape and covers a total area of approximately 0.95km^2. The majority of the site, approximately 95%, is undeveloped and vacant with sparse halophytic vegetation, unsurfaced access roads and evidence of fly-tipped waste. There is evidence of disturbance of some of the soils by heavy plant and some accumulations of earth mounds from earthworks activities. Also there is an earth bank road running along the site parallel to the shoreline with two smaller earth bank roads extending to the water line.

The northern elevation of the site comprises KAZ Jetty No. 1 (see *Photograph 6.2*) and areas of unsurfaced, derelict land with areas utilised for the storage of scrap metal, much of which appears to be marine-derived (see *Photograph 6.3*). During the site walkover, fragments of suspected asbestos sheeting were noted within the area of the scrap metal storage (see *Photograph 6.4)*.

The intertidal zone is littered with domestic waste deposited by the river as well as large metal objects such as redundant pipework (see *Photograph 6.2*).

Photograph 6.2: *Looking northwards along the intertidal zone towards KAZ Jetty No. 1. Please note the redundant pipework.*

Photograph 6.3: *Scrap metal storage*

Photograph 6.4: *Suspected Asbestos sheeting*

Furthermore, three shipwreck fragments, from the vessel *Palestine*, are present in the intertidal zone, these are currently supposed to be in the process of being removed by GCPI (for onward shipment to the steel works for processing), however, is understood that this process has been halted at present. It is not known when it will resume.

Photograph 6.5: *Shipwreck sections from the Palestine located on the intertidal zone*

Historical Site Use

It is understood that the majority of the site has never been developed, however, the site walkover, various maps of the region and remote sensing data has indicated signs of anthropogenic impacts including fly tipping/dumping, off road vehicle activities and the remnant signs of war. Consequently, whilst the site as a whole may be regarded as "greenfield" developmentally, it is a site that has been disturbed by a number of activities.

Geology and Geomorphology

The Khor Al-Zubair area is one of the largest zones of tidal mud flats in the north-western Arabian Gulf. These estuarine and marine deposits form the extreme south-eastern boundary of the larger Mesopotamian Plain. The Plain is a vast lowland area with clearly defined physiographic and structural boundaries and an imperceptible gradient from northwest to the southeast towards to the Persian Gulf. The Plain is considered to be a huge aggradational geomorphologic unit; where the fluvial, lacustrine and Aeolian landforms prevail, however, estuarine and marine units are also present[6].

The structural setting of the Khor Al-Zubair is the result of the formation of a fault structure which represented an extension of the ancient Euphrates river course[7]. The uplift of the adjacent areas around the Khor Al-Zubair and the subsidence of others led to the propagation of the sea level and disconnection from the River Euphrates. Subsequently, the Khor Al-Zubair become an elongated marine lagoon[8]. However, since 1983, the Khor Al-Zubair has been connected to the Shatt Al-Basra Canal, converting it from a marine lagoon into an estuary.

Dibddiba Formation is the result of a giant, triangular-shaped alluvial fan of the Wadi ar Rimah-Wadi al Batin drainage system which is the longest ephemeral watercourse in Arabia, draining most of the northern Arabian Shield. The fan extends over parts of Saudi Arabia, over most of Kuwait and south-east Iraq, where it has deflected the course of the Euphrates causing the formation of the Haur Al-Hammer Lake. The Formation was formed by sheet floods during the Pleistocene with sandy horizons representing periods of reduced precipitation[9].

[6] Geomorphology of the Mesopotamia Plain, Yacoub S. Y., Iraqi Bulletin of Geology and Mining, Special Issue No. 4, 2011

[7] Khor Al-Zubair Classification and Possibility to Detection Dimensions during Stages of Different Tectonic Development, Al-Mosawi S.N., Third Symposium about Marine Natural of Khor Al-Zubair, Marine Sciences Centre,/Basra University, 1991

[8] Sedimentological and mineralogical Study of Rocky Island in Khor Al-Zubair Area north-west of the Arabian Gulf, Wasil S.A., M.Sc. Thesis, Basra University, 2003

[9] Arabian Deserts: Nature, Origin and Evolution, Edgell H. S., Springer, 2006

Alluvium and Aeolian Deposits

The sediments of the tidal flats comprise an upper layer which is approximately 6 - 8m thick, sequentially underlain by the Hammar Formation and the Dibdibba Formation.

The general area surrounding the Project site is overlain by recent estuarine and marine alluvium which predominantly comprises clay and silt with some sand and pebbles[10.] The clay and silt fractions predominant and the deposits are commonly lenticular, poorly indurated and nearly flat lying. The upper 1m of the alluvium contains abundant salt and gypsum crystals[11].

Hammar Formation

The Hammar Formation (also known as Mesopotamian Plain Alluvium) is from the Pleistocene Age[12] and predominantly comprises lacustrine deposits (silts and clays) which have been deposited in a uniform and consistent manner[13].

Dibdibba Formation

The Dibdibba Formation comprises '*mainly sand and gravel of igneous rocks, including pink granite, various liver-coloured and slate-grey intrusive, dolerites, etc., and white quartz pebbles. Not infrequently the rock is cemented to a hard grit'*[14]. The formation is between 30 – 260m thick[15], however, wells from the Zubair oil field indicate that it is up to 354m thick[7]. The aforementioned hard grit is likely to be due to gypsum acting as a cementing agent between soil particles.

[10] Physical Characteristics of Mesopotamian Marshlands of Southern Iraq, The Iraq Foundation, January 2003
[11] Geology of the Arabian Peninsula Southwestern Iraq, Naqib K. M., U.S. Geological Survey Professional Paper 560-G, 1967
[12] Sedimentation in lakes and marshes (Ahwar) of the Tigris-Euphrates Delta, southern Mesopotamia, Aqraqi A. A. M and Evans G. 1994
[13] Some Geotechnical Soil Properties of Western Bank of Khor Al Zubair Channel Coast at Khor Al Zubair Port Location, Southern Basrah, Iraq, Muttashar W. R., Mesopotamian Journal of Marine Science, Volume 25, 2010
[14] Water Supplies in Iraq, Macfadyen W. A., Iraq Geology Department, 1938
[15] Hydrogeology of Al-Basrah Area, Krasny J., Iraq GEOSURV, Number 1337, 1982

6.2.3 Baseline Ground Conditions

Borehole Locations

All seven boreholes were drilled between the 13th and 15th August 2014.

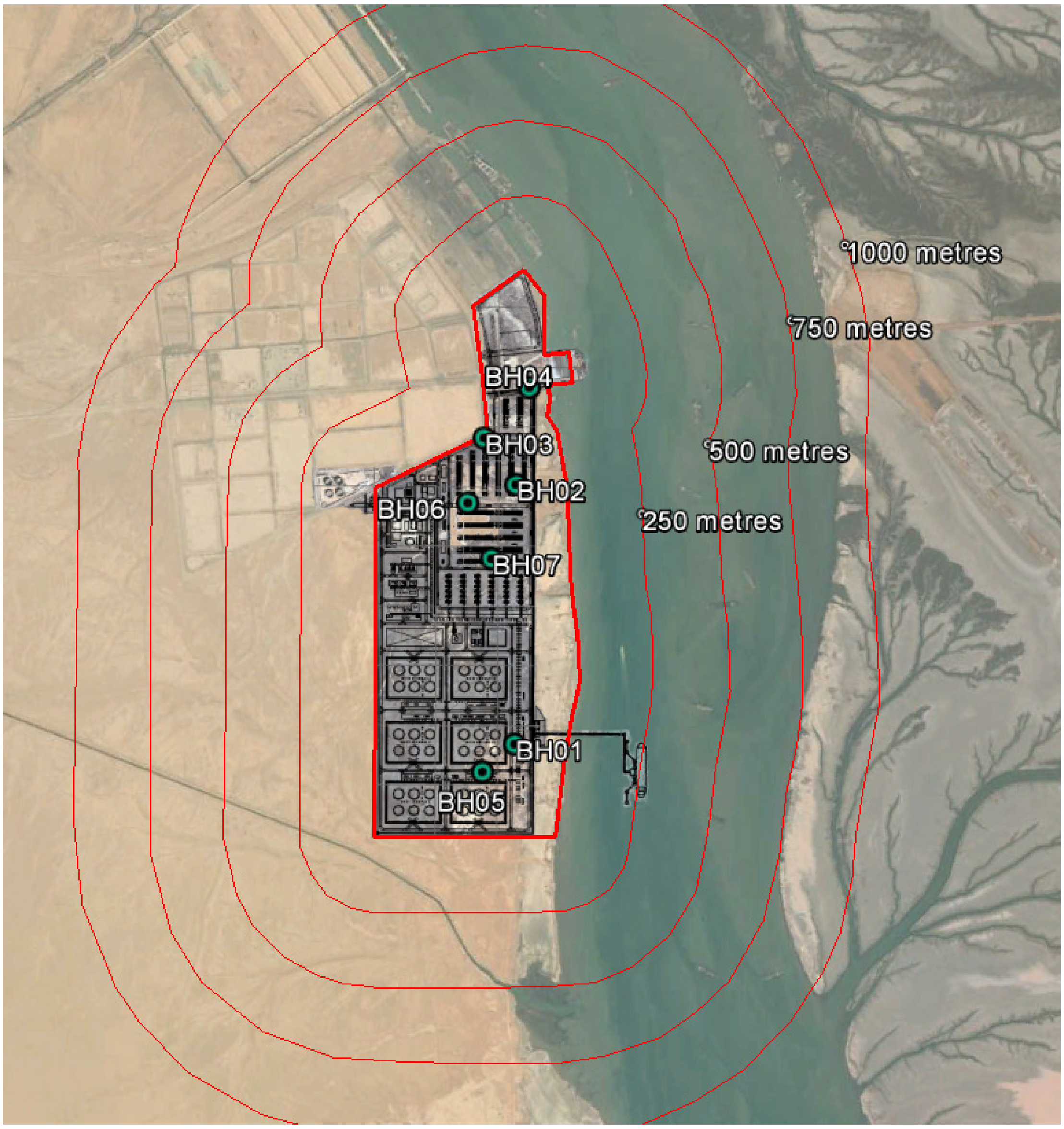


Figure 6.1: *Borehole locations*

Google Earth Pro Imaging with the permission of Google Licensed to Earth and Marine Environmental Consultants Ltd

The rationale for the borehole location is presented in *Table 6.2*.

Table 6.2: Borehole Location and Rationale				
Location ID	**Easting, Northing**	**Latitude, Longitude**	**Elevation (m IGRS)**	**Rationale**
BH01	778507.201 3341149.746	30°10'12"N 47°53'33"E	3.709	Close to the Khor Al-Zubair
BH02	778489.365 3342026.42	30°10'40"N 47°53'31"E	4.628	Close to the Khor Al-Zubair
BH03	778405.253 3342177.245	30°10'45"N 47°53'27"E	5.228	Boundary with the Freezone
BH04	778521.197 3342333.51	30°10'38"N 47°53'25"E	4.276	Targeting part of the site currently utilized
BH05	778410.867 3341038.085	30°10'09"N 47°53'27"E	4.09	Spatial coverage
BH06	778349.064 3341969.954	30°10'38"N 47°53'25"E	4.686	Spatial coverage
BH07	778399.976 3341775.446	30°10'32"N 47°53'28"E	4.851	Spatial coverage

Surface Soil Sample Locations

The surface soil samples were collected on the 11th August 2014.

Field observations and measurements of the surface soil samples are presented in *Table 6.3*. The samples were collected from across the site in an approximate grid pattern in order to provide spatial coverage.

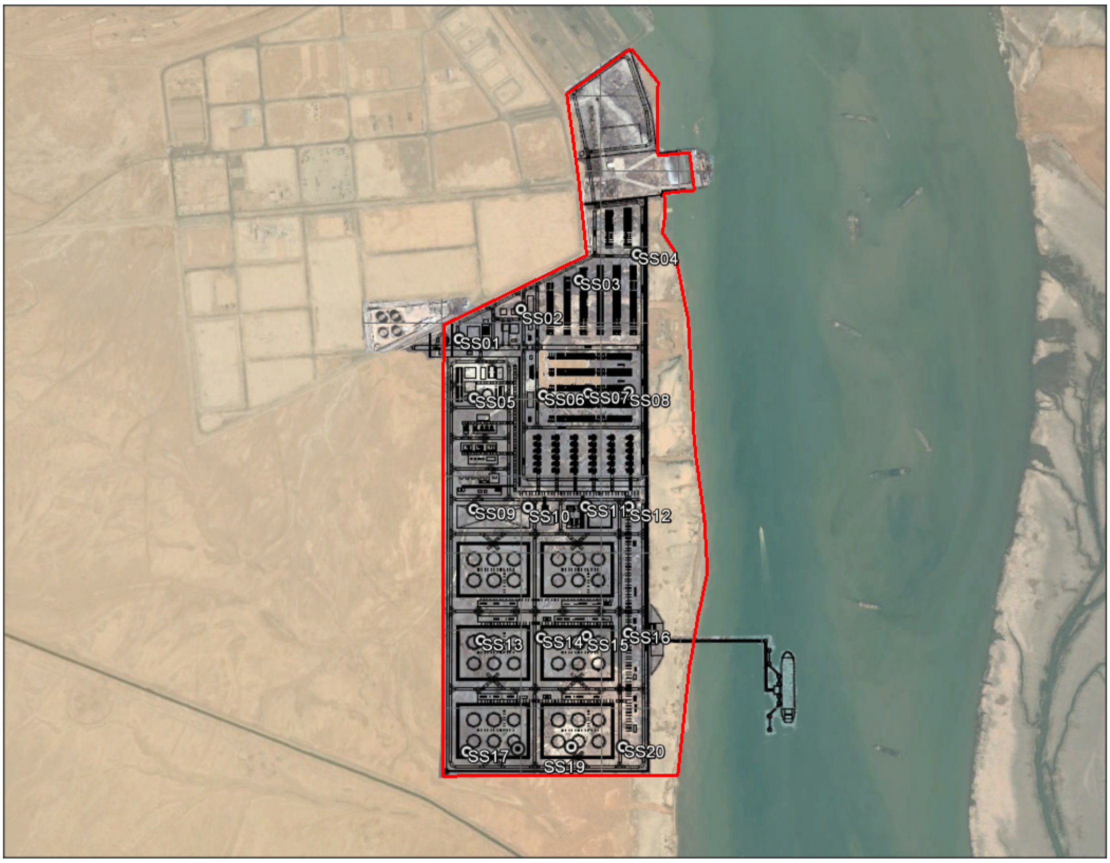


Figure 6.2: *Surface soil sample locations*

Google Earth Pro Imaging with the permission of Google Licensed to Earth and Marine Environmental Consultants Ltd

Table 6.3: Surface Soil Samples Field Observations and Measurements

Sample ID	Grid Reference	Description	Munsell Colour	PID Reading
SS01	30°10'38.29"N, 47°53'14.96"E	Dry light grey – brown fine sandy SILT	10YR 7/2 Light gray	<0.1
SS02	30°10'40.79"N, 47°53'20.98"E	Dry light grey – brown fine sandy SILT	2.5Y 7/2 Light gray	<0.1
SS03	30°10'43.27"N, 47°53'26.65"E	Dry light grey – brown fine sandy SILT	2.5Y 7/2 Light gray	<0.1

Table 6.3: Surface Soil Samples Field Observations and Measurements

Sample ID	Grid Reference	Description	Munsell Colour	PID Reading
SS04	30°10'45.46"N, 47°53'32.32"E	Dry light brown – yellow fine sandy SILT	2.5Y 8/3 Pale yellow	<0.1
SS05	30°10'33.33"N, 47°53'16.44"E	Dry grey – light brown fine sandy SILT	2.5Y 6/1 Gray	<0.1
SS06	30°10'33.55"N, 47°53'23.16"E	Dry grey – light brown fine sandy SILT	2.5Y 6/1 Gray	<0.1
SS07	30°10'33.71"N, 47°53'27.52"E	Dry grey – light brown fine sandy SILT	2.5Y 5/2 Grayish brown	<0.1
SS08	30°10'33.86"N, 47°53'31.44"E	Dry grey slightly gravelly sandy SILT	10YR 8/4 Very pale brown	<0.1
SS09	30°10'23.98"N, 47°53'16.44"E	Dry grey coarse SAND with salt crystals	10YR 8/4 Very pale brown	<0.1
SS10	30°10'24.13"N, 47°53'21.68"E	Dry grey coarse SAND with salt crystals	10YR 6/2 Light brownish gray	<0.1
SS11	30°10'24.21"N, 47°53'27.26"E	Dry light brown slightly gravelly fine sandy SILT	10YR 8/4 Very pale brown	<0.1
SS12	30°10'24.20"N, 47°53'31.44"E	Dry grey – light brown fine sandy SILT	5Y 7/2 Light gray	<0.1
SS13	30°10'13.05"N, 47°53'17.14"E	damp brown silty soft CLAY	10YR 8/4 Very pale brown	<0.1
SS14	30°10'13.26"N, 47°53'22.97"E	Dry grey – light brown fine sandy SILT	2.5Y 7/1 Light gray	<0.1

Table 6.3: Surface Soil Samples Field Observations and Measurements

Sample ID	Grid Reference	Description	Munsell Colour	PID Reading
SS15	30°10'13.41"N, 47°53'27.34"E	Dry grey – light brown coarse sandy SILT	2.5Y 7/1 Light gray	<0.1
SS16	30°10'13.65"N, 47°53'31.36"E	Dry grey – light brown fine sandy SILT	2.5Y 5/2 Grayish brown	<0.1
SS17	30°10'3.82"N, 47°53'15.82"E	Dry light brown fine sandy SILT	2.5Y 8/4 Pale yellow	<0.1
SS18	30°10'4.06"N, 47°53'20.71"E	Dry light brown fine sandy SILT	10 YR 8/4 Very pale brown	<0.1
SS19	30°10'4.23"N, 47°53'25.86"E	Dry light yellow – light brown coarse sandy SILT	2.5Y 8/2 Pale yellow	<0.1
SS20	30°10'4.22"N, 47°53'30.83"E	Dry light grey – light brown fine sandy SILT	10YR 8/4 Very pale brown	<0.1

Ground Conditions

The ground conditions at the site were found to be broadly consistent with published information. In summary, the top 1.0m comprised loose gravelly coarse SAND, typically underlain by silty CLAY or clayey SILT. No rockhead was encountered during the investigation. The borehole lithological logs are presented in *Appendix G1*.

The surface soil samples were noted to be predominantly grey – brown fine sandy SILT with a highly desiccated crust and salt crystal inclusions.

Field Evidence of Contamination

No visual or olfactory observation of potential contamination was observed in terms of oil or chemical staining or odours, furthermore, no VOC readings, above the instrument's level of detection (>0.1 ppmv), was noted.

6.2.4 Baseline Conditions – Chemical Contamination

Analytical Strategy

In total, fourteen soil samples, two from each borehole, and the twenty surface soil samples were submitted for chemical analysis. The analytical strategy was designed by EAME to provide an assessment of the presence of a common range of potential contaminants.

Table 6.4: Analytical Strategy

Parameter	Rationale
General Inorganics pH, Total Cyanide, Complex Cyanide, Free Cyanide, Total Sulphate as SO_4, Total Chloride, Water Soluble Phosphate as P (2:1), Total Nitrogen (Kjedahl), Total Organic Carbon (TOC)	Commonly associated with industrial sites
Asbestos Screen and Identification (5 samples)	Associated with general fill material, demolition wastes and ship scrap
Total Phenols (Monohydric)	Commonly associated with industrial sites
Total Speciated PAHs	Speciated suite to determine the presence of fuel derivatives and associated compounds
Heavy Metals and Metalloids	Commonly associated with industrial sites
Total Petroleum Hydrocarbons (C_{10} – C_{40})	Targeted analysis for fuels and oils
VOCs	Targeted analysis for fuels and oils
SVOCs	Targeted analysis for PAH compounds and phenols
Radiation Screening	Targeted analysis for NORMs and DU remnants

Assessment of Analytical Results

EAME has used a tiered approach in order to assess the analytical data and provide a preliminary qualitative assessment of the soil analytical results. This has focussed on risks to human health assuming a future industrial land use (as opposed to a more sensitive but unlikely residential end use).

The first stage of assessment was to screen out those compounds that were not present above the method detection limit (MDL) of the laboratory. These are provided in the list below, and have thus not been considered further within the assessment and are assumed to not be present on the site in significant concentrations.

- Cyanide (Total, Complex and Free);
- Total Phenols (Monohydric);
- Speciated PAHs;
- Cadmium
- Chromium;
- Mercury;
- Tin;
- Total Petroleum Hydrocarbons C_{10} - C_{40};
- VOCs;
- SVOCs; and
- Radiaiological Species.

The remaining determinants that were present above the laboratory MDL were then compared against a screening criteria value, where available. The samples were tested at an accredited UKAS laboratory (i2 Analytical), with the full analytical certificates presented in *Appendix G2* and summarised in *Table 6.6*.

Table 6.6: Summary of Soil Analytical Results

Contaminant	Conc. Range (mg/kg)	Location of Sample with Max. Conc.	Screening Criteria	No. of Exceedances of Screening Criteria
General Inorganics				
pH	7.4 – 8.4	BH05: 0.5 – 1.0m	NG	-
Total Sulphate as SO_4	1,900 – 72,000	BH04: 0.5 – 1.0m	NG	-

Table 6.6: Summary of Soil Analytical Results				
Contaminant	**Conc. Range (mg/kg)**	**Location of Sample with Max. Conc.**	**Screening Criteria**	**No. of Exceedances of Screening Criteria**
Total Chloride	870 – 22,000	BH05: 0.5 – 1.0m	NG	-
Water Soluble Phosphate as P (2:1)	<MDL – 0.59	BH03: 1.0 – 1.5m	NG	-
Total Nitrogen (Kjeldahl)	160 - 620	BH02: 3.0 – 3.5m	NG	-
TOC	0.3 – 2.0%	SS09, SS20	NG	-
Asbestos				
Asbestos Screen and Identification	Present: chrysotile – loose fibres	1 location only (SS03)	NG	-
Heavy Metals and Metalloids				
Arsenic	1.5 – 6.6	BH05: 0.5 – 1.0m, SS06	55 *1	*0*
Copper	5.8 - 34	SS07	190 *1	*0*
Iron	4,500 – 30,000	SS07	NG	-
Lead	<MDL – 46	SS03	530 *1	*0*
Manganese	79 - 440	SS07	7,500 *2	*0*
Nickel	12 - 100	SS07	210 *1	*0*
Tin	<MDL – 1.3	SS04	NG	-
Zinc	11 - 120	SS03	720 *1	*0*

Notes:

*1 Dutch Intervention Values

*2 NEPC

Units are mg/kg except where indicated otherwise

NG = No Guideline available

<MDL = Below the Method Detection Limit

Conceptual Site Model

The ground conditions on the site, as determined through the site investigation process, have been summarised into a Conceptual Site Model (CSM), which defines the key sources, pathways and receptors that have been identified as being relevant to this site. The CSM within this chapter summarises the following:

- the identification of contaminants within the soil that represent potential pollution sources;
- the identification of the potential exposure pathways between the potential sources;
- the identification of the potential receptors for the contamination; and
- the identification of potential pollutant linkages.

All discussions in this section have been made in relation to the site's proposed industrial/commercial setting.

Identification of Soil Contaminants (Potential Sources)

The only potential sources of contamination identified relates to the asbestos fibres located on the northern elevation of the site as all other parameters were recorded at concentrations below the relevant screening criteria are not considered to be environmentally significant.

Potential Receptors

Based on the site's environmental setting and the proposed future end use of the site following redevelopment, the following receptors have been identified:

- Groundwater;
- Surface water;
- Current site works and trespassers;
- Future site workers (*i.e.* future employees located at the site);
- Future on-site buildings and services;
- Groundworkers *(i.e.* construction workers, maintenance workers or other personnel who may be directly exposed to contaminated soil in the course of their activities);

- Local flora and fauna whose habitat could be damaged or altered by chemical contamination;

- Third party land (*i.e.* the possibility of contamination migrating off-site onto third party via contaminated groundwater); and

- Risks to water resources are reported within *Chapter 7: Water Quality.*

It should be noted that there is little if any potential for the on-site contamination to impact upon human health in the off-site community as there is no evident on site source or nearby residential community and no plausible pathway exists for impact on the nearest residential community, even if a source were present. This has thus been discounted as a potential receptor. It is recognised, however, that there may be dust emissions during construction works, however, with sensitive receptors at least 5km distant, it is unlikely that emissions of dust would cause a nuisance. Nevertheless, it should be noted that mitigation measures will be included as part of the Construction Environmental Management Plan (CEMP) which will reduce the level of impact.

Identification of Potential Exposure Pathways

Exposure pathways are the potential routes that link the potential on-site sources to the identified potential receptors. However, it should be stressed that these risks have to be considered only through plausible pathways. The following potential exposure pathways have been identified at the site:

- Inhalation, ingestion or skin contact with contaminated soils and dusts (although generally risks to construction workers or maintenance workers should be manageable by standard health and safety procedures such as wearing appropriate PPE and observing normal site hygiene practices);

- Migration of soil contaminants v*ia* transmission along conduits; and

- Migration of contaminated horizons with uncontaminated horizons through piling activities.

Potential Pollutant Linkages

In order for there to be a plausible pollutant linkage there must be a source, receptor and pathway and a feasible linkage between them (a so called pollutant linkage). Consequently, even where a contaminant is identified, if there is no pathway for the contamination to reach a receptor, or no receptor then there can be no significant risk and remedial actions are not required. Furthermore, even if there is a complete pollutant linkage, it is possible that the contaminant concentration that can pass along the linkage does not represent a significant risk to human health or the environment. Central to this risk assessment process is the development of a 'conceptual model'. This is a descriptive and/or pictorial representation of the area of potential contamination, the surrounding environment and the processes acting on the contaminants by which they can move and come into contact with receptors (*e.g.* by leaching and migration into groundwater).

Production of a conceptual model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, in order to assess risk both the likelihood and the consequences of an event must be taken into account. This report adopts the methodology for risk evaluation presented in CIRIA report C552 'Contaminated Land Risk Assessment – A Guide to Good Practice', 2001. The method is qualitative and involves the classification of the following:

- the magnitude of the potential severity or consequence of the risk occurring (*Table 6.7*);
- the magnitude of the likelihood or probability of the risk occurring (*Table 6.8*); and
- once the likelihood of an event occurring and its severity have been classified, a risk category can be assigned using *Table 6.9*.

Table 6.7: Classification of Consequence

Consequence	Definition
Severe	Short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short term risk of (significant) pollution of sensitive water resource. Catastrophic damage to building/property. A short term risk to a particular ecosystem, or organism forming part of such ecosystem.
Medium	Chronic damage to human health (significant harm). Pollution of sensitive water resources. A significant change in a particular ecosystem, or an organism forming part of such an ecosystem.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.
Minor	Harm, although not necessarily significant harm, which may results in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.). Easily repairable effects of damage to buildings, structures and services.

Table 6.8: Classification of Probability	
Likelihood	**Definition**
High	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollutant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period that such an event would take place and is even less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Table 6.9: Risk Assessment Matrix					
		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Likelihood of Occurrence	**High**	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low	Moderate	Moderate/Low	Low	Very Low
	Unlikely	Moderate/Low	Low	Very Low	Very Low

EAME has devised a conceptual model based on the information obtained through the site investigation and is based on future commercial/industrial redevelopment. This is detailed in tabular format in *Table 6.10*.

Table 6.10: Conceptual Site Model – Current Site Conditions			
Source			
(A) Presence of chryostile fibres on the northern elevation of the site			
Source	**Pathway**	**Receptor**	**Potential Pollutant Linkage and Significance**
(A)	Ingestion Inhalation	**Human Health (HHR)** Current site works and trespassers Off-site general public	**HHR – High Risk** During the site investigation, asbestos fibres were recorded on the northern elevation of the site. Asbestos sheeting was observed in close proximity. There is a risk of exposure if asbestos contaminated materials are disturbed in close proximity to site workers.

No other risk scenarios were identified.

Summary of Chemical Baseline Conditions

In summary, none of the samples recorded concentrations above their respective screening criteria for risk to human health (where published criteria exist). It is notable that none of the samples were positively identified in the radiation screening as having detectable radioactivity.

Cemented asbestos sheeting was observed within the area of scrap metal storage on the northern elevation of the site (see *Photograph 6.4*). As such, a number of samples were submitted for asbestos screening, one sample, SS03, was found to contain loose chrysotile fibres.

From a baseline assessment perspective it can be concluded from the soil survey that the site is effectively uncontaminated with any of the species targeted for analysis and in that regard there are no obvious contamination legacy issues that need to be addressed as part of the site development works.

It should be noted, however, that there is a possibility of contamination in the scrap metal waste area. It was not possible to sample beneath the scrap metal and there is a possibility of asbestos and hydrocarbon contamination in this area.

6.2.5 Impact Assessment

The impact assessment in the context of an ESIA, considers the potential for the development proposals to impact on the baseline conditions. In addition to the potential pollution sources that already exist at the site (which other than localised asbestos are negligible), the following potential sources of pollution may arise as a result of the construction and operational phases of the proposed development impacting upon the site.

Table 6.11: Potential Future Sources of Soil Contamination at the Site

Construction Phase	Operational Phase
Spillages of polluting materials during construction activities (e.g. fuel spills during plant refuelling).	Poor housekeeping operations or the occurrence of spillages such as fuel and oil leaks
Mobilisation of oil residues in scrap vessels stored on the site.	Transfer of petroleum products from marine tankers to tanks
	Storage of petroleum products
	Transfer of petroleum products from tanks to road tankers

When the proposed Terminal is closed and decommissioned (and possibly demolished), there may be impacts associated with this too if residual materials are not removed from the site and mismanaged. The activities that would typically be involved in the closure and decommissioning of such a facility would be similar to those during construction, involving plant and machinery, earthworks, materials movement and management. Likewise, therefore, the impacts would be similar. It is unlikely that a site such as this would be returned to the status of the present undeveloped site. Whilst potentially polluting materials and valuable or recyclable infrastructure (for example, tanks, pipes, scrap metal, machinery, plant) will be removed, the major structures (concrete, berths, drainage systems, walls, fences, etc) would be unlikely to be removed. In all likelihood, the site would probably be re-used for alternative uses or redeveloped. As such the extent of the works and associated traffic and construction type activities (machinery, earthworks, etc) associated with closure of the facility, whilst similar in nature to the construction activities, are expected to be lesser in scale and duration, as would be the associated impact. It is considered, therefore, that the impact of closure and decommissioning activities upon the terrestrial environment will be negligible.

6.2.6 Mitigation

The site's redevelopment proposals will mitigate the key pollutant linkages of human health exposure and on-site buildings and services. This is detailed in *Table 6.12:*

Table 6.12: Conceptual Site Model – Potential Impacts Following Site Development

Source			
(A) Presence of chryostile fibres on the northern elevation of the site			
Source	**Pathway**	**Receptor**	**Potential Pollutant Linkage and Significance**
(A)	Ingestion Inhalation	**Human Health (HHR)** Current site works and trespassers Off-site general public	**HHR – Low Risk** The asbestos sheeting and impacted areas will be further investigated and removed as part of the development works and thus eliminated as a source.

Consideration has also been given to the mitigation of potential impacts associated with the construction phase of the site's redevelopment in addition to the operational phase of the site following its redevelopment.

Construction Phase

Construction vehicles will be properly maintained to reduce the risk of hydrocarbon contamination and will only be active when required. Construction materials will be stored, handled and managed with due regard to the sensitivity of the local aquatic environment, thus, the risk of accidental spillage or release will be minimised.

Furthermore, mitigation measures will be incorporated into a CEMP, which sets out measures for the control of site drainage, reducing the risk of accidental spillages and the storage and handling of materials.

No underground storage tanks will be used during the construction phase. Any liquids such as degreasers, oils, diesel, required as part of the construction works will be stored in above ground tanks and located on designated areas of hardstanding.

Operational Phase

Hydrocarbon contamination from the on-site storage tanks (and associated transfer from marine tanker to tankage and then to road tankers) is considered to be a potential source of contamination from the routine operation of the site. The proposed Terminal will utilise industry standard equipment, thereby, reducing the potential risk of contamination, particularly when compared to the existing facilities. Furthermore, once operational, the terminal will operate relevant response procedures which, if needed, will react to reduce the impact of any contamination.

6.2.7 Residual impacts

It is considered that the identified pollutant linkages will be minimised to an acceptable level by the development proposals.

Residual impact after mitigation; Minor Positive

6.3 Sediment Quality

This section of the ESIA report describes the baseline sediment quality of the Khor Al-Zubair. Sediment is defined as the soils that have formed below the high water mark as a result of settlement and sedimentation from the water column. These sediments are either periodically (twice daily) wetted by the tide (in the intertidal zone) or permanently submerged in the river.

6.3.1 Assessment Methodology

Baseline Conditions

This study involved a combination of desk-based study, consultation with stakeholders and regulators, sediment sampling and testing, and associated analysis and risk assessment.

In order to determine the sediment quality, five sediment samples were collected from the Khor Al-Zubair riverbed in the Terminal development area (in addition to those samples collected for the ecological survey described in *Chapter 8*).

For collecting the sediment samples, a Van Veen Sediment Sampler was utilised. A Van Veen is a clamshell-shaped sampler which is lowered through the water column on a cable to the sediment surface. Upon reaching the river bed, the slack in the winch line causes the locking mechanism to release, allowing the sampler to close under its own weight, thereby, collecting a sample of sediment. The sampler was then pulled out of the water and returned to the vessel deck, where it was opened by hand and sediment was allowed to drop onto a clean plastic lining and placed in appropriate glassware. Two 'grabs' were completed at each sample location to provide a representative sample of the river bed at each location. Depth to riverbed will be noted using an echo sounder. The sampling was undertaken using a locally chartered vessel which had been audited and pre-approved by EAME.

During the sampling of the channel bed sediments, the condition, colour, odour and temperature of each sample was noted and recorded. The sediment was logged in accordance with accepted international logging nomenclature and the soil colour was determined in the field using the Munsell Colour Chart system.

All collected samples were collected in pre-cleaned sample jars of appropriate size and type for each laboratory analysis to be performed. All samples were given a unique reference number, dated and the information recorded on an appropriate Chain of Custody form for dispatch with the samples to the laboratory.

Photograph 6.6: *Van Veen Sediment Sampler*

Assessment Criteria

The chemical analysis results for sediment have been compared, where available, to the following standards:

- World Health Organisation (WHO) standards; and
- North American (US and Canadian) guideline values.

Whilst these guidelines are not directly applicable, they do provide a useful indicator value in the absence of Iraqi promulgated standards.

Identification of Impacts

The following effects are anticipated to occur from the construction and operational phases of the proposed development:

- the potential movement and dispersion of material in the various media during the construction phase from earthmoving and general construction works;
- potential for piling and dewatering of excavations to enable cross contamination of the ground strata; and

- mobilisation of contaminants and leaching through the sub strata to impact identified controlled waters, such as surface watercourses and groundwater bodies by the creation of new pathways.

Assessment and Evaluation of Effects

The assessment of effects has involved the following general approach:

- the identification and assessment of potential sources, pathways and receptors in relation to the proposed end use of the site during and following development;
- the sensitivity of receptors has been established on the basis of their use, proximity to the site, existing quality or resource value and consideration of potential pathways;
- the potential effects have been classified, prior to mitigation, as minor, moderate or major (either positive or negative); and
- where the predicted effects are considered to be significant, mitigation measures have been incorporated to eliminate or reduce the impacts to an acceptable level. The residual effects (post mitigation) are discussed in the final subsection of this chapter.

6.3.2 Baseline Conditions – Desk-based Research

In 2012, EAME undertook an environmental survey of the Khor Al-Zubair, relating to the rehabilitation of KZP, which included the collection of marine water and sediment samples from within the channel. The principal findings of the study were:

- There is generally a lack of evidence of significant pollution in the water, sediment and soils that were tested;
- The concentrations of target analytes, for both the sediment and water samples, were generally less than those observed during a previous study undertaken in 2009. However, this was deemed attributable to different laboratory techniques and large scale water and sediment transportation creating a different environment over time, rather than a notable improvement in water quality *per se*; and
- The levels of contaminants observed are not a significant cause for concern and should not prove to be an impediment to the dredging and disposal operations.

The JICA SAPROF report[16] indicated that over 200 sediment samples have been taken from forty locations within the Khor Al-Zubair channel; this includes thirty-five wrecks sites and five mid-channel sites. When compared to North American Guideline values, acceptable levels of sediment contamination have been noted:

- Heavy metal concentrations predominantly fall within North American guidelines, with relatively high levels of chromium, nickel and some other metals were attributed to high natural concentrations in the sediment;
- Uranium concentrations were also consistent with the crustal abundance;
- Hydrocarbon pollution was evident at a number of wreck sites distributed throughout project waters;
- Two samples submitted for PAHs analysis reported concentrations that exceeded North American guideline value; and
- There is no evidence of pollution from chlorinated pesticides and Polychlorinated Biphenyls (PCBs).

6.3.3 Baseline Conditions – Field Sampling

Sampling Locations

The sediment samples were obtained from positions adjacent to the proposed Terminal development area.

[16] Final Report For Special Assistance for Project Formation (SAPROF) on Port sector Rehabilitation Project in the Republic of Iraq, Japan Bank for International Cooperation (JBIC), 2005

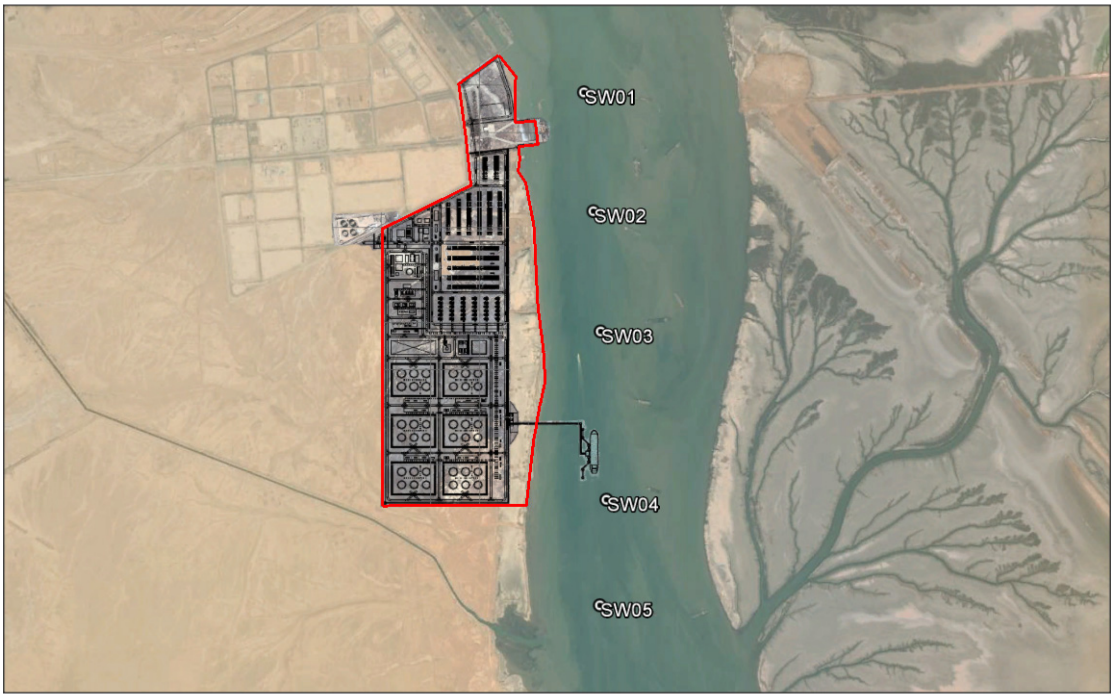


Figure 6.3: *Sediment sample locations*

Google Earth Pro Imaging with the permission of Google Licensed to Earth and Marine Environmental Consultants Ltd

Table 6.13: Sediment Sampling Locations				
Location ID	**Grid Reference**	**Depth to Sea Bed (m)**	**Meteorological Information**	**Sea State**
SW01	30°10'58.12"N, 47°53'45.18"E	13.7	Sunny, windy	Choppy, 0.5m waves
SW02	30°10'41.95"N, 47°53'46.66"E	14.3	Sunny, windy	Choppy, 0.5m waves
SW03	30°10'25.60"N, 47°53'47.81"E	16.1	Sunny, windy	Choppy, 0.5m waves
SW04	30°10'2.73"N, 47°53'48.72"E	11.00	Sunny, windy	Choppy, 0.5m waves
SW05	30° 9'48.38"N, 47°53'47.68"E	12.00	Sunny, windy	Choppy, 0.5m waves

The river condition during the sampling was choppy with 0.5m waves as a result of the strong summer *Shamal* winds which are typical of this time of the year.

Field Observations and Measurements

The sediment samples were obtained on the 13th September 2014 using a Van Veen Sediment Sampler on a vessel which had been audited and pre-approved by EAME.

Table 6.14: Sediment Sampling - Field Observations and Measurements

Location ID	Description	Temp. (°C)	Munsell Colour Chart
SW01	Grey-brown fine GRAVEL	27.5	10YR 7/3 Very pale brown
SW02	Grey – brown coarse SAND with numerous shells	26.3	5Y 6/2 Light olive gray
SW03	Grey – brown silty CLAY	31.6	10YR 6/2 Light brownish gray
SW04	Grey silty CLAY	28.4	10YR 7/1 Light gray
SW05	Grey silty CLAY	30.0	2.5YR 5/2 Brown

Analytical Strategy

The analytical strategy was designed by EAME to provide an assessment of the presence of a common range of potential contaminants.

Table 6.15: Analytical Strategy

Parameter	Rationale
General Inorganics pH, Total Cyanide, Complex Cyanide, Free Cyanide, Total Sulphate as SO_4, Total Chloride, Water Soluble Phosphate as P (2:1), Total Nitrogen (Kjedahl), Total Organic Carbon (TOC)	General indicators of contamination
Total Phenols (Monohydric)	General indicator of contamination
Total Speciated PAHs	Speciated suite to determine the presence of fuel derivatives and associated compounds
Heavy Metals and Metalloids	General indicators of contamination
TPH ($C_{10} – C_{40}$)	Targeted analysis for fuels and oils

Assessment of Analytical Results

EAME has undertaken a tiered approach in order to provide a preliminary qualitative assessment of the sediment analytical results. The first stage of assessment was to screen out those compounds that were not present above the method detection limit (MDL) of the laboratory. These are provided in the list below, and have thus not been considered further within the assessment.

- Cyanide (total, complex and free);
- Total phenols (monohydric);
- Total Speciated PAHs;
- Cadmium,
- Chromium (hexavalent);
- Mercury;
- Tin; and
- TPH (C_{10} – C_{40})

The remaining determinants that were detected above the laboratory MDL were then compared against a screening criteria value, where available. The samples were tested at an accredited UKAS laboratory (i2 Analytical), with the full analytical certificates presented in *Appendix G3* and summarised in *Table 6.16*.

Table 6.16: Summary of Sediment Analytical Results

Contaminant	Conc. Range (mg/kg)	Location of Sample with Max. Conc.	Screening Criteria (mg/kg)	No. of Exceedances of Screening Criteria
General Inorganics				
pH	7.5 – 8.0	SW02 and SW04	NG	-
Total Sulphate as SO_4	1,060 – 5,280	SW05	NG	-
Total Chloride	1,200 – 11,000	SW04	NG	-
Water Soluble Phosphate as P	<MDL – 0.12	SW05	NG	-

Table 6.16: Summary of Sediment Analytical Results				
Contaminant	**Conc. Range (mg/kg)**	**Location of Sample with Max. Conc.**	**Screening Criteria (mg/kg)**	**No. of Exceedances of Screening Criteria**
(2:1)				
Total Nitrogen (Kjeldahl)	270 – 1,200	SW01	NG	-
TOC	0.2 – 0.7%	SW04 and SW05	NG	-
Heavy Metals and Metalloids				
Arsenic	3.0 – 4.3	SW01	5.9 *1	0
Copper	4.4 - 26	SW04	35.7 *1	0
Iron	4,800 – 34,000	SW04	NG	-
Lead	1.4 – 4.6	SW04	3.5 *1	**3 - SW03, SW04, SW05**
			91.3 *2	0
Manganese	100 - 400	SW04	NG	-
Nickel	8.6 – 89	SW04	NG	-
Zinc	11 – 41	SW04	123 *1	0

Notes:

Units are mg/kg except where indicated otherwise

NG = No Guideline available

<MDL = Below the Method Detection Limit

*1 = Interim Sediment Quality Guidelines (ISQG) correspond to threshold level effects below which adverse biological effects are not expected.

*2 = PEL – Probable Effect Level defines the level above which adverse effects are expected to occur frequently.

ISQG and PEL developed by Task Group of the Canadian Council of Ministers of the Environment (CCME).

Summary of Chemical Baseline Conditions (Sediment)

In summary, the only elevated parameter above its respective screening criteria was lead. Lead is a naturally-occurring element that can be harmful to humans when ingested or inhaled. For hundreds of years, lead has been mined, smelted, refined, and used in products (*e.g.*, as an additive in paint, gasoline, leaded pipes, solder, crystal, and ceramics). According to the USEPA natural levels of lead in soil range between 50 – 400 parts per million (ppm)[17]. Mining, smelting, and refining activities have resulted in substantial increases in lead levels in the environment, especially near mining and smelting sites.

All samples were above the Canadian Interim Sediment Quality Guidelines below which adverse biological effects are not expected but the results were below the Probable Effect Level (PEL) above which adverse effects are expected to occur frequently. The level of contamination is considered to be moderate.

The only potential source of contamination identified relates to elevated lead concentrations identified at three locations. All other parameters were recorded at concentrations below the relevant screening criteria are not considered to be environmentally significant. Considering the results overall and previous studies, the contamination levels of the sediments is considered to be low as is their associated pollution potential.

6.3.4 Impact Assessment

Construction and Operational Activities

The following potential sources of pollution could be associated with the construction and operational phases of the proposed development have been identified.

Table 6.17: Potential Future Sources of Sediment Contamination at the Site

Construction Phase	Operational Phase
Spillages of polluting materials during construction activities (e.g. fuel spills during plant refuelling).	Poor housekeeping operations or the occurrence of spillages such as fuel and oil leaks
	Spillage during transfer of petroleum products from marine tankers to tanks

It should be noted, however, that the sediment in this channel is very mobile and the sediment beneath the jetty is likely to change over a relatively short period of time. The river is also strongly tidal. Consequently, minor spills and leaks are likely to be more of an issue for water quality and will remain entrained in the water column rather than interact with the sediments.

[17] http://www.epa.gov/superfund/lead/health.htm

It would take a major incident for a release to be of sufficient magnitude to interact with the sediments. Such large scale disaster incidents are dealt with in *Chapter 10 – Hazard Analysis and Risk Assessment*.

Closure and Decommissioning

When the proposed Terminal is closed and decommissioned (and possibly demolished), there may be impacts associated with this. The activities that would typically be involved in the closure and decommissioning of such a facility would be similar to those during construction, involving plant and machinery, earthworks, materials movement and management. Likewise, therefore, the impacts would be similar. It is unlikely that a site such as this would be returned to the status of the present undeveloped site. Whilst potentially polluting materials and valuable or recyclable infrastructure (for example, tanks, pipes, scrap metal, machinery, plant) will be removed, the major structures (concrete, berths, drainage systems, walls, fences, etc) would be unlikely to be removed. In all likelihood, the site would probably be re-used for alternative uses or redeveloped. As such the extent of the works and associated traffic and construction type activities (machinery, earthworks, etc) associated with closure of the facility, whilst similar in nature to the construction activities, are expected to be lesser in scale and duration, as would be the associated impact. It is considered, therefore, that the impact of closure and decommissioning activities upon the sediment environment will be negligible.

6.3.5 Mitigation

Construction Phase

Plant machinery will be properly maintained to reduce the risk of hydrocarbon contamination and will only be active when required. Construction materials will be stored, handled and managed with due regard to the sensitivity of the local aquatic environment, thus, the risk of accidental spillage or release will be minimised.

Furthermore, mitigation measures have been incorporated into a CEMP, which sets out measures for the control of site drainage, reducing the risk of accidental spillages and the storage and handling of materials.

Any liquids such as degreasers, oils, diesel, required as part of the construction works will be stored in above ground tanks and located on designated areas of hardstanding.

Operational Phase

Hydrocarbon contamination from the transfer from marine tanker to tankage is considered to be a potential source of contamination from the routine operation of the site. The proposed Terminal will utilise modern industry standard equipment, thereby, reducing the potential risk of contamination, particularly when compared to the existing facilities. Furthermore, once operational, the terminal will operate relevant response procedures which, if needed, will react to reduce the impact of any contamination.

6.3.6 Residual Impacts

It is considered that the identified pollutant linkages will be minimised to an acceptable level by the development proposals.

Residual impact after mitigation; Neutral

6.4 Waste Management

6.4.1 Introduction

Wastes are an inevitable aspect of any business activity and often waste disposal (especially solid wastes) can impact on the land. There will be three aspects to waste management associated with the development. Firstly, wastes will be generated temporarily during the construction phase and secondly, once the site is developed and operational, there will be routine wastes associated with the activities of the proposed development, which will continue to be generated during the lifetime of the project. Finally during decommissioning of the closed facility wastes may once again be generated temporarily.

This section of the chapter considers the proposed development and how the waste characteristics of the current site use (and how they impact on the environment) may be altered by future waste generation activities associated with the development proposals.

6.4.2 Assessment Methodology and Significance Criteria

The waste management evaluation has considered the wastes that are likely to be generated as a result of the present site usage and the likely future construction and site operational wastes based on similar scale construction projects and operations.

The potential effects have been classified, prior to mitigation, as minor, moderate or major (either “Adverse”, “Beneficial” or “Neutral”). Where the predicted effects are considered to be significant, mitigation measures have been incorporated to eliminate or reduce the impacts to an acceptable level.

6.4.3 Legislation

Chapter V of Public Health Act (Law No. 89, 1981) sets 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. This, however, relates to dedicated sites for waste disposal (landfill) rather than waste producing sites. There is no specific legislation targeted at waste production from industrial and commercial sources.

6.4.4 Baseline Data

The following pertinent information was derived from the ESIA fieldworks undertaken in August and September 2014.

The northern elevation of the site comprises KAZ Jetty No. 1 and areas of unsurfaced land with areas utilised for the storage of scrap metal, much of which appears to be marine-derived (wreck salvage). However, the majority of the site, approximately 95%, is undeveloped. During the site walkover, fragments of suspected asbestos sheeting was noted within the area of the scrap metal storage. The intertidal zone is littered with domestic waste deposited by the river as well as large metal objects such as shipwrecks and redundant pipework.

Consequently, the site presently houses a large amount of scrap metal waste from the ship-breaking that has been taking place on the Khor Al-Zubair, however, this waste can be considered as historic. There are no waste generating activities on the site at present. The tide also washes a certain amount of waste and debris onto the shoreline. None of these wastes are managed in a controlled way and could be regarded as uncontrolled tipping.

6.4.5 Identification and Evaluation of Key Effects

For the proposed development site, the anticipated waste types that are predicted for both the construction and operational phases are presented in *Table 6.18*.

Table 6.18: Construction and Operational Phase Predicted Waste Types

Predicted Construction Phase Wastes	Predicted Operational Phase Wastes
Building demolition rubble comprising brick, glass, timber and concrete	Small quantities of waste oils and chemicals from site support activities
Asbestos containing materials (noted on-site)	Paper, cardboard and plastic packaging wastes
Excavated soil associated with foundation excavation and trenching for services	Soils and possible contamination from minor earthworks (sewer repair, trenching, post boring, *etc*)
Spoil from piling operations (if required)	Scrap metal and redundant plant and equipment
Waste oils, chemicals and potentially hazardous materials from buildings clearance	Waste vegetation from routine maintenance of landscaped areas (if present)
Scrap metal from the shipwrecks and redundant pipework located on-site	Construction/demolition wastes from periodic contractor activities
Vegetation from site stripping (if required)	Sanitary effluent
Waste paper, plastic, cardboard and wood from delivery of construction material and site activities during the works	Wastes deposited along the intertidal zone

Table 6.18: Construction and Operational Phase Predicted Waste Types	
Predicted Construction Phase Wastes	**Predicted Operational Phase Wastes**
Redundant unused construction materials	
Collected groundwater and rainwater	
Wastes deposited along the intertidal zone	

The volume of the wastes that will be generated cannot be specified at this time. It is possible, however, to give a relative assessment of the potential waste quantities and their intended fate (*Table 6.19*).

Table 6.19: Fate of Generated Wastes			
Waste Type	**Phase**	**Relative Volume**	**Fate**
Building demolition rubble comprising brick, glass, timber and concrete	Construction	Small to Moderate	Mixture of on-site re-use of materials and off-site recycling or disposal of unsuitable materials.
Asbestos containing material (noted on-site)	Construction	Small	Specialist removal by an appropriate contractor.
Excavated soil	Construction	Small	On-site reuse and re-profiling. Off-site disposal for materials that cannot be managed on-site effectively.
Redundant construction materials	Construction	Small	Return to supplier, recycling, sale or disposal.
Collected perched groundwater and rainwater	Construction	Small	Discharge to site surface or drainage system under controlled conditions if suitable or off-site treatment.

Table 6.19: Fate of Generated Wastes

Waste Type	Phase	Relative Volume	Fate
Trade effluent from vehicle wheel washing	Construction	Small	Discharge to site surface or drainage system under controlled conditions if suitable or off-site treatment.
Waste paper, plastic, cardboard and wood	Construction	Small to moderate	Off-site recycling and disposal via contracted waste management firm.
Waste oils, chemicals and potentially hazardous materials	Construction and operational	Small	Removal to appropriate treatment and disposal facilities.
Scrap metal and redundant plant and equipment	Construction and operational	Small	Off-site recycling.
Vegetation from site stripping	Construction and operational	Small	Off-site recycling or composting.
Sanitary waste water	Construction and operational	Small	Treatment by onsite Effluent Treatment Plant
General waste; paper, plastic, cardboard, food waste etc.	Operational	Small	Removal to appropriate disposal facilities.
Construction wastes from periodic contractor activities.	Operational	Small	Removal to appropriate disposal facilities.

Key:

Small = tens of tonnes

Moderate = hundreds of tonnes

Large = thousands of tonnes

Solid Waste Generation and Management – Construction Phase

Demolition rubble and excavated soils associated with the construction works will be the dominant and most environmental significant waste stream, however, it will be temporary in nature. Insofar as a summary of the management of wastes arising from the proposed development is concerned, the following aspects are pertinent:

- Any asbestos containing materials (ACMs) on-site will have to be removed and disposed of appropriately;
- Removal of scrap metal and shipwrecks from the site and intertidal zone;
- Removal of wastes deposited along the intertidal zone;
- All excavations will be monitored and analysed by qualified and experienced field scientists to ensure the chemical characteristics of the materials are understood and that they are handled and segregated appropriately;
- Arising from piling operations, if required, will be treated similarly to other excavated materials and will be appropriately monitored, analysed and managed;
- Detailed records (and where appropriate a photographic log) will be kept of all construction phase waste arisings and their management and fate; and
- All works will be undertaken with due attention to appropriate guidance.

Overall, the generation and management of solid waste associated with the construction phase is considered to have a ‘minor positive effect’, predominantly due to the removal of the asbestos sheeting, scrap metal and wastes deposited along the intertidal zone.

Solid Waste Generation and Management – Operational Phase

Once operational, the main solid waste stream will be general domestic waste from kitchens, offices and accommodation.

The overall solid waste generation and management operational phase effects are considered to be a ‘minor adverse effect’.

Waste Water Generation and Management

In addition to the aforementioned solid wastes, the proposed development will also generate waste waters. As with most aspects of the proposed development, the construction and operational phases need to be considered separately. These are discussed below.

Construction Phase

Waste waters likely to be generated on-site during the construction phase include the following:

- temporary septic tanks and/or portable toilets to be utilised by the construction workers;
- waste waters from dewatering of excavations (groundwater and surface water runoff);
- dirty water from the temporary on-site wheel wash (should one be required during the construction works);
- The dewatering of groundwater from excavations in any significant quantities is not anticipated to be required. However, any water arising from the dewatering of excavations will either be discharged back over the ground surface and allowed to infiltrate or discharged into the Khor Al-Zubair; and
- Waste water generated from the on-site wheel wash (if required) will be either be collected in a sealed system for reuse, or collected in a sealed system for authorised disposal.

Overall, the generation and management of waste water associated with the construction phase is considered to have a 'minor adverse effect' which will be temporary in nature.

Operational Phase

The main waste water stream once the site is operational will be sanitary wastewater from the toilet blocks, washrooms and catering facilities associated with the plant. It has been assumed that sanitary waste water will be treated by an on-site Effluent Treatment Plant.

Overall, the generation and management of waste water associated with the operational phase is considered to be 'neutral'.

6.4.6 Mitigation

The measures to be taken to manage solid wastes generated during the construction and operational phases are described previously. No additional mitigation measures are considered to be required.

The proposed development shall apply the waste hierarchy, as outlined below, where disposal is considered as the last choice.

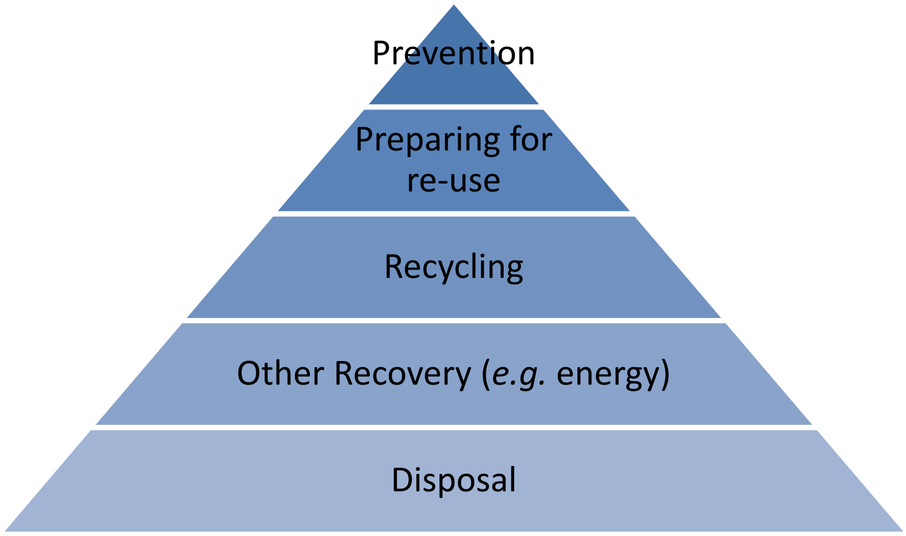


Figure 6.4: *Waste hierarchy*

A Site Waste Management Plan (SWMP) will be produced for the proposed development. The main objectives of which will to sure that all building materials are managed efficiently and that material recycling, re-use and recovery is maximised.

6.4.7 Residual Effects – Construction Phase

The effects arising from the construction phase are transient in nature and as such they are considered to have a 'neutral' residual effect.

6.4.8 Residual Effects – Operational Phase

Once operational, the main solid waste stream will be general domestic wastes from kitchens, offices and accommodation.

The main waste water stream once the site is operational will be sanitary wastewater from the toilet blocks, washrooms and catering facilities associated with the plant.

As such, the residual effect of the operational phase is considered to be 'neutral'.

Chapter 7 – Water Quality

Contents

7 Water Quality

7.1 Introduction

This section of the Environmental and Social Impact Statement deals with the assessment of the potential impacts of the proposed development on surface and groundwater quality and hydrology in the study area. The assessment of effects encompasses surface water and groundwater quality, and surface water and groundwater resources (in terms of water quantity and dynamics).

7.2 Assessment Methodology

7.2.1 Baseline Conditions

This study involved a combination of desk-based studies, consultations with stakeholders, review of previous investigation reports, surface water and groundwater sampling and testing and associated analysis and risk assessment.

EAME undertook a comprehensive desk study[1] of the proposed Terminal site covering a large number of relevant topics (geology, water usage and quality, etc). The information obtained during this study enabled EAME to design a sampling programme to provide additional information on the baseline conditions of the area sufficient to assess the potential impact risks associated with the development.

This assessment has been undertaken in accordance with current guidance on EIA[2] and has involved a review of the following sources of baseline data:

- Site walkovers undertaken in August and September 2014 to provide an assessment of current site activities and the site's environmental setting;
- Desk-based research;
- A environmental site investigation which involved the drilling of the seven boreholes to 6m depth, all of which were be converted to long-term groundwater monitoring wells comprising 50mm standpipes (with geosock) for subsequent monitoring to determine the hydro-geological conditions (such as groundwater flow direction) and to establish baseline groundwater quality conditions;

[1] WTPS Iraq Oil Terminal Desk Study, Earth & Marine Environmental Consultants, August 2014, REF: 014-1287 REV00
[2] Environmental Impact Assessment – A Guide to Procedures, DETR, November 2000.

Photograph 7.1: *Application of Geotextile screening sock and a completed installation*

- The wells were surveyed in to the Iraqi Geospatial Reference System (IGRS) to allow an accurate representation of the true depth to groundwater and allow the hydraulic gradient (if any) to be determined;

- Prior to groundwater monitoring, the wells were dipped using a groundwater interface probe to ascertain groundwater levels within the wells and the presence (if any) of free-phase product;

Photograph 7.2: *BH03 being dipped using a groundwater interface probe and training Iraqi personnel to purge the monitoring wells*

- The wells were then developed to ensure a good interface within the groundwater bearing strata, by purging and removing standing water amounting to approximately three well volumes. Following this process, a representative groundwater sample from was obtained from each well. Samples collected were visually assessed, particularly for the presence of free-phase product, oil sheens or unusual colouration. Relevant field observations and in-situ measurements were recorded during groundwater monitoring;

- All groundwater samples were analysed, at an appropriately accredited laboratory, for a number of parameters including metals and metalloids, pH, Total Sulphate, Chloride, Phosphate, Monohydric Phenols, Cyanide, Speciated Polycyclic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbons (C_{10} – C_{40}), Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs);

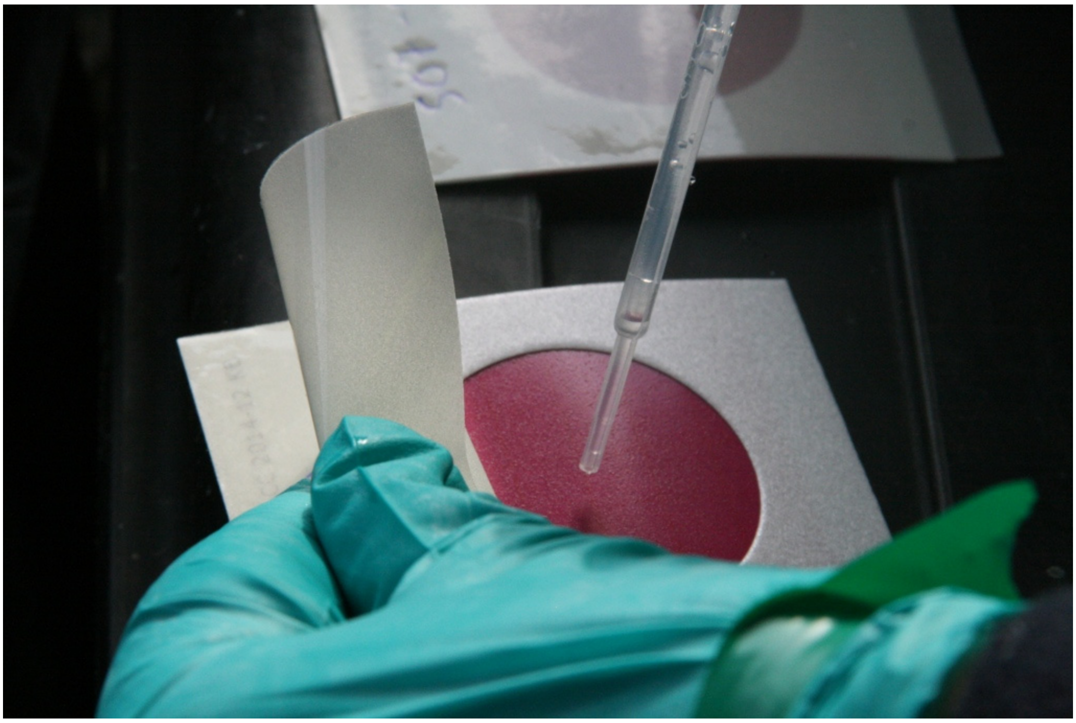
- In addition, automatic level loggers were installed in each borehole so as to assist in the characterisation of the hydrogeological regime and to ascertain whether the groundwater within the site is tidally influenced. The monitoring devices were left in place for at least 72 hours to ensure that several tidal cycles had been observed;

- Ten surface water samples, five from 1.0m below the water surface and five from 1.0m above the river bed, were collected from the Khor Al-Zubair in the Terminal development area using a Niskin Water Sampler. All collected samples were placed in pre-cleaned sample jars of appropriate size and type for each laboratory analysis to be performed. All samples were given a unique reference number, dated and the information recorded on an appropriate Chain of Custody form for dispatch with the samples to an appropriately accredited laboratory;

Photograph 7.3: *Niskin Water Sampler*

- During the surface water sampling events, field water quality data was also obtained for temperature, pH, Oxygen Reduction Potential (ORP), conductivity, turbidity, Total Dissolved Solids (TDS) and DO using a Xylem EXO Sensor. In addition, other relevant observations including the Forel-Ule colour comparator scale, Secchi depth, sea state and meteorological information were recorded; and

- It is not possible to obtain reliable coliform data from a laboratory as the travel time between the field and a suitably accredited laboratory was too great, therefore, field testing was undertaken. A small aliquot of each water sample was obtained, added to individual coliform count plates and placed in an incubator for 24 hours, at the end of which, coliform bacteria, if present, was observed in the count plates.



Photograph 7.4: *Sample being added to a Coliform Counting Plate*

7.2.2 Assessment Criteria

Standard practice for the assessment of contaminated waters follows a risk-based approach and is structured in a tiered manner. As well as having a systematic approach to collecting the data it is also necessary to adopt recognised techniques and standards in assessing them and particularly with regard to environmental risk assessment.

Table 7.1: Tiered Assessment	
Tier 1 Assessment	Comparison of site contaminant concentrations against generic standards and compliance criteria including an assessment of risk using the source pathway target model
Tier 2 Assessment	Derivation of site specific risk assessment criteria and calculation of site specific clean up goals

The groundwater analytical results have been compared to Iraqi Drinking Water Standards (IQS 417/2001) and where Iraqi standards do not exist, World Health Organisation (WHO) Guidelines, has been used. However, it should be noted that the IQS appear to be adapted from WHO guidelines and not from appropriate local epidemiological studies, so in that respect are still generic criteria.

The chemical analysis results for the surface water samples have been compared, where available, to the following standards:

- Iraqi promulgated contamination standards (i.e. *The New Determinants for the Prevention of Pollution of Rivers No. (25), 1967* as amended);
- World Health Organisation (WHO) standards;
- North American (US and Canadian) guideline values;
- European Community (EC) Environmental Quality Standards (EQSs); and
- UK Environment Agency (EA).

Whilst these guidelines are not directly applicable, they do provide a useful indicator value for water quality in the absence of Iraqi promulgated standards.

Identification of Impacts

The effects on water quality likely to arise from the construction and operational phases of the proposed development are principally the following:

- the potential disruption of groundwater flows from piling, in ground structures and the dewatering of excavations;
- mobilisation of contaminants and cross contamination between water bodies by the creation of new pathways;

- spillage and leaks of new potential contaminants either directly into the river or onto exposed soils and thence groundwater;
- effects related to the discharge of routine site runoff on local land drainage and water quality;
- Disruption of tides and currents by in-water structures; and
- potential impacts arising in relation to water demand.

The impact assessment considered the likelihood of each of these scenarios.

Assessment and Evaluation of Effects

The assessment and evaluation of effects considers how those impacts that are likely could change the baseline conditions with respect to water quality and behaviour.

The assessment of effects has involved the following general approach:

- the sensitivity of aquatic receptors has been established on the basis of their use, proximity to the site, existing quality or resource value and consideration of potential pathways;
- evaluation of the significance of the potential changes in water quantity and quality and assessment of the sensitivity of the resource to the predicted changes;
- the potential effects have been classified, prior to mitigation, as minor, moderate or major (either positive or negative); and
- where the predicted effects are considered to be significant, mitigation measures have been incorporated to eliminate or reduce the impacts to an acceptable level. The residual effects (post mitigation) are discussed in the final subsection of this chapter.

7.3 Baseline Conditions – Desk-based Research

7.3.1 Groundwater

This section provides a summary of the relevant desk study information only.

Alluvium and Aeolian Deposits

The porous nature of the alluvial and Aeolian deposits suggests that any perched groundwater contained within them is likely to be in hydraulic continuity with the adjacent

Khor Al-Zubair, and the groundwater level is likely to rise up and down with the ebb and flow of the tides to a certain extent. As such there is unlikely to be a strong groundwater flow direction. As such, the groundwater contained in these deposits is likely to demonstrate high salinity levels.

Hammar Formation

It should also be noted that the Hammar Formation and the higher horizons of the Dibdibba Formation may also be in continuity with the Khor Al-Zubair channel.

Dibdibba Formation

The Dibdibba Formation comprises gravels and coarse-grained sandstones which is important in supplying water for irrigation purposes. Due to high porosity of the deposits over the site, any rainfall will either evaporate or will percolate into the ground. Water in great quantities can be found stored in this Formation, however, its quality may be highly variable, especially if the Formation is in continuity with the Khor Al-Zubair and saline intrusion is occurring.

This Formation reportedly contains two water layers, an unconfined upper layer containing brackish water and a lower, semi-confined containing saline water. These layers are separated by a hard clay bed locally known as 'Jojeb'. The salinity in the upper layer does not exceed 10,000 mg/l, while the lower layer is characterized by salinity in excess of 10,000 mg/l in most areas.

The lower horizons may not be in continuity and natural slope of the Mesopotamia Plane suggests groundwater flow direction is towards the Arabian Gulf.

7.3.2 Surface Water

This section provides a summary of the relevant desk study information only.

In 2012, EAME undertook an environmental survey of the Khor Al-Zubair, relating to the rehabilitation of KZP, which included the collection of marine water and sediment samples from within the channel. The principal findings of the study were:

- There is generally a lack of evidence of significant pollution in the water, sediment and soils that were tested;
- The concentrations of target analytes, for both the sediment and water samples, were generally less than those observed during a previous study undertaken in 2009. However, this was deemed attributable to different laboratory techniques and large

scale water and sediment transportation creating a different environment over time, rather than a notable improvement in water quality *per se*; and

- The levels of contaminants observed are not a significant cause for concern and should not prove to be an impediment to any dredging and disposal operations.

7.4 Baseline Conditions – Field Data

7.4.1 Groundwater

Borehole Locations

All seven boreholes were drilled, using rotary methods, on the 13th August 2014. All drilling works were conducted using clean drilling methods *i.e.* no oils or other contaminative fluids were used or added during drilling. Each borehole was installed to facilitate follow-on groundwater monitoring.

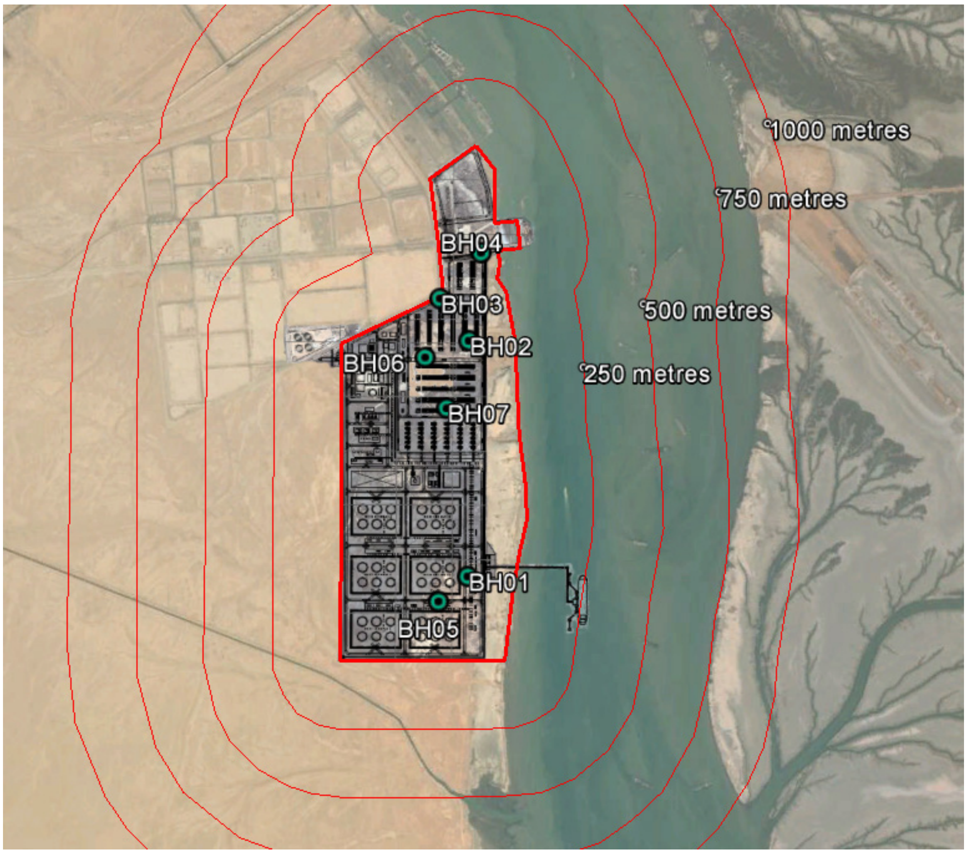


Figure 7.1: *Borehole locations*

Google Earth Pro Imaging with the permission of Google Licensed to Earth and Marine Environmental Consultants Ltd

Table 7.2: Borehole Location and Rationale

Location ID	Easting, Northing	Latitude, Longitude	Elevation (m IGRS)	Rationale
BH01	778507.201 3341149.746	30°10'12"N 47°53'33"E	3.709	Close to the Khor Al-Zubair
BH02	778489.365 3342026.42	30°10'40"N 47°53'31"E	4.628	Close to the Khor Al-Zubair
BH03	778405.253 3342177.245	30°10'45"N 47°53'27"E	5.228	Boundary with the Freezone
BH04	778521.197 3342333.51	30°10'38"N 47°53'25"E	4.276	Targeting part of the site currently utilized
BH05	778410.867 3341038.085	30°10'09"N 47°53'27"E	4.09	Spatial coverage
BH06	778349.064 3341969.954	30°10'38"N 47°53'25"E	4.686	Spatial coverage
BH07	778399.976 3341775.446	30°10'32"N 47°53'28"E	4.851	Spatial coverage

Groundwater Survey

It was not possible to ascertain the presence (and depth) of any groundwater strikes during the drilling due to the water which was added to aid the drilling process.

Groundwater samples were obtained from the borehole and window sample locations after completion of the well installations and development of the wells. Prior to sampling the groundwater in each well, the depth to groundwater was first measured and the well developed by the removal of at least three equivalent well volumes using an electric pump. The groundwater levels were then allowed to recover before sampling to ensure that the samples were of “fresh” groundwater, representative of the surrounding water bearing strata. Samples were obtained using disposable HDPE bailers, which were specifically dedicated to each well to avoid cross-contamination between sampling locations. These were disposed of following use. The groundwater samples were assessed in the field for sheens, colour and odours and particularly examined for the presence of free-phase product (*i.e.* a distinct layer of contaminated liquid).

Groundwater Field Monitoring

During the groundwater sampling, the pH, temperature, conductivity (salinity) and ORP were recorded via hand-held field instruments. The results are presented below.

Table 7.3: Groundwater Field Observations and Measurements

BH ID	Description	Electrical Conductivity (µS/m)	pH	Temp (°C)	ORP (mV)
BH01	Brown, sediment-rich	>2,000	7.78	39.4	-40
BH02	Light brown sediment-rich	>2,000	7.13	39.7	-14
BH03	Light brown sediment-rich	>2,000	7.21	36.8	21
BH04	Light brown sediment-rich	>2,000	7.29	31.9	-26
BH05	Light brown sediment-rich	>2,000	7.81	35.8	46
BH06	Light brown sediment-rich	>2,000	7.20	40.5	-16
BH07	Light brown sediment-rich	>2,000	7.76	38.5	-29

The most notable feature of these results is the very high conductivity values (beyond the upper range of the instrument), indicating saline water. The salinity has been imparted from the saline marine soils and associated evaporation and concentration of salts as well as interaction with the tidal waters of the Khor Al-Zubair (which was initially a marine lagoon).

During groundwater sampling and monitoring, no visual or olfactory evidence of hydrocarbon contamination was noted. Following purging, it was noted that a number of the boreholes were very slow to recharge (indicating a relatively inactive groundwater regime).

Groundwater Flow Direction

The surveying of the boreholes to IGRS allows the relative resting groundwater levels to be accurately calculated which permits the determination of hydraulic gradient and hence the flow direction of the groundwater body beneath the site. The resting groundwater elevations for the seven boreholes (m bgl and to IGRS) are presented in *Table 7.4*:

Table 7.4: Resting Groundwater Depths

Location	14th August 2014		28th August 2014	
	m bgl	m IGRS	m bgl	m IGRS
BH01	4.00	7.709	3.45	7.159
BH02	4.20	8.828	3.75	8.378
BH03	4.50	9.128	3.60	8.828
BH04	3.42	7.696	3.00	7.276
BH05	5.00	9.09	5.05	9.14
BH06	5.52	10.206	5.35	10.036
BH07	5.65	10.501	5.00	9.851

Based on the resting groundwater levels, as depicted in *Figures 7.2* and *7.3* overleaf, the gradient and relative elevation of the water table in each borehole does not appear to change between monitoring visits (two weeks apart). The predominant groundwater flow appears to be towards the Khor Al-Zubair (as would be expected). However, the respective elevations show a difference of almost 3m between resting water levels in BH07 and BH01. For a contiguous water body gradient over this distance such a differential would be highly unusual (normally only a few cm difference would be observed all other things being equal). It seems likely, therefore, that the groundwater exists in different perched horizons on the site and may not behave as contiguous water body interacting with the Khor Al-Zubair channel.

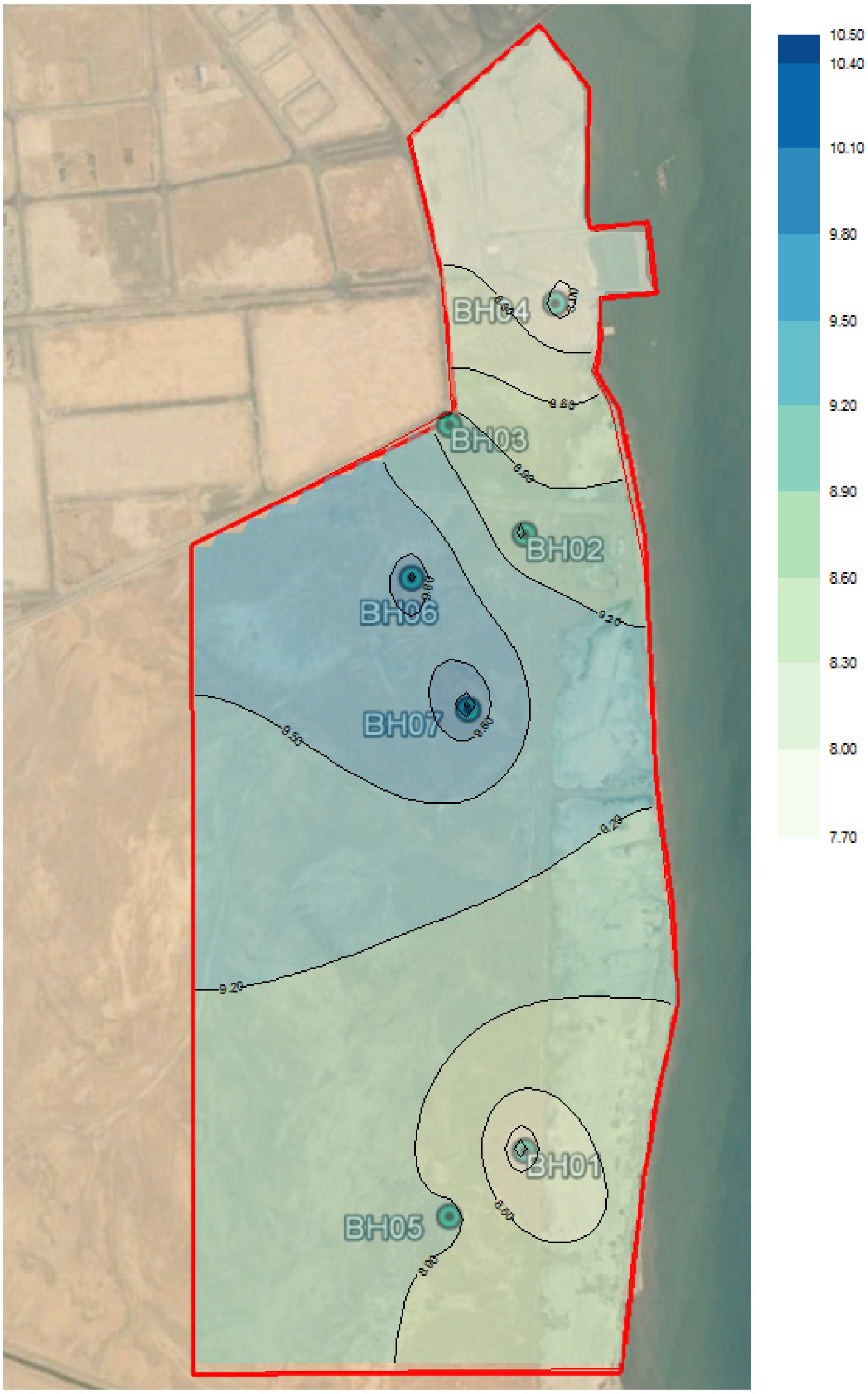


Figure 7.2: *Groundwater regime 14th August 2014*

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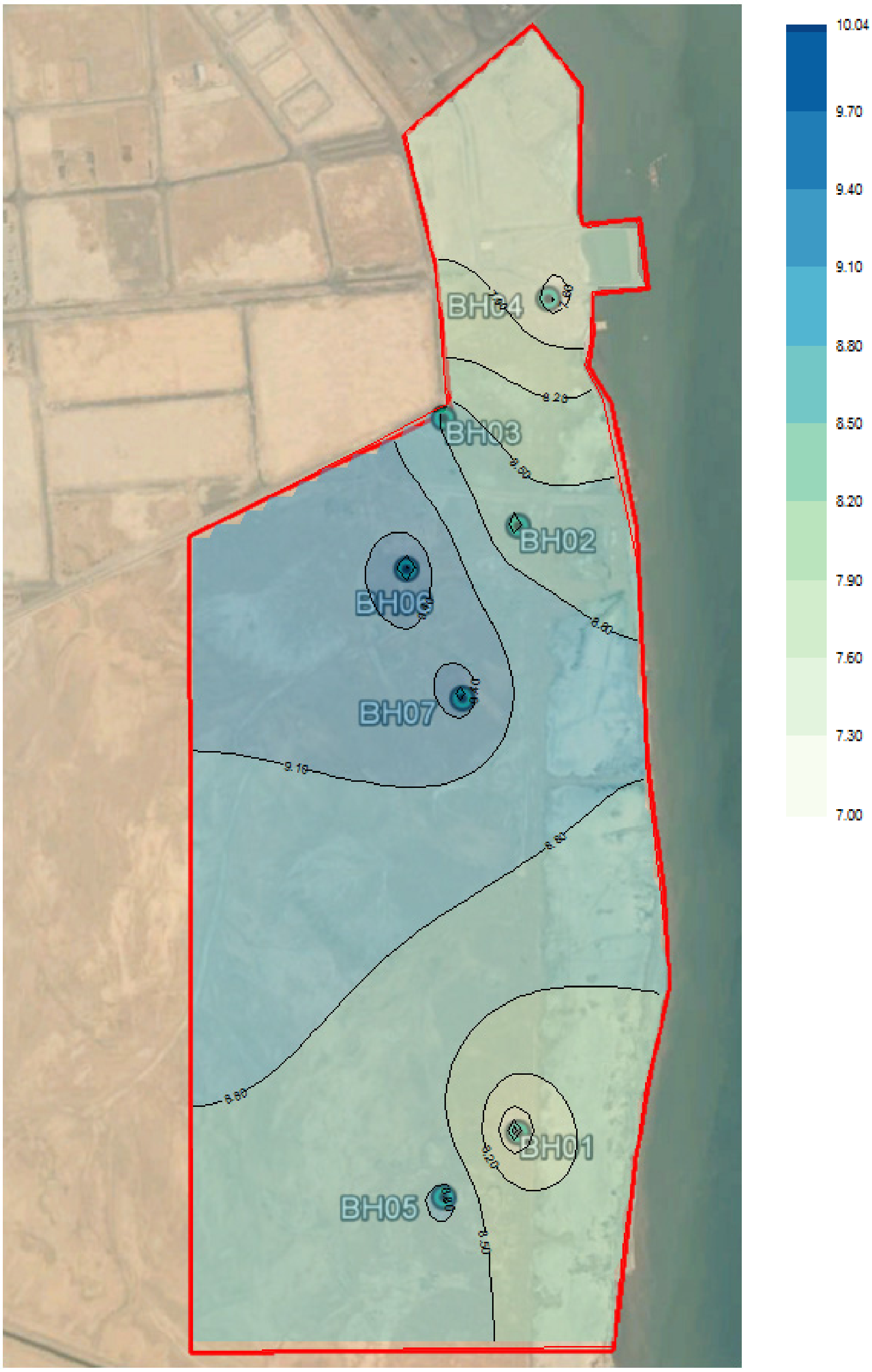

Figure 7.3: *Groundwater regime 28th August 2014*

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Groundwater Level Monitoring

In order to try and understand the relationship between groundwater and the Khor Al-Zubair channel, automatic level loggers were installed in each of boreholes. In particular this was intended to determine if the site's groundwater is tidally influenced. The level loggers were installed and operated from 28th to the 30th August 2014.

The tides in this region are termed 'irregular semi-daily tides' with two high and two low tides per day with markedly differing heights and a maximum tidal range in the order of 5m[4]. If there was a strong tidal influence on the groundwater beneath the Terminal site then a similar daily variation in groundwater level could be expected. This was not strongly observed but ignoring the water level changes at a microlevel (mm) there is an underlying rise and fall of the water level over the monitoring period (albeit only by a few millimetres). This is evident in the groundwater level data from the boreholes closest to the river, BH01 and BH02 (see *Figures 7.1* and *7.2*).

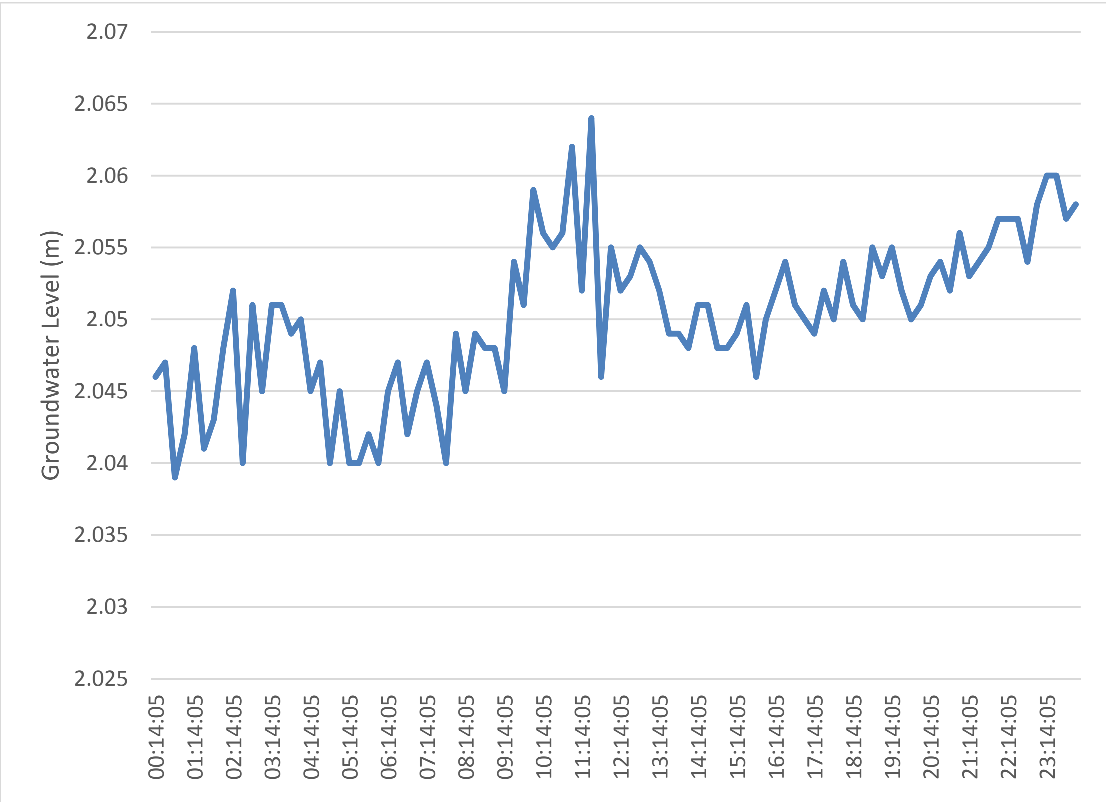

Figure 7.4: *Groundwater level data from BH01 (29th August 2014)*

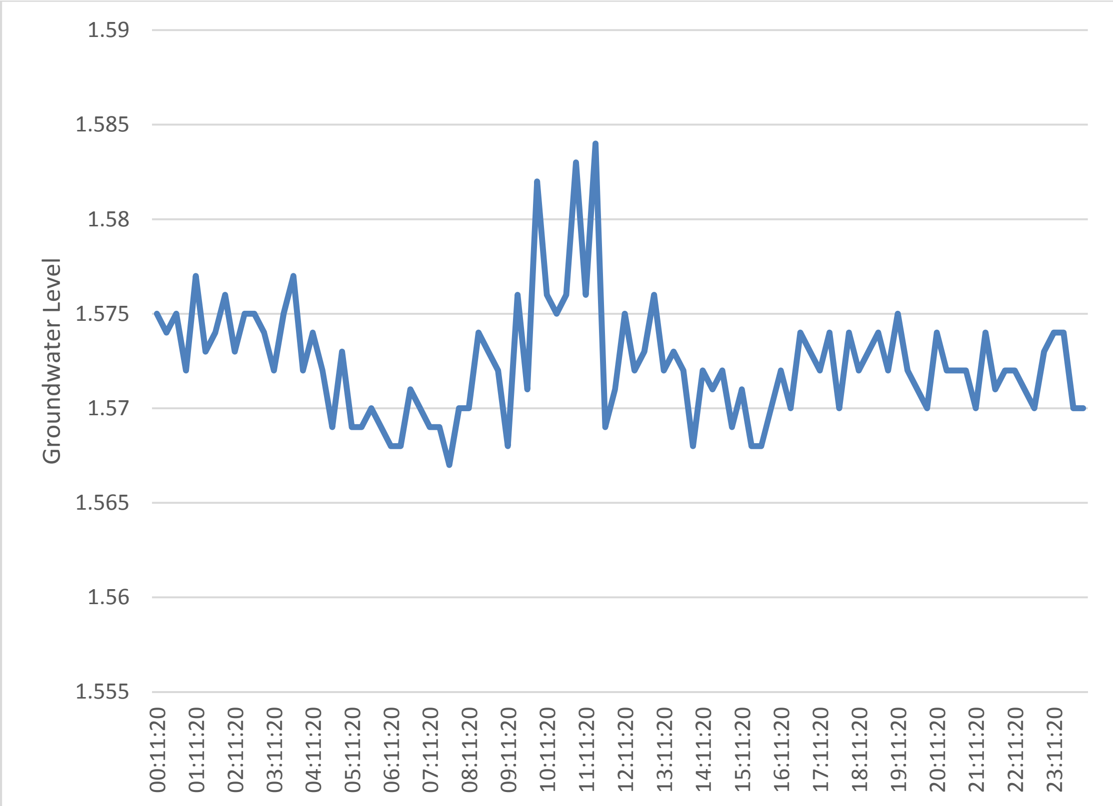

Figure 7.5: *Groundwater level data from BH02 (29th August 2014*)

The small changes in water level observed do not necessarily mean that there is direct daily interaction and transfer of water between the groundwater and Khor Al-Zubair. The small and muted tidal signature that seems to be present may simply be from increases and decreases in pore pressure in the site soils induced by the tidal fluctuations in the Khor Al-Zubair. As such, contamination of groundwater on the site would not necessarily present a migration risk to the Khor Al-Zubair and marine area.

7.4.2 Surface Water

Sampling Locations

The surface water samples were obtained from positions adjacent to the proposed Terminal development area.

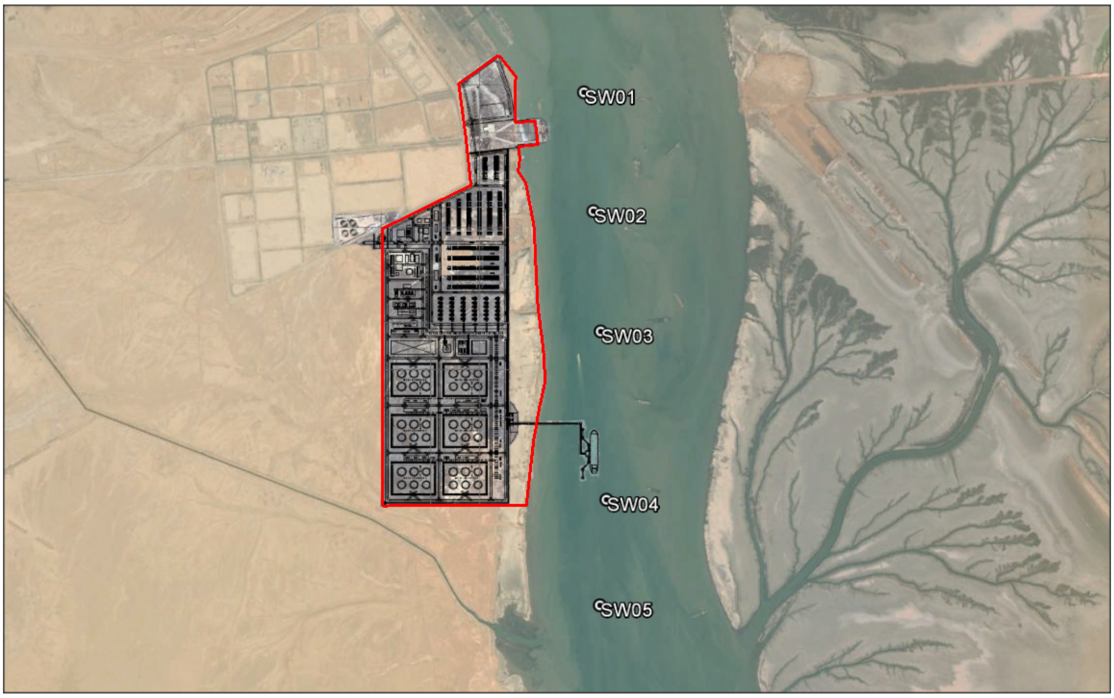

Figure 7.6: *Surface water sampling locations*

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Table 7.5: Surface Water Sampling Locations				
Location ID	**Grid Reference**	**Depth to Sea Bed (m)**	**Meteorological Information**	**Sea State**
SW01	30°10'58.12"N, 47°53'45.18"E	13.7	Sunny, windy	Choppy, 0.5m waves
SW02	30°10'41.95"N, 47°53'46.66"E	14.3	Sunny, windy	Choppy, 0.5m waves
SW03	30°10'25.60"N, 47°53'47.81"E	16.1	Sunny, windy	Choppy, 0.5m waves
SW04	30°10'2.73"N, 47°53'48.72"E	11.00	Sunny, windy	Choppy, 0.5m waves
SW05	30° 9'48.38"N, 47°53'47.68"E	12.00	Sunny, windy	Choppy, 0.5m waves

The river conditions during the sampling was choppy with 0.5m waves as a result of the strong *Shamal* winds which are typical of this time of the year. The water was notably turbid.

Field Observations and Measurements

The surface water samples, obtained from two different depths, were collected using a Niskin Water Sampler on the 13th September 2014. The sampling was undertaken on a suitable vessel which had been audited and pre-approved by EAME.

Table 7.6: Surface Water Sampling - Field Observations and Measurements

Location ID	Depth (m)	Coliform Count (cfu/100ml)	Secchi Depth (m)	Water Colour
SW01	1.0	23,750	0.15	XV 86% Green, 14% Brown
	12.7	23,350		
SW02	1.0	23,300	0.35	XV 86% Green, 14% Brown
	13.3	26,600		
SW03	1.0	24,900	0.15	XV 86% Green, 14% Brown
	15.1	25,300		
SW04	1.0	23,650	0.30	XV 86% Green, 14% Brown
	10.0	22,150		
SW05	1.0	26,650	0.20	XV 86% Green, 14% Brown
	11.0	21,200		

The coliform count plate was prepared in the field and immediately placed in an incubator for 24 hours. This technique gives the total coliforms for a 2ml sample of water.

Although the total coliform count does not differentiate between coliform types, *i.e.* innocuous coliforms and faecal coliforms (such as *E.Coli*), it would be expected that due to the lack of proper sanitation in Iraq, faecal coliforms are likely to represent a significant proportion of the overall coliform count. The EU Directive 2006/7/EC concerning the management of bathing water quality sets the following classification thresholds:

- Inland waters

Intestinal enterococci – Excellent (200 cfu/100ml), Good (400 cfu/100ml), Sufficient (330 cfu/100ml)

Escherichia coli – Excellent (500 cfu/100ml), Good (1000 cfu/100ml), Sufficient (900 cfu/100ml)

- Coastal and transitional waters

Intestinal enterococci – Excellent (100 cfu/100ml), Good (200 cfu/100ml), Sufficient (185 cfu/100ml)

Escherichia coli – Excellent (250 cfu/100ml), Good (500 cfu/100ml), Sufficient (500 cfu/100ml)

The excellent and good classifications are based upon a 95-percentile evaluation whilst the sufficient classification is based upon a 90-percentile evaluation.

Although the EU guideline values have no jurisdiction in Iraq, it is clear to see that the total coliform values observed in the channel hugely exceed by orders of magnitude even the "sufficient" criteria applied in the EU. Consequently, the waters of the Khor Al-Zubair should be regarded as polluted from a coliform perspective. This is not surprising given the discharge of raw or poorly treated sewage and agricultural run-off that occurs into the channels that ultimately flow into the Khor Al Zubair.

Water Quality Field Monitoring Data

In addition, at the same time as the water sampling, EAME also used a Xylem EXO sensor to record in-situ water quality data. This is presented below.

Table 7.7: SW01 Physico-chemical In-situ Water Quality Data

Depth (m)	Temp (°C)	Cond (µS/cm)	TDS (mg/l)	Sal (psu)	ODO (mg/l)	pH	ORP (mV)	Turbidity (FNU)
0.133	28.137	44,172.6	27,089	26.64	5.26	8.09	124.2	226.97
0.165	28.202	45,715.3	28,002	27.64	5.9	8.72	95.5	221.87
1.203	28.167	45,509.1	27,893	27.52	5.68	8.29	128.6	224.68
1.327	28.143	44,217.1	27,113	26.67	5.26	8.1	124.3	227.2
1.742	28.14	44,334.2	27,187	26.75	5.26	8.1	124.7	224.57
2.914	28.145	44,268.7	27,144	26.7	5.27	8.1	124.4	230.31

Table 7.7: SW01 Physico-chemical In-situ Water Quality Data								
Depth (m)	Temp (°C)	Cond (µS/cm)	TDS (mg/l)	Sal (psu)	ODO (mg/l)	pH	ORP (mV)	Turbidity (FNU)
3.246	28.141	44,286.9	27,158	26.71	5.26	8.1	124.6	229.87
4.287	28.161	45,359.8	27,805	27.42	5.52	8.17	130.8	225.24
5.529	28.152	45,271.1	27,755	27.37	5.45	8.16	130.8	241.26
6.319	28.165	45,127.3	27,660	27.26	5.36	8.14	129.3	231.15
7.577	28.16	44,505.4	27,282	26.85	5.28	8.11	125.3	227.56
8.145	28.153	44,992.7	27,584	27.18	5.34	8.14	128.6	233.62
9.444	28.159	44,896.4	27,522	27.11	5.3	8.13	127.7	230.61
10.067	28.185	44,704.6	27,391	26.97	5.28	8.11	125.8	255.62
11.235	28.174	44,795.4	27,453	27.04	5.29	8.12	127	236.73
12.39	28.187	44,782.9	27,438	27.02	5.28	8.12	126.6	250.85

Table 7.8: SW02 Physico-chemical In-situ Water Quality Data								
Depth (m)	Temp (°C)	Cond (µS/cm)	TDS (mg/l)	Sal (psu)	ODO (mg/l)	pH	ORP (mV)	Turbidity (FNU)
0.127	27.807	42,789.4	26,398	25.89	4.99	8.03	180.3	309.4
1.509	27.924	43,581	26,829	26.36	5.23	8.08	193.9	250.81
2.393	27.924	43,442.8	26,744	26.27	5.13	8.08	190.7	275.99
3.56	27.922	43,399.1	26,718	26.24	5.11	8.07	189.7	280.84
4.54	27.904	43,340.6	26,691	26.21	5.1	8.07	188.9	355.75
5.014	27.818	42,824.2	26,414	25.91	4.97	8.03	180.8	330.51
6.04	27.902	43,198.3	26,604	26.11	5.04	8.06	185.9	339.02
7.439	27.892	43,123.7	26,563	26.07	5.03	8.06	184.8	346.6
8.813	27.884	43,074.9	26,537	26.04	5.01	8.05	183.9	357.23
9.981	27.834	42,885.7	26,443	25.94	4.98	8.04	181.2	348.14

Table 7.8: SW02 Physico-chemical In-situ Water Quality Data

Depth (m)	Temp (°C)	Cond (µS/cm)	TDS (mg/l)	Sal (psu)	ODO (mg/l)	pH	ORP (mV)	Turbidity (FNU)
10.009	27.871	43,028.8	26,515	26.02	5	8.05	183.4	346.67
11.116	27.887	43,023.7	26,503	26	5.01	8.04	182.6	331.54
12.096	27.878	43,005.9	26,496	26	5.01	8.05	181.9	325.31
13.168	27.831	42,889.6	26,448	25.95	5	8.04	181.5	342.79

Table 7.9: SW03 Physico-chemical In-situ Water Quality Data

Depth (m)	Temp (°C)	Cond (µS/cm)	TDS (mg/l)	Sal (psu)	ODO (mg/l)	pH	ORP (mV)	Turbidity (FNU)
0.522	27.346	42,184.1	26,244	25.74	4.98	8.08	19.1	109.1
1.61	27.355	41,858.6	26,037	25.51	4.96	8.06	21.8	110.59
3.829	27.345	42,342.9	26,343	25.84	5	8.09	17.5	108.57
5.905	27.363	41,934.4	26,080	25.56	4.95	8.04	25	110.33
7.199	27.363	41,825.9	26,013	25.48	4.93	8.03	27.8	112.41
9.469	27.362	41,741.3	25,961	25.43	4.92	8.02	30.2	109.92
11.632	27.368	41,656	25,905	25.37	4.93	8.01	34.9	108.44
13.875	27.365	41,691.1	25,928	25.39	4.92	8.01	32.6	110.59
15.224	27.367	41,667.8	25,913	25.37	4.91	8.01	33.9	109.91

A malfunction occurred with the sensor at SW04 (which was the final location surveyed) and no data was recorded.

Table 7.10: SW05 Physico-chemical In-situ Water Quality Data

Depth (m)	Temp (°C)	Cond (µS/cm)	TDS (mg/l)	Sal (psu)	ODO (mg/l)	pH	ORP (mV)	Turbidity (FNU)
0.17	26.962	54,782.2	34,322	34.76	4.91	7.94	196.2	98.53

Table 7.10: SW05 Physico-chemical In-situ Water Quality Data

Depth (m)	Temp (°C)	Cond (µS/cm)	TDS (mg/l)	Sal (psu)	ODO (mg/l)	pH	ORP (mV)	Turbidity (FNU)
0.198	26.942	54,731.7	34,303	34.74	5.12	7.93	200.1	94.31
0.319	26.981	54,830	34,340	34.78	4.81	7.94	193.1	95.07
0.524	26.988	54,852.1	34,350	34.79	4.78	7.94	191.5	95.26
1.232	26.998	54,899.3	34,374	34.81	4.76	7.94	190.1	110.58
1.829	27.000	54,902.4	34,373	34.81	4.73	7.94	185.9	105.61
2.926	27.014	54,964.9	34,404	34.85	4.7	7.94	184.7	105.8
3.992	27.039	55,040.4	34,435	34.88	4.66	7.93	182.4	113.92
4.632	27.035	55,030.6	34,432	34.88	4.64	7.93	181.3	123.87
5.808	27.045	55,070.2	34,450	34.9	4.64	7.93	180.2	141.26
6.118	27.050	55,095.6	34,463	34.91	4.63	7.93	179.7	178.16
6.21	27.034	55,032.4	34,433	34.88	4.61	7.93	177.6	154.08
6.321	27.058	55,121.3	34,474	34.92	4.61	7.93	176.2	217.59
6.515	27.049	55,088.5	34,459	34.91	4.61	7.93	174.7	148.1
7.423	27.059	55,149.8	34,491	34.94	4.58	7.93	174.3	236.93
8.185	27.059	55,164	34,500	34.95	4.57	7.93	173	310.45
9.168	27.060	55,192.1	34,517	34.97	4.56	7.93	172.1	818.38
10.313	27.370	32,186.3	20,028	19.08	3.56	7.61	47.5	262.44

The results from the in-situ measurements appear to be relatively consistent and do not indicate that there is stratification of the water, rather there seems to be a good level of mixing (which again would be expected for a river with two strong tides and a large tidal range where extensive mixing would be promoted).

7.5 Baseline Conditions – Chemical Contamination

7.5.1 Groundwater

Analytical Strategy

A groundwater sample from each borehole was submitted for chemical analysis. The analytical strategy was designed to provide an assessment of the presence of a common range of potential contaminants.

Table 7.11: Groundwater Analytical Strategy

Parameter	Rationale
General Inorganics pH, Electrical Conductivity, Salinity, Total Cyanide, Complex Cyanide, Free Cyanide, Sulphate as SO_4, Chloride, Phosphate as PO_4, Phosphate as P, Ammonia as NH_3, Total Nitrogen (Kjeldahl), Nitrate as N, Nitrate as NO_3, Nitrite as N, Nitrite as NO_2,	Commonly associated with industrial sites
Total Phenols (Monohydric)	Commonly associated with industrial sites
Heavy Metals and Metalloids	Commonly associated with industrial sites.
Monoaromatics	
TPH (C_{10} – C_{40})	Targeted analysis for fuels and oils
VOCs	Targeted analysis for fuels and oils
SVOCs	Targeted analysis for PAH compounds and phenols
Radiation Screening	Targeted analysis for NORMs

Assessment of Analytical Results

The first stage of assessment was to screen out those compounds that were not present above the MDL of the laboratory. These are provided in the list below, and have thus not been considered further within the assessment.

- Cyanide (Total, Complex and Free);

- Phosphate as PO_4;
- Phosphate as P;
- Total Phenols (monohydric);
- Hexavalent Chromium; and
- Monoaromatics.

The remaining results are presented in *Appendix H1* and summarised in *Table 7.12*.

Table 7.12: Summary of Groundwater Analytical Results

Parameter	Concentration Range (µg/l)	Guideline Value	No. of Exceedances Above Guideline Value
General Inorganics			
pH	7.5 – 8.5	6.5 – 8.5*[1]	0
Electrical Conductivity	17,000 – 120,000 µS/cm	NG	-
Salinity	11.2 - >42 ppt	NG	-
Sulphate as SO_4	722,000 – 2,470,000	250,000*[1]	**All**
Chloride	4,100 – 45,000 mg/l	250 mg/l*[1]	**All**
Ammonia as NH_3	780 – 6,000	NG	-
Total Nitrogen (Kjeldahl)	3.2 – 5.4	NG	-
Nitrate as N	<MDL – 1.2 mg/l	11mg/l*[2]	0
Nitrate as NO_3	<MDL – 5.4 mg/l	50 mg/l*[1]	0
Nitrite as N	<MDL – 970	900*[2]	**2 – BH04 and BH06**
Nitrite as NO_2	<MDL – 3,200	3,000*[1]	**2 – BH04 and BH06**
Heavy Metals / Metalloids			
Arsenic (dissolved)	1.05 – 3.57	10*[1]	0
Cadmium (dissolved)	<MDL – 0.23	300*[1]	0
Iron (dissolved)	5 – 67 mg/l	300*[1]	0
Lead (dissolved)	0.4 – 1.5	10*[1]	0

Table 7.12: Summary of Groundwater Analytical Results			
Parameter	**Concentration Range (µg/l)**	**Guideline Value**	**No. of Exceedances Above Guideline Value**
Manganese (dissolved)	68 - 710	400 *2	**2 – BH02 and BH07**
Mercury (dissolved)	<MDL – 1.32	1*1	**2 – BH03 and BH05**
Nickel (dissolved)	9 – 23	20*1	**1 - BH07**
Tin (dissolved)	<MDL – 1.2	NG	-
Zinc (dissolved)	1.6 – 5.7	3,000*1	0
Petroleum Hydrocarbons			
TPH $C_{10} – C_{40}$	<MDL – 1,120	NG	-
VOCs			
1,2-dichloroethane	638 – 990	NG	-
SVOCs			
2-Methylnaphthalene	<MDL – 0.84	NG	-
Dimethylphthalate	<MDL – 2.0	NG	-
Diethyl phthalate	<MDL – 0.13	NG	-

Notes:
All results expressed in µg/l except for pH and where indicated
<MDL = Below the Method Detection Limit
NG = No guideline value calculated
- = Not relevant
*1 = Iraqi Drinking Water Standards (2001)
*2 = World Health Organisation (WHO) Guidelines for Drinking Water Quality

Summary of Groundwater Quality Baseline Conditions

A number of contaminants were found to be elevated when compared to relevant guideline values including sulphate, chloride, nitrate, manganese, mercury and nickel.

The elevated sulphate, chloride and manganese concentrations were not unexpected due to the hypersaline marine environment of the site and such levels are considered natural in this environment.

The elevated mercury may be a result of its natural occurrence in the environment, significant mercury deposits exist in the Alpine – Himalayan orogenic belt[3] but there could also be an anthropogenic contribution from nearby industrial emissions. Similarly Nickel could be both natural and anthropogenic in origin.

TPH was noted, above laboratory's level of detection, in three boreholes, BH01, BH05 and BH06. No hydrocarbon contamination was noted in the soil samples or observed on-site, which suggests that the hydrocarbons observed may the remnants of historic contamination that may have occurred on the site. The levels are not considered to be problematic.

One VOC, 1,2-dichloroethane, was detected in all seven groundwater samples and the highest concentration was detected in BH02. This compound is added to leaded gasoline as a lead scavenger. This implies a generally low level of contamination throughout the groundwater body.

In total, three SVOCs were detected in the groundwater samples:

- 2-Methylnaphthalene, a natural component of crude oil and coal and is found in pyrolysis,combustion products such as used oils and emissions from combustion engines, was detected in BH05, BH06 and BH07;
- Diethyl phthalate (DEP) was detected in the sample obtained from BH07 only. This compound is a solvent most commonly used to make plastics more flexible; and
- Dimethyl phthalate (DMP) was detected in BH01, BH02, BH04, BH05 and BH07. DMP has many uses including in solid rocket propellants, lacquers, plastics, safety glasses, rubber coating agents, molding powders, insect repellents and pesticides.

Again the presence of these substances at these levels are not considered to be problematic but it is indicative of low levels of contamination.

[3] GESAMP: Arsenic, Mercury and Selenium in the Marine Environment, UNEP Regional Seas Reports and Studies No 92, UNEP, 1988

7.5.2 Surface Water

Analytical Strategy

The analytical strategy was designed by EAME to provide an assessment of the presence of a common range of potential contaminants.

Table 7.13: Surface Water Analytical Strategy

Parameter	Rationale
General Inorganics pH, Electrical Conductivity, Salinity, Total Cyanide, Complex Cyanide, Free Cyanide, Sulphate as SO_4, Chloride, Phosphate as PO_4, Phosphate as P, Total Nitrogen (Kjedahl), Nitrate as N, Nitrate as NO_3, Nitrite as N, Nitrite as NO_2	General indicators of water quality
Total Phenols (Monohydric)	General indicator of water quality
Speciated Total PAHs	Speciated suite to determine the presence of fuel derivatives and associated compounds
Heavy Metals and Metalloids	General indicator of water quality
TPH (C_{10} – C_{40})	Targeted analysis for fuels and oils

Assessment of Analytical Results

EAME has undertaken a tiered approach in order to provide a preliminary qualitative assessment of the sediment and surface water analytical results.

The first stage of assessment was to screen out those compounds that were not present above the method detection limit (MDL) of the laboratory. These are provided in the list below, and have thus not been considered further within the assessment:

- Cyanide (total, complex and free);
- Nitrite as N;
- Nitrite as NO_2;

- Total phenols (monohydric);
- Total EPA-16 PAHs;
- Chromium (hexavalent); and
- TPH (C_{10} – C_{40}).

The remaining results are presented in *Appendix H2* and summarised in *Table 7.14*.

Table 7.14: Summary of Surface Water Analytical Results

Parameter	Concentration Range (µg/l)	Guideline Value	No. of Exceedances Above Guideline Value
General Inorganics			
pH	7.8 – 7.9	6.5 – 8.5*1	0
Electrical Conductivity	50,000 – 74,000 µS/cm	NG	-
Salinity	36.7 - >42 ppt	NG	-
Sulphate as SO_4	3,810,000 – 5,020,000	200,000*1	**All**
Chloride	11,000 – 17,000 mg/l	200 mg/l*1	**All**
Phosphate as PO_4	<MDL - 62	NG	-
Phosphate as P	<MDL - 20	NG	-
Total Nitrogen (Kjeldahl)	1.4 – 7.3	10*2	0
Nitrate as N	<MDL – 0.4 mg/l	15 mg/l*1	0
Nitrate as NO_3	<MDL – 1.9 mg/l	15 mg/l*1	0
Heavy Metals / Metalloids			
Arsenic (dissolved)	342 – 5.04	50*1	0
Cadmium (dissolved)	<MDL – 0.05	5*1	0
Copper (dissolved)	11 - 19	50*1	0
Iron (dissolved)	0.015 – 0.026 mg/l	0.3 mg/l*1	0
Lead (dissolved)	0.5 – 5.9	50*1	0
Manganese (dissolved)	0.31 - 1.3	10*1	0

Table 7.14: Summary of Surface Water Analytical Results

Parameter	Concentration Range (µg/l)	Guideline Value	No. of Exceedances Above Guideline Value
Mercury (dissolved)	1.02 – 1.45	1*1	**All**
Nickel (dissolved)	2.9 – 4.9	10*1	0
Tin (dissolved)	<MDL – 0.6	NG	-
Zinc (dissolved)	3.1 - 13	50*1	0

Notes:

All results expressed in µg/l except for pH and where indicated

<MDL = Below the Method Detection Limit

NG = No guideline value calculated

- = Not relevant

*1 = The New Determinants for the Prevention of Pollution of Rivers (No. 25, 1967)

*2 = US EPA Drinking Water Guideline

Based on the above factors, an initial qualitative assessment of the presence of potential pollutant linkages can be undertaken.

Conceptual Site Model

The ground and surface water conditions, as determined through the site investigation process, have been summarised into a Conceptual Site Model (CSM), which defines the key sources, pathways and receptors that have been identified as being relevant to this site. The CSM within this chapter summarises the following:

- **SOURCES** - the identification of contaminants within the ground and surface water that represent potential pollution sources;
- **PATHWAYS** - the identification of the potential exposure pathways between the potential sources;
- **RECEPTORS** - the identification of the potential receptors for the contamination; and
- **LINKAGES** - the identification of potential pollutant linkages.

All discussions in this section have been made in relation to the site's proposed industrial/commercial setting.

Identification of Potential Sources

Based on the information gained during the desk study and field work, a summary of the contaminant sources is outlined below:

- **Surface Water:** All ten samples were found to have elevated concentrations, above the relevant guideline values of sulphate, chloride and mercury; and

- **Groundwater:** A number of contaminants were found to be elevated under relevant guideline values including sulphate, chloride, nitrate, manganese, mercury and nickel. In addition, TPH was noted, above laboratory's level of detection, in three boreholes. One VOC, 1,2-dichloroethane, was detected in all seven groundwater samples and the highest concentration was detected in BH02. In total, three SVOCs were detected in the groundwater samples; 2-Methylnaphthalene, Diethyl phthalate (DEP) and Dimethyl phthalate (DMP).

In addition to the limited potential pollution sources that already exist on and around the site, the following potential sources of pollution that may arise as a result of the construction and operational phases of the proposed development have been identified.

Table 7.15: Potential Future Sources of Water Pollution

Construction Phase	Operational Phase
Spillages of polluting materials during construction activities (e.g. fuel spills during plant refuelling)	Increased surface water run-off (which although should be clean rainwater, could pick up contaminants if housekeeping on the site is poor or spillages have occurred, such as fuel and oil leaks from parked vehicles)
Dewatering of contaminated groundwater from excavations and the associated generation of large volumes of potentially contaminated water	Increased wastewater from sanitary usage. In addition, there is the potential for vehicle washing to be undertaken on site
	Storage of refined petroleum products
	Transfer of refined petroleum products

Potential Receptors

Accepting that the potential pollution sources are well understood, the following project related receptors, with regards to water quality, have been identified:

- groundwater underlying the site;
- surface water *(i.e*. Khor Al-Zubair);
- ecological diversity in the receiving waters could also be impacted by certain contaminants that could render the water quality incapable of supporting pollution intolerant species;
- river users (current and future);
- construction workers (when construction commences);
- on-site buildings and services (when construction commences); and
- third party land (*i.e.* the possibility of contamination migrating off-site onto third adjacent land *via* contaminated surface water and groundwater or run-off).

Identification of Potential Exposure Pathways

Exposure pathways are the potential routes and mechanisms by which potential on-site sources could be linked to the identified potential receptors and thereby expose them to potential harm. **Only plausible pathways need be considered**. The following potential pollutant pathways, with regards to water quality, have been identified at the site:

- Dermal;
- Ingestion;
- Migration of contaminants to shallow groundwater bodies and aquifer and to surface water *via* leaching and run-off, or transmission along conduits;
- Spillages and infrastructure failure; and
- Cross contamination of water bodies and soil contaminants through piling activities.

Potential Pollutant Linkages

In order for there to be a plausible pollutant linkage there must be a source, receptor and pathway and a feasible linkage between them (a so called pollutant linkage). Consequently, even where a contaminant is identified, if there is no pathway for the contamination to reach a receptor, or no receptor then there can be no significant risk and remedial actions are not required. Furthermore, even if there is a complete pollutant linkage, it is possible that the contaminant concentration that can pass along the linkage does not represent a significant risk to human health or the environment. Central to this risk assessment process is the development of a 'conceptual model'. This is a descriptive and/or pictorial representation of the area of potential contamination, the surrounding environment and the processes acting on the contaminants by which they can move and come into contact with receptors (*e.g.* by leaching and migration into groundwater).

Production of a conceptual model requires an assessment of risk to be made. Risk is a combination of the likelihood of an event occurring and the magnitude of its consequences. Therefore, in order to assess risk both the likelihood and the consequences of an event must be taken into account. This report adopts the methodology for risk evaluation presented in CIRIA report C552[4]. The method is qualitative and involves the classification of the following:

- the magnitude of the potential severity or consequence of the risk occurring (*Table 7.16*);
- the magnitude of the likelihood or probability of the risk occurring (*Table 7.17*); and
- once the likelihood of an event occurring and its severity have been classified, a risk category can be assigned using *Table 7.18*.

[4] Contaminated Land Risk Assessment – A Guide to Good Practice, CIRIA report C552 2001

Table 7.16: Classification of Consequence

Consequence	Definition
Severe	Short term (acute) risk to human health likely to result in 'significant harm' as defined by the Environment Protection Act 1990, Part IIA. Short term risk of (significant) pollution of sensitive water resource. Catastrophic damage to building/property. A short term risk to a particular ecosystem, or organism forming part of such ecosystem.
Medium	Chronic damage to human health (significant harm). Pollution of sensitive water resources. A significant change in a particular ecosystem, or an organism forming part of such an ecosystem.
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.
Minor	Harm, although not necessarily significant harm, which may results in a financial loss, or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing etc.). Easily repairable effects of damage to buildings, structures and services.

Table 7.17: Classification of Probability

Likelihood	Definition
High	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollutant linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period that such an event would take place and is even less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

Table 7.18: Risk Assessment Matrix

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Likelihood of Occurrence	**High**	Very High	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low	Moderate	Moderate/Low	Low	Very Low
	Unlikely	Moderate/Low	Low	Very Low	Very Low

EAME has devised a conceptual model based on the information obtained through the site investigation and is based on future commercial/industrial redevelopment. This is detailed in tabular format in *Table 7.19*.

Table 7.19: Conceptual Site Model

Source			
(A) **Groundwater:** Elevated concentrations of sulphate, chloride, nitrate, manganese, mercury and nickel. In addition, TPH was noted, above laboratory's level of detection, in three boreholes. One VOC, 1,2-dichloroethane, was detected in all seven groundwater samples. In total, three SVOCs were detected in the groundwater samples; 2-Methylnaphthalene, DEP and DMP. (B) **Surface Water:** Samples were found to have elevated concentrations of sulphate, chloride and mercury.			
Source	**Pathway**	**Receptor**	**Potential Pollutant Linkage and Significance**

Table 7.19: Conceptual Site Model

(A)	Cross contamination between groundwater bodies due to the piling exercise Direct leaching into groundwater from contaminated soils	**Controlled Waters (CWR)** On-site groundwater bodies	**CWR – Low Risk** Limited contamination noted
(A)	Direct contact with building materials	**Built Environment (BER)** On-site buildings and services	**BER – Low Risk** Limited contamination noted although the high sulphate and chloride content of this saline/marine environment may be aggressive towards building materials.
(B)	Cross contamination between groundwater and surface water	**Ecosystems (ESR)** Ecology of Khor Al-Zubair	**ESR – Low Risk** Groundwater and surface water do not appear to be in dynamic hydraulic conductivity and transfer of pollutants between them is unlikely.
(B)	Direct leaching into Khor Al-Zubair from contaminated soils Contaminated water run-off during construction and operational phases Increased waste water consumption	**Controlled Waters (CWR)** Surface water bodies (i.e. Khor Al-Zubair)	**CWR - Low risk** No significant soil contamination was noted.

Table 7.19: Conceptual Site Model			
(A) (B)	Spillages during operational phase	**Built Environment (BER)** On-site buildings and services **Human Health (HHR)** Future site users **Controlled Waters (CWR)** Surface water bodies (i.e. Khor Al-Zubair)	**BER – Low Risk** Appropriate industry standard pollution prevention and housekeeping protocols to be implemented **HHR – Low Risk** Appropriate industry standard pollution prevention and housekeeping protocols to be implemented **CWR – Low Risk** Appropriate industry standard pollution prevention and housekeeping protocols to be implemented
(A) (B)	Dermal, Ingestion	**Human Health (HHR)** River users (current and future) Construction workers	**HHR – Low Risk** Limited contamination noted Appropriate PPE to be utilised by construction workers

Summary of Chemical Surface Water Baseline Conditions

In summary, all ten samples were found to have elevated concentrations of sulphate and chloride, above the relevant guideline values, but this is effectively a marine environment so such high levels are natural and to be expected.

In terms of potential contamination, elevated concentrations of mercury were noted in all ten samples. These concentrations could be the result of natural accumulations in the environment (of geological origin) but may also be related to anthropogenic sources given the proximity of a port, heavy industry and major city, with limited pollution control measures employed.

Overall, whilst some elevated concentrations of certain species have been observed and the water quality of the Khor Al-Zubair channel is clearly impacted by coliforms, the site is not regarded as a contaminated and the levels of contaminants observed are not considered to be significant. Other than the potential for the high sulphate and chloride levels in the soils and groundwater (and of course river water) to be aggressive towards construction materials (concrete), the chemical conditions of the groundwater and river water are not considered to be problematic from a development perspective

7.6 Impact Assessment

The impact assessment in the context of an ESIA, considers the potential for the development proposals to impact on the baseline conditions. The groundwater and surface water within the development area can be regarded as uncontaminated on the whole.

Based upon this conceptual model, the following discussion addresses the impact assessment for the site, based on the current understanding and whether plausible pollutant linkages are likely to be created by the proposed development and lead to significant impacts.

Potential Risks to the Groundwater and Surface Water – Construction Phase

The proposed development is unlikely to significantly impact on the baseline groundwater environment under normal operating conditions (abnormal conditions are dealt with in *Chapter 10*). The risk of accidental spillage of pollutants to ground during the construction phase will be controlled by the implementation of a Construction Environmental Management Plan (CEMP). Any uncontrolled releases of potential contaminants to ground will be managed through the pollution response plan in the CEMP and any impacted area will be remediated. Furthermore, no significant mobile contamination source was observed on the site that could be mobilised by earthworks or piling works. It is recognised, however, that any site investigation is a limited sampling exercise and that there is a possibility of pockets of contamination existing in parts of the site that have not been investigated. Consequently there is a small potential for piling and earthworks impacts if such areas exist and are disturbed.

Environmental Implications of Piling

In impact terms, the principal concerns with piling are:

- piling equipment can generate both noise and vibration that could be evident off-site (this is dealt with in the air quality chapter);
- certain piling methods can bring spoil (some of which may be contaminated) to the surface and other methods may drive contaminated soil down into deeper horizons where it would not have previously existed and those expose groundwater to it; and
- any piling method that passes through contaminated ground or groundwater into underlying uncontaminated strata creates a potential pathway for downward migration of contaminants (i.e. can cross-contaminate previously uncontaminated ground or

groundwater) by allowing contaminated water to drain along the sides of the pile into deeper strata.

It is understood that KZP used 24m deep piles for the berth construction and a similar depth of pile can be anticipated here. The evidence of the site investigation would suggest that the site is not particularly contaminated and there is a low likelihood of contamination been dragged into the deeper groundwater horizons. If any contamination does exist on the site it is likely to be in the near surface zone. If the piling is achieved by pre-cast driven piles, the potential for cross contamination is further reduced. If augered piles are used, these bring material to the surface and thus would also convey contamination to the surface rather than down into deeper groundwater bodies, but the open pile hole does provide a temporary (albeit limited) conduit for cross contamination temporarily (if mobile contamination existed).

The potential for impact from the construction activities does exist but the works will be undertaken under a CEMP and the likelihood of significant impact on groundwater and surface water quality is **Low**.

Potential Risks to the Groundwater and Surface Water – Operational Phase

The developed and operational site will involve the storage and transfer of large volumes of potentially polluting hydrocarbon products across the marine, inter-tidal and land zones. This means there is the potential for substantial releases of these substances from the site. This could have a major impact on soil, groundwater and surface water quality if it occurs. Large scale accidents and incidents and their associated impacts are addressed in *Chapter 10*. Under normal operating conditions, the storage areas will be bunded (secondary containment), the pipelines and transfer systems will be monitored and surveyed regularly and will be operated by trained personnel and all of the equipment will be designed and built to international standards. The operators will also have a comprehensive preventive maintenance programme for all critical infrastructure, plant and equipment. Bearing all of this in mind, the potential impact on groundwater and surface water quality during normal operating conditions is **low**.

The remaining impact consideration is physical disturbance of the groundwater and surface water regimes by the built development.

The surfacing of the site and installation of surface water drainage systems will effectively prevent future percolation and infiltration of rainwater into the ground and thus may limit groundwater recharge where the site has been hard surfaced. This area, however, is very small in surface area and rainfall in this region is very low. Compared to the surrounding unsurfaced land limiting effect on groundwater re-charge will be **negligible**.

The other main area of interaction between the operational development and the water environment will be the placement of piles and the jetty structures in the river channel itself. These could potentially interrupt currents and tidal flows but the relative cross sectional area of these structures compared to the river flow will be very low. The main impact will be localised transient eddy currents and vortices around the legs of the jetty. The overall impact on the tidal currents and flows will be **negligible** as the water will be able to pass around the structures and will not be impeded by them.

Closure and Decommissioning

When the proposed Terminal is closed and decommissioned (and possibly demolished), there may be impacts associated with this. The activities that would typically be involved in the closure and decommissioning of such a facility would be similar to those during construction, involving plant and machinery, earthworks, materials movement and management. Likewise, therefore, the impacts would be similar. It is unlikely that a site such as this would be returned to the status of the present undeveloped site. Whilst potentially polluting materials and valuable or recyclable infrastructure (for example, tanks, pipes, scrap metal, machinery, plant) will be removed, the major structures (concrete, berths, drainage systems, walls, fences, etc) would be unlikely to be removed. In all likelihood, the site would probably be re-used for alternative uses or redeveloped. As such the extent of the works and associated traffic and construction type activities (machinery, earthworks, etc) associated with closure of the facility, whilst similar in nature to the construction activities, are expected to be lesser in scale and duration, as would be the associated impact. It is considered, therefore, that the impact of closure and decommissioning activities upon the water environment will be negligible.

7.7 Mitigation

Control of Surface Water Drainage during Construction

The operation of construction vehicles and general construction activities give rise to the potential for surface runoff to become contaminated with hydrocarbons, silt or other construction materials. This may in turn lead to a contamination event should site drainage be allowed to enter surface watercourses or the ground untreated. These and other pollution risks will be mitigated by the use of a Construction Environmental Management Plan (CEMP) which will require specific pollution prevention and environmental protection techniques to be employed. This may include:

- The use of settlement ponds ponds to aid the removal of any potentially contaminated suspended material that might be derived from construction materials;

- Construction vehicles will be properly maintained to reduce the risk of hydrocarbon contamination and will only be active when required; and
- Construction materials that could spill and cause pollution will be stored, handled and managed with due regard to the sensitivity of the local aquatic environment and provided with secondary containment such that the risk of accidental spillage or release will be minimised.

Residual impact after mitigation: Minor Positive

Wastewater Generation

It is also necessary to consider the potential wastewater generation associated with the new development. The main wastewater stream generated once the site is operational will be sanitary waste water from the toilet blocks, washrooms and catering facilities associated with the site tenants.

Once the site is operational, given the absence of access to a foul sewer, it will be necessary for Terminal to either discharge to a bespoke sewage treatment plant (package plant) that will treat the sanitary waste to a sufficient standard to allow discharge of the treated wastewater to a watercourse or to collect and store sewage to facilitate transport to an offsite treatment facility. The project is not yet at a stage where the detailed design or capacity of these systems can be established, but either option will meet relevant discharge criteria.

Residual impact after mitigation: Minor Negative

Potential Groundwater Interruption during Construction

During construction, dewatering of excavations may be required. Waters generated in this manner will be controlled, treated and discharged appropriately.

Residual impact after mitigation: Neutral

Control of Surface Water or Groundwater by Routine (Operational) Drainage

The principal source of contamination from routine operation of the site is hydrocarbon contamination from the transfer and storage of petroleum products. As such, the management and housekeeping protocols must meet industry standards. Once constructed, the Terminal will allow for the poorly maintained and inefficient infrastructure at KZP to be abandoned and the berths returned to their original design purpose. This will help to reduce the likelihood of pollution incidents of the Khor Al-Zubair.

Residual impact after mitigation: Moderate Positive

Increased Water Consumption

Water efficiency measures can reduce consumption. Therefore, water minimisation and conservation measures are important considerations for the proposed development, to minimise the increase in water demand. Water demand will be reduced as far as possible, by the incorporation of appropriate water saving devices, wherever practicable.

Residual impact after mitigation: Minor Negative

Mitigation of Piling Impacts

A detailed Method Statement will be then agreed setting out the piling technique and protection methods that will be employed. It is likely that this will include:

- augered Piling to bring the contaminated material up to the surface where it can be managed and controlled;
- pre-emptive or simultaneous advancement of solid casing, which will isolate the material being excavated from the surrounding material and prevent groundwater seepages into the borehole, and
- in-situ casting of the Piles with secondary sealing of the made-ground/natural ground interface so that groundwater cannot be transmitted downwards along the outside edge of the formed pile.

The rotary auger piling will bring materials to the surface from each horizon that it passes through. It is proposed that these pile horizons are monitored and periodically sampled to enable them to be characterised and, where possible, segregated. This will enable contaminated material (if any) and uncontaminated material to be defined and segregated for management and handling.

In conclusion, given the location and nature of the nearest sensitive receptors, the overall environmental impact of the proposed development in relation to water quality and hydrology is considered to be Minor Positive.

7.8 Residual Impacts

7.8.1 Residual Effects – Operational Phase

The effects arising from the construction phase are transient in nature.

Residual impact after mitigation; Neutral

7.8.2 Residual Effects – Operational Phase

Once operational, the main waste water stream once the site is operational will be sanitary wastewater from the toilet blocks, washrooms and catering facilities associated with the plant.

Residual impact after mitigation; Neutral

7.9 Flood Risk

A final environmental consideration is flood risk to the development site. EAME has been provided with a standalone preliminary Flood Risk Assessment (FRA) relating to the site. The FRA was undertaken to quantify the risk of flooding, identify potential flooding mechanisms and appropriate mitigation measures (if required).

The site was identified as potentially being at risk from tidal ingress, fluvial flooding from wadis to the west of the site and pluvial flooding. Proposed flood mitigation measures include the construction of a flood bund along the bank of the Khor Al-Zubair, ensuring that the western perimeter wall is water tight and the implementation of an approximately designed site drainage system. It was recommended that a detailed FRA be undertaken prior to moving into the Front End Engineering Design (FEED) phase of the project following the collection of additional data (meteorological, geotechnical, topographic, hydrological and infrastructure).

Residual impact after mitigation: Neutral

Chapter 8 - Ecology

Contents

8 Ecology

8.1 Introduction

This Chapter addresses the natural environment that could be affected by the proposals. It presents a description of the assessment methodology, observed baseline conditions, significant impacts and mitigation proposals relating to the terrestrial and marine ecology and habitats within the potential zone of influence of the proposed development.

The project area comprises three distinct habitat zones:

- **Terrestrial Zone** (Characterised by bare soil and sparse sabkha vegetation);
- **Intertidal Zone** (Characterised by mud flats with limited vegetation and numerous mud-skipper colonies); and
- **Marine Zone** (Characterised by unvegetated bottom sediments and tidal estuarine waters).

Each of these habitat zones is discussed in more detail below. This section of the report is arranged as follows:

- Description of methodology (field surveys, how ecological conservation value has been assigned and impact assessment);
- Description of baseline ecological conditions for land, inter-tidal and marine environments based on desk-based review and field surveys; and
- Impact assessment of the proposed development. Definition of mitigation measures and description of residual impacts.

8.2 Methodology

This section describes the basic principles and references applied to the assessment of ecological conditions and the related impact assessment for the terminal project. The information provided within this chapter in terms of specific conditions observed on the site is based largely on site walkovers undertaken in August and September 2014 and the prior remote sensing habitat surveys completed as part of the desk study report[1] (the latter are described in the desk-based report).

[1] WTPS Iraq Oil Terminal Desk Study, Earth & Marine Environmental Consultants, August 2014, REF: 014-1287 REV00

8.2.1 Field Surveys

The land and intertidal field surveys comprised walk-over surveys targeting the vegetated areas and bare areas and the field survey results are based on visual observation. No samples were collected. For the marine survey, sampling of water and sediment was undertaken at five locations opposite the project site (within the main water channel) and laboratory based species identification was undertaken on the collected samples by Basra University ecological specialists. The sediment samples were obtained using a Van Veen Sediment Sampler and the water samples using a Niskin discrete depth sampler (see *Chapter 7 – Water Quality* for a fuller description of these techniques).

The sample locations for the marine survey are identified below.

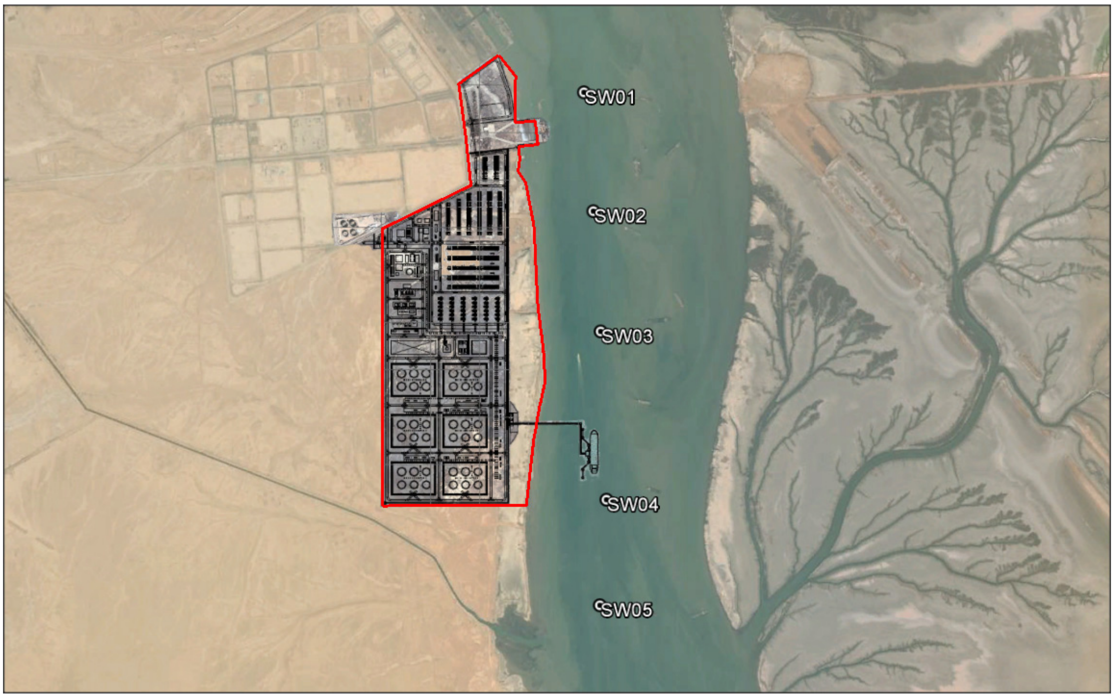

Figure 8.1: *Water and sediment sampling locations (Marine Ecology)*

8.2.2 Determining Conservation Value

Assigning values to habitats and species assists in identifying those of particular ecological conservation value and aids in the development of suitable mitigation and management opportunities. However, the lack of local and national Biodiversity, Species and Habitat Action Plans within Iraq results in a reliance on other published literature resources to assign the conservation value.

In the absence of a rigorous Iraqi system for designating ecological sites and protective status for species, the species status from the International Union for Conservation of Nature (IUCN) Red List, where available, along with available scientific literature has been used in identifying the species conservation value that may be present in the study area.

In consideration of the above, the species recorded within the sites boundaries have been assigned conservation values as per *Table* **8.1***8.1* below:

Table 8.1: Conservation Values

Value	Description
Very High	Internationally important and/or rare. Decreasing worldwide population and localized world breeding population.
High	Nationally important and/or rare. Decreasing worldwide population and localized breeding population.
Medium	Regionally important and/or rare. Stable population worldwide and nationally.
Low (or Lower)	Locally common and Nationally Abundant. Stable/Increasing population.
Negligible	Locally/Regionally/Internationally abundant with increasing population.

These descriptions have been used in the assessment of baseline ecological quality and sensitivity.

8.2.3 Ecological Impact Assessment

Following the completion of the baseline survey, the data gathered was used to undertake an Ecological Impact Assessment of the proposed development in accordance with the following technical guidelines:

- Guidelines for Ecological Impact Assessment: Terrestrial, Freshwater and Coastal (2006). Institute of Ecology and Environment Management (IEEM); and
- Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal (2010). Institute of Ecology and Environment Management.

Whilst not country specific, the IEEM Ecological Impact Assessment guidelines focus purely on the potential impacts of any proposed activity on the ecological features of a given area.

As a result, the guidelines have been utilized in preference of generic Environmental Impact Assessment Guidelines

8.2.4 Legislation

Currently, the protection of all environmental features within the country of Iraq falls under Iraqi Law of Protection and Improvement of the Environment, No. 27 of 2009 which came in to force in 2010. This Law aims to improve and to protect the environment by handling the damages, protecting the public health and the natural resources within Iraq.

The Ministry of Environment (MoE), and through cooperation with other Ministries, is charged with establishing the duties and responsibilities for the protection and improvement of the environment.

In accordance with the Law, clean technologies must be utilized and organisations are to establish suitable environmental policies. The use of sensors for pollution monitoring and control is recommended as well as the incorporation and use of renewable energy technologies.

Key points of the Law include:

- An Environmental Impact Assessment shall be done for any new project in the country;
- Protection of water sources from pollution;
- Regulating effluent discharge whether they are of domestic, industrial or agricultural origin;
- Regulation of air pollution and noise reduction;
- Earth protection;
- Biodiversity protection;
- Management of hazardous waste;
- Protection of the environment from pollution resulting from exploration and extraction of oil and natural gas;
- Establishment of an environmental protection fund; rewards; compensation for damages; and
- Penal provisions.

This Law supersedes Law No. 3 of 1997 on the protection and improvement of the environment.

8.3 Terrestrial Ecology Baseline Conditions

This section of the report deals with the species and habitat types identified on the land area of the proposed project (above the high water mark).

8.3.1 Baseline Conditions – Desk Study

It is important to recognise that the ecological field surveys are only a snapshot of what could be present on the site in terms of species, but the desk based study gives an indication of what could be present based on the observed habitat types and literature reviews. This is described below. The wider area generally (Southern Iraq coastal zone) comprises three key terrestrial habitat types: cultivated land (irrigated Agriculture/Farms), alluvial plains and sabkha (see *Figure 8.2*). In the vicinity of the project site itself it is sabkha that dominates**.**

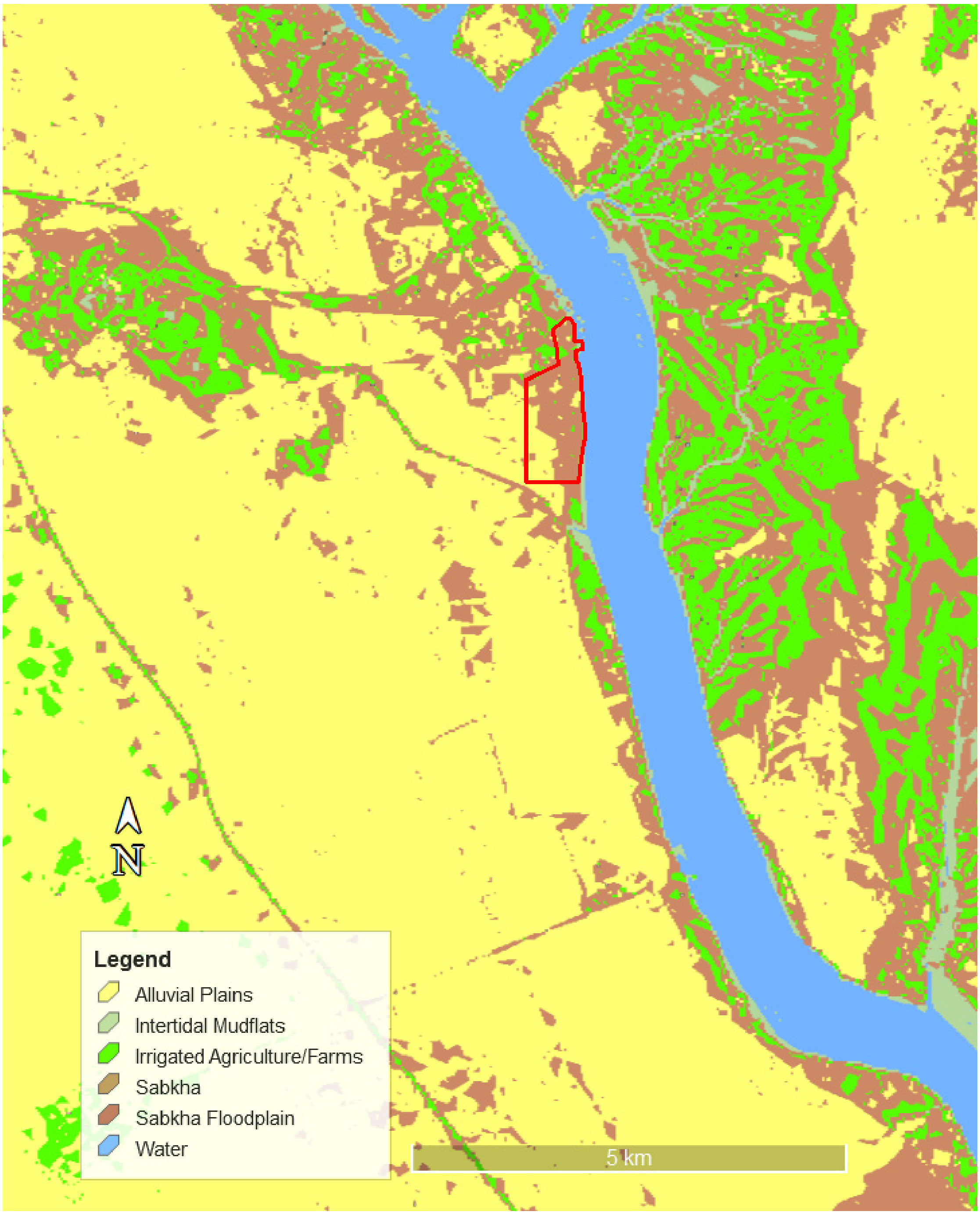

Figure 8.2: *Remote sensing habitat mapping showing habitat types*

Sabkha

Sabkha based habitats are a hyper saline, vegetative poor habitat. Where vegetation does exist, it is predominantly found around the fringes of the habitat and primarily comprises of high salt tolerant, halophytic species of the families Boraginaceae, Chenopdiaceae and Zygophyllaceae. Whilst void of vegetation, sabkha habitats are known for supporting various species of mammal, reptiles and birds.

Mammals

The nature of the study area and associated high anthropogenic activity potentially limits the number of native mammal species likely to be present. It is probable that those species which do exist within the study area, are to some degree tolerant to the existing activities. *Table 8.2* provides the status of mammals likely to exist within or in close proximity to the study area.

Table 8.2: Possible Mammal Species within the Study Area

Common Name	Latin Name	IUCN Red List
Wild Boar	*Sus scrofa*	Least Concern
Wild Dog	*Canis lupus*	Not Listed
Red Fox	*Vulpes*	Least Concern
Cape Hare	*Lepus capensis*	Least Concern
Lesser Jerboa	*Jaculus jaculus*	Least Concern
Egyptian Jerboa	*Allactaga euphratica*	Near Threatened
Cheesman's Gerbil	*Gerbillus cheesmanii*	Least Concern
Black Rat	*Rattus rattus*	Least Concern
Brown Rat	*Rattus norvegicus*	Least Concern
House Mouse	*Muscus muscus*	Least Concern
Source: www.iucnredlist.org		

The habitats associated throughout the study area, comprising predominantly of Sabkha and Alluvial Plains, have the ability to support small mammal species, in particular, rodents. Species of gerbil, namely Cheesman's Gerbil (*Gerbillus cheesmani*), are likely to be present.

This species of gerbil is commonly found throughout Iraq and Arabia and due to a stable population and wide spread distribution, it is listed as Least Concern on the IUCN Red List[2].

Similarly, alluvial plains habitats are known to support populations of Lesser Jerboa (*Jaculus jaculus*). The population of this species throughout Iraq and Arabia is stable and in combination with its wide spread distribution, it is listed as Least Concern on the IUCN Red List[3]. A member of the Jerboa Family, Euphrates Jerboa (*Allactaga euphratica*), possibly exists in Iraq, however there have been no recent confirmations. Populations of Euphrates Jerboa is always lower when found in areas populated by Lesser Jerboa[4]. This species is currently listed as Near Threatened on the IUCN Red List due to a decreasing population and distribution throughout Arabia.

Small rodent species inclusive of Brown Rat (*Rattus norvegicus*), Black Rat (*Rattus rattus*) and House Mouse (*Muscus muscus*) are likely to be present within the study area, particularly near areas of human habitation or activities such as wharf sites and industrial areas.

Recordings of possible fox tracks during a site visit by EAME staff indicate a potential presence in the area. The highly disturbed nature of the site and close proximity to human activity indicates that the species most likely to occur is that of Arabian Red Fox (*Vulpes vulpes*). Arabian Red Fox are more tolerant of human presence and increased levels of disturbance compared to other fox species. It should also be noted that there are feral dogs in the area too so it is possible these small tracks are from a juvenile feral dog.

8.3.2 Baseline Conditions - Fieldwork

A baseline survey was completed by EAME staff during August and September 2014. The purpose of the walk-over survey was to assess the terrestrial areas of the proposed Terminal and identify vegetation coverage, habitat type and observe any potential ecologically sensitive receptors. The project site itself shows signs of anthropogenic impacts including disused port facilities, fly tipping/dumping, off road vehicle activities, earthworks, dredging disposal and the remnant signs of war (e.g. tank emplacements, defensive mounds, etc). These activities would lead to disturbance of natural habitats that could develop but there are no signs of cultivation or agricultural activity on the project site.

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[2] Gerbillus cheesmani. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. Shenbrot, G. & Amr, Z. 2008. <www.iucnredlist.org>. Downloaded on 23 February 2012

[3] *Jaculus jaculus*. The IUCN Red List of Threatened Species, Amori, G., Hutterer, R., Kryštufek, B., Yigit, N., Mitsain, G., Palomo, L.J. & Aulagnier, S. 2008. Version 2014.3

[4] *Allactaga euphratica*. The IUCN Red List of Threatened Species. Kryštufek, B. 2008. Version 2014.3

Habitats

The survey undertaken throughout the project site identified the following habitat types:

- Coastal Sabkha; and
- Vegetated Coastal Strip.

Coastal Sabkha

Coastal sabkha habitat is located throughout the site and, as a result of the hyper saline soil conditions, it is mainly devoid of any vegetation. Where vegetation was recorded, the species *Atriplex* sp and *Salsola* sp were noted (see *Photograph 8.1*). Vegetation coverage across the site was estimated to be less than 5% of the site as a whole, but where it did occur it was concentrated in dense patches with open space between (as illustrated below).

Photograph 8.1: *Sparsely vegetated Sabkha plain*

Other than feral dogs, no mammals were observed on the site. Birds were also absent from the land areas of the site (as opposed to the intertidal area described below). Overall the terrestrial habitat was found to be a poor quality, low diversity habitat of no great ecological significance.

8.4 Intertidal Ecology Baseline Conditions

This section describes the species and habitat types associated with the intertidal area. This is the strip of land between the high and low water mark which is subjected to twice daily tidal inundation and thus spends alternating periods submerged and exposed.

The most notable aspect of the intertidal zones along the Iraqi coast are that they are important sites for wading birds and are internationally recognised for such.

Khor Al-Zubair Port Protected Area

There are two Important Bird Areas (IBA) located within the Khor Al-Zubair Port study area. Firstly, Khor Al-Zubair IBA is located to the north east of the site, as shown on *Figure 8.3*. This site was allocated IBA Status by BirdLife International in 2001 for its importance in providing suitable habitat to water birds[5]. This site, approximately 40km south east of Basra, comprises of an extensive tidal inlet and associated intertidal mudflats located at the head of the Arabian Gulf[5].

In addition to being internationally recognized as an IBA by BirdLIfe International, during 2009, a series of surveys were undertaken to identify sites as Key Biodiversity Conservation Areas. The outcome of the survey highlighted that Khor Al-Zubair be included as one of Iraq's Key Biodiversity Areas[6].

The second IBA, Khor Abdullah, is located along the coast of Iraq. This location comprises of approximately 90,000 hectares (ha) swampy grass-flats and approximately 36,000ha of intertidal mudflats and was nominated in 2001 to be incorporated into BirdLIfe International as an IBA[7].

The huge expanses of suitable habitat resulted in the site being recognized as internationally important for populations of Eurasian Curlew (*Numenius arquata*), Crab Plover (*Dromas ardeola*) and Gull Billed Tern (*Gelochelidon nilotica*)[7].

Furthermore, the site supports resident populations of Iraq Babbler (*Turdoides altirostris*) as well as 1% or more of the recorded global population of wintering African Sacred Ibis (*Threskiornis aethiopicus*)[8].

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[5] Endemic Bird Areas factsheet: Mesopotamian Marshes. Birdlife International. Downloaded from http://www.birdlife.org on 22/01/2014
[6] Key Biodiversity Site of Iraq: 2010 Site Review. Bachmann, A. Chappell, B. Elliott, N. & Matti, N. Nature Iraq. 2011
[7] Important Bird Areas factsheet: Khawr Al Zubair. Birdlife International. Downloaded from http://www.birdlife.org on 22/01/2014
[8] Important Bird Areas in the Middle East. Evans, M. BirdLife International. 1994

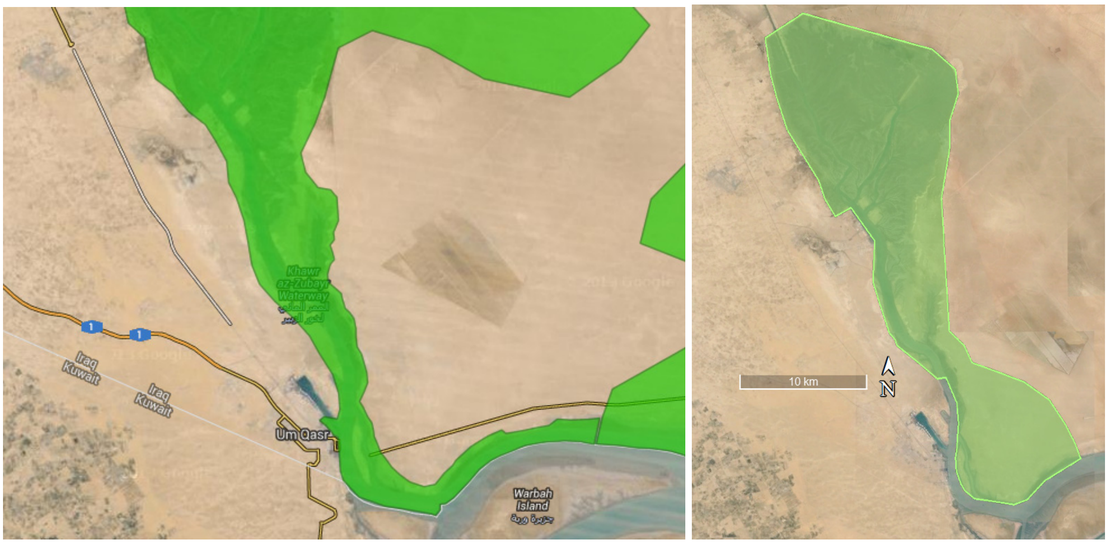

Figure 8.3: *KAZ Important Bird Area (IBA) and Key Biodiversity Area (KBA)*

Birds

As part of a biodiversity study undertaken by Nature Iraq in 2009 for the Khor Al-Zubair area, a total of 27 species of bird were recorded (see *Table 8.3*). With the exception of two species, Greater Spotted Eagle (Vulnerable) and Eurasian Curlew (Near Threatened), all birds recorded within the survey area are considered as species of Least Concern.

BirdLife International currently estimate that the global population of Greater Spotted Eagle range between 5,000 and 13,000 mature birds. Due to the limited population, believed to be declining from extensive habitat loss and persecution, it is listed as Vulnerable by BirdLife International[9]. Similarly, declines in populations of Eurasian Curlew have been recorded in several key populations, as a result, the species is as Near Threatened by BirdLife International[10].

The findings of the survey indicate that common species of water bird are present within the site boundaries and include Grey Heron (*Ardea cinerea*), Little Egrets (*Egretta garzetta*), Western Reef Heron (*Egretta gularis*), Kentish Plovers (*Charadrius alexandrinus*), Common Sandpipers (*Actitis hypoleucos*) Slender-billed Gull (*Larus genei*), Gull-billed Tern

[9] Species factsheet: Aquila clanga. Downloaded from http://www.birdlife.org on 28/02/2012. Recommended citation for factsheets for more than one species: BirdLife International (2012) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 28/02/2012.
[10] Species factsheet: Numenius arquata. Downloaded from http://www.birdlife.org on 28/02/2012. Recommended citation for factsheets for more than one species: BirdLife International (2012) IUCN Red List for birds. Downloaded from http://www.birdlife.org on 28/02/2012

(*Gelochelidon* [Sterna] *nilotica*), Caspian Tern (*Hydroprogne* [Sterna] *caspia*) and Little Tern (*Sternula* [Sterna] *albifrons*)[11].

In the addition to the above, the survey identified the presence of approximately 50 adult Crab Plover (*Dromas ardeola*). Preliminary findings indicate that previously, this species of bird might not have been recorded in the south of Iraq at Khor Al-Zubair and Ras Al Beesha[11]. Whilst listed as a species of Least Concern by BirdLife International, it is regionally important with the wintering population throughout Arabia consisting of approximately 5,000 birds[12].

Table 8.3: Bird Species Recorded at Khor Al-Zubair by Nature Iraq

Common Name	Latin Name	BirdLife International
Black-crowned Night Heron	*Nycticorax nycticorax*	Least Concern
Squacco Heron	*Ardeola ralloides*	Least Concern
Grey Heron	*Ardea cinerea*	Least Concern
Purple Heron	*Ardea purpurea*	Least Concern
Little Egret	*Egretta garzetta*	Least Concern
Western Reef Heron	*Egretta gularis*	Least Concern
Great Cormorant	*Phalacrocorax carbo*	Least Concern
Marsh Harrier	*Circus aeruginosus*	Least Concern
Hen Harrier	*Circus cyaneus*	Least Concern
Greater Spotted Eagle	*Aquila clanga*	Vulnerable
Little Ringed Plover	*Charadrius dubius*	Least Concern
Kentish Plover	*Charadrius alexandrinus*	Least Concern
Eurasian Curlew	*Numenius arquata*	Near Threatened
Ruff	*Philomachus pugnax*	Least Concern
Armenian Gull	*Larus armenicus*	Least Concern
Black headed Gull	*Larus ridibundus*	Least Concern
Gull billed Tern	*Gelochelidon [Sterna] nilotica*	Least Concern

[11] Key Biodiversity Survey of Southern Iraq Site Review: Winter & Summer 08 Survey. Nature Iraq. Abdulhasan N. A & Salim, M. A. 2008
[12] Breeding Birds of the United Arab Emirates. Aspinall, S. 2010. Emirates Printing Press.

Table 8.3: Bird Species Recorded at Khor Al-Zubair by Nature Iraq

Common Name	Latin Name	BirdLife International
Caspian Tern	*Hydroprogne [Sterna] caspia*	Least Concern
Collared Dove	*Streptopelia decaocto*	Least Concern
White-throated Kingfisher	*Halcyon smyrnensis*	Least Concern
Grey Shrike	*Lanius sp.*	Least Concern
Rook	*Corvus frugilegus*	Least Concern
Crested Lark	*Galerida cristata*	Least Concern
Graceful Prinia	*Prinia gracilis*	Least Concern
House Sparrow	*Passer domesticus*	Least Concern
Spanish Sparrow	*Passer hispaniolensis*	Least Concern
Dead Sea Sparrow	*Passer moabiticus*	Least Concern
Reference: www.natureiraq.org		

Finally, other studies completed by EAME throughout the Faw region of Iraq identified resident or wintering species, inclusive of Black-winged Stilt (*Himantopus himantopus*), Grey Heron (*Ardea cinerea*), Purple Heron (*Ardea purpurea*), Little Egret (*Egretta garzetta*), Mesopotamian Crow (*Corvus capellanus*), White Wagtail (*Motacilla alba*) and House Sparrow (*Passer domesticus*).

Reptiles

Iraq has approximately 77 terrestrial reptile species, however, due to a significant lack of information regarding their distribution, range and population, most are not classified on the IUCN Red List. Of those that are classified, all are listed as species of Least Concern due to a wide distribution and stable population. Desert Monitor (*Varanus griseus*) is listed as an Appendix I CITES species and of conservation importance. However, given that this species favours sand dune based habitats, it is unlikely that it will be present within the survey area.

A study undertaken by EAME during 2011 in Fao identified the sole presence of Shokars Sand Racer (*Psammophis schokari*). A non-poisonous diurnal species of snake, Schokari's Racer predates on insects and small mammals[13].

Reptiles that could potentially exist within the study area include geckoes, diurnal lizards and snakes. *Table 8.4* provides the status of reptiles that are likely to exist within the sites boundaries.

Table 8.4: Possible Reptile Species within the Study Area		
Common Name	**Latin Name**	**IUCN Red List**
Baluch Rock Gecko	*Bunopus tuberculatus*	Least Concern
Slevin's Sand Gecko	*Stenodactylus slevini*	Least Concern
Schmidt's Fringed Toed Lizard	*Acanthodactylus schmidti*	Least Concern
Short Nosed Desert Lizard	*Mesalina brevirostris*	Least Concern
Schokari Sand Race	*Psammophis schokari*	Least Concern
Source: www.iucnredlist.org		

Field Study Observations (Reptiles)

No reptile species were observed on the site during any of the survey activities.

Field Study Observations - Flora

A narrow coastal strip (approximately 20m wide) comprising of the species *Atriplex* sp and *Salsola* sp was located between the high tide mark and the existing Sabkha habitat. This habitat type is important in supporting native species of fauna, in particular reptiles and bird species. Vegetation coverage was estimated between 2 - 5%. The intertidal zone supported dense stands of *Arthrocnemum macrostachyum*, a species of Chenopod commonly found throughout the Gulf (*Photograph 8.2*)[14].

[13] Snakes of Arabia: A Field Guide to the Snakes of the Arabian Peninsula and its Shores. Arabian Heritage Guides. Egan, D. 2007
[14] Wildflowers of the UAE. ERWDA. Jongbloed, M. 2003

Photograph 8.2: *Exposed vegetated intertidal zone at low tide revealing Arthrocnemum macrostachyum community*

The field survey identified four species of flora, all belonging to the Chenopod family. All species are recognized plants of hypersaline soil conditions and regularly associated with coastal and Sabkha habitats.

The species *Arthrocnemum macrostachyum* was recorded within the intertidal zone of the site. A species commonly found throughout the Persian Gulf, it is regularly recorded within, or in close proximity to, intertidal zones.

Similarly, the species *Atriplex leucoclada* and *Salsola sp* are commonly found throughout coastal and hyper saline environs in the Middle East and Gulf region[14].

Table 8.5: Flora Species Recorded On-site

Family	Species Name	Annual/Perennial
Chenopodiaceae	*Arthrocnemum macrostachyum*	Perennial
	Atriplex leucoclada	Perennial
	Bienertia cycloptera	Annual
	Salsola sp	Perennial

These species are present in dense stands extending along the full length of the intertidal zone, but only around 20m wide at the widest point.

Field Study Observations - Mammals

The survey of the study area identified the presence of two mammal species. Signs of feral dog and camel were recorded during the September 2014 survey period. *Table 8.6* provides details on the species identified during the survey and their IUCN Red List status.

Table 8.6: Mammal Species Recorded On-site

Common Name	Latin Name	IUCN 2014 status
Feral Dog	*Canis lupus*	Not Listed
Camel	*Camelus sp.*	Not Listed
Source: IUCN Red List 2012: www.iucnredlist.org		

Tracks of both feral dog and wild camel were recorded within the proposed development site (*Photograph 8.3*). Whilst no sightings were recorded, based on the evidence obtained, the populations within the area are expected to be small. Furthermore, both species are likely to be introduced to the area. As a result of both species recognized as introduced species, they are not listed on the IUCN Red List.

Photograph 8.3: *Dog tracks recorded across the intertidal zone*

Field Study Observations - Birds

The survey recorded a total of three bird species during the site visit undertaken in September. Details on the species recorded are provided in *Table 8.7* along with the BirdLife International Status.

Table 8.7: Bird Species Conservation Value

Common Name	Latin Name	BirdLife 2014 International Value
Purple Heron	*Ardea purpurea*	Least Concern
Western Reef Egret	*Egretta gularis*	Least Concern
Black-winged Stilt	*Himantopus*	Least Concern
Source: BirdLife International: www.birdlife.org		

The bird species recorded within the sites boundaries are all considered common resident species associated with coastal and intertidal areas throughout Iraq. Western Reef Egret (*Egretta gularis*) was recorded through sightings along the intertidal zone at low tide. A common wader species in the Middle East, populations of this species have benefitted from an increase in agricultural activities located near coastal environs.

Single sightings of both Black-winged Stilt (*Himantopus himantopus*) and Purple Heron (*Ardea purpurea*) were recorded within the proposed site area. Both species were noted at Low Tide.

The population of birds observed in the intertidal area over the course of the project was small (often only one or two birds were seen during each site visit). So whilst the area provides foraging habitat for birds, it is not extensively inhabited.

Photograph 8.4: *Egret and Heron observed on project site*

Benthic Communities

The most abundant species dwelling in the intertidal are mudskippers (*periophthalmus gracilis*). The mudskipper colonies are virtually ubiquitous across the intertidal zone both within the vegetation zones and in the unvegetated exposed mud (see photographs below).

Photograph 8.5: *Mudskippers and extensive colonies (burrows) in intertidal zone*

These amphibious fish are common along the entire foreshore and tidal creeks around the Iraqi coast and are not considered to be threatened or endangered.

The only other species identied in the inter-tidal zone was a crab species (fiddler crab, *paraleptuca sindensis*), but these were only observed in small numbers typically sheltering under debris on the shore.

Photoraph 8.6: *Fiddler Crabs observed in project site intertidal zone*

8.5 Marine Ecology

Although the majority of the project assets and associated disturbance are land (or shoreline) based, given that there will be some in-water assets (the jetty) and associated construction activities, it is also important to consider the marine ecology.

8.5.1 Field Survey

EAME undertook sampling at the same five locations as the surface water and sediment sampling. All sampling was undertaken on the 13th September 2014 from a vessel which was audited and pre-approved by EAME. The collected samples were processed and analysed at Basra University. The results are presented below.

Phytoplankton

At each location, a phytoplankton sample was collected at the surface and bottom depth (1m above the river bed) using a Niskin Water Sampler. The samples were preserved with formalin solution and were visually assessed using microscopes equipped with Differential Interface Contrast. The species were identified using up-to-date identification keys and a species count was also undertaken.

Zooplankton

Zooplankton was collected using a 0.5m bongo net. The net was lowered to approximately 1m above the river bed and then hauled back to the surface through the water column to collect a composite sample through the entire water profile. The contents of the net were rinsed into a dedicated collection bottle and preserved with formalin.

Photograph 8.7: *Zooplankton, Sediment and Phytoplankton sampling devices*

At the university laboratory, the examination of samples was undertaken using stereo microscopes and the identification of species of the different groups using appropriate published keys and literature. The species density was determined by taking sub-samples of 10ml to a Bogrov tray for counting. All species were identified and counted and the number of individuals/m^3 calculated.

Benthic Animals

Sampling for benthic organisms was undertaken using a Van Veen Sediment Sampler. Two grab samples were taken at each of the five sampling locations to obtain sufficient volume of sample for examination and the colour and visual appearance of the sediment samples was recorded. The sediment samples were then sieved through a 0.5mm mesh and preserved with formalin solution. The samples were then refrigerated and stored prior to despatch to the laboratory for analysis (identification and species count).

Photograph 8.8: *Illustrating the range of sediment types from sandy gritty sediment with numerous shells to soft fine silt with no shells or inclusions*

Sea Birds

During the marine biology sampling survey, all survey staff remained vigilant for the appearance of sea-birds. A record of all such sightings and a description of the birds observed was made and is described in the intertidal section.

8.5.2 Baseline Data

Sampling Locations

The marine ecology samples were obtained from the same positions as the sediment and surface water samples.

Phytoplankton

The phytoplankton was dominated by the following species:

- *Actinocyclus octonarius* Ehr.
- *Coscinodiscus oculus-iridis* Her.
- *Coscinodiscus* spp.
- *Campylodiscus clypeus* Her.
- *C. noricus* ex tz
- *Cyclotella* sp
- *Planktoniella sol* (Wallich) Schutt 1893

- *Rhizosolenia imbricata* Brightwell
- *Thalassionema nitzschioides* Grun
- *Protoperidinium* depressum

The following species were also encountered but their occurrence was rare:

- *Gomphotheca sinensis* (Skvortzow)Hen.&Sims
- *Surirlla gemma* Her.
- *S. striatula* Turp.
- *Pleurosigma* sp.
- *Dinophysis caudata* Saville-Kent

Table 8.11 presents total cell count for each sampling location:

Table 8.11: Total Phytoplankton Cell Count

Species	SW01: 1.0m	SW01: 12.7m	SW02: 1.0m	SW02: 3.3m	SW03: 1.0m	SW03: 5.1m	SW04: 1.0m	SW04: 10.0m	SW05: 1.0m	SW05: 11.0m
Bacillariophyceae									40	20
Actinocyclus octonarius Ehr.	40	20	40	10	40	10	20			
Campylodiscus clypeus Her.			160		30		40			
C. daemelinus			10				30			
C. echeneis			30				20			
C. noricus ex Ktz	40	20				20	10		20	40
Coscinodiscus asteromphalus Ehr.	20			10	10					
C. mariginatus.	10	10		10					20	10
C. oculus-iridis Her.	100			10	140	20	60	160	40	
C. radiatus Her	20			10						

Table 8.11: Total Phytoplankton Cell Count

Species	SW01: 1.0m	SW01: 12.7m	SW02: 1.0m	SW02: 3.3m	SW03: 1.0m	SW03: 5.1m	SW04: 1.0m	SW04: 10.0m	SW05: 1.0m	SW05: 11.0m
Cyclotella sp	60	20		10	80		30	20	20	10
Dactyliosolen fragilissimus Husle 1996	20									
Ditylum brightweellii (T.West)Grun.e	20									
Gomphotheca sinensis(Skvortzow) Hen.&Sims			60				30	40		
Gyrosigma sp.	10		10							
Lauderia annulata Cleve	10		10							
Nitzschia sigma (Kuetz.) W.Smith										
Planktoniella sol (Wallich) Schutt 1893	80		120	20	60	20	60	80	60	
Pleurosigma sp W.Smith			20	10					20	
Proboscia alata (Brightwell) Sundström 1986			20							
Pseudo-nitzschia (Grun ex Cleve) Hasle	10									
Rhizosolenia alata forma indica Gran			10		10	10				
Rhizosolenia imbricate	10		10		10			10	40	10
Rhizosolenia clevei Sund.1984	10		10		10					
Rhizosolenia	10	10	10		10		10			

Table 8.11: Total Phytoplankton Cell Count

Species	SW01: 1.0m	SW01: 12.7m	SW02: 1.0m	SW02: 3.3m	SW03: 1.0m	SW03: 5.1m	SW04: 1.0m	SW04: 10.0m	SW05: 1.0m	SW05: 11.0m
setigera Brightwell 1858										
Surirlla gemma Her.	10		30							
S. striatula Turp.	10		20							
Syndra ulna (Nitzsch) Ehrenberg	10		50	30				20		
Thalassionema nitzschioides Grun.	50			80			40	20		10
T. frauenfeldii (Grun) Hallegraeff 1986				10						
Dinophysis caudata Sav.-Kent	10									10
Dinophysis miles										
Protoperidinium obtusum	10			10	10					
Protoperidinium depressum				10	10	20	20	10	20	
Total	**560**	**80**	**620**	**230**	**600**	**100**	**370**	**360**	**280**	**110**

In all cases except SW04, the species abundance of the shallow sample is greater than that of the deeper sample. This is to be expected given that the turbidity levels in these waters are high so light scattering (which provides the energy for phytoplankton) will be more limited at depth than the surface. There is, however, no significant difference between the sample locations per se. This is probably due to the twice daily tides which are strong and which will cause dynamic mixing of the water. Furthermore, there are no greatly differing land uses that would have notable localized impacts on the water quality adjacent to them (e.g. sewage outfall or agricultural run-off).

Zooplankton

A full breakdown of the zooplankton species found at SW01 is detailed in *Table 8.12*:

Table 8.12: SW01 Total Number of Individuals/ml and Percentage of Zooplankton

Species	Individuals per ml	% of Population
COPEPODA		
CALANOIDA		
Acartia (Acartilla) faoensis	10	3.5
Acartia (Odontacartia) pacifica	90	31.6
Bestiolina Arabica	35	12.3
Paracalanus sp.	15	5
Parvocalanus sp.	10	3.5
Eucalanus sp.	5	1.76
Temora sp.	0	0
Labidocera sp.	5	1.76
Nauplii – Copepoda	20	7.0
Copepodite Stages	60	21.1
Harpacticoid	0	0
Microsetella sp.	5	1.76
Cyclopoid	1	0.35
Oithiona spp.	5	1.76
Total of Copepoda	261	91.91
Total of Calanoida	250	88.02
Other Zooplankton		
Oikopleura sp.	6	2.1
Sagitta sp.	4	1.4
Isopoda	1	0.35
Megalop larvae	0	0

Table 8.12: SW01 Total Number of Individuals/ml and Percentage of Zooplankton		
Species	**Individuals per ml**	**% of Population**
Polychaeta adult	0	0
Polychaeta lavae	4	1.4
Mysids	1	0.35
Ostracoda	2	0.7
Cirripedia larvae	5	1.7
Total of others	23	8.09
Final total	**284**	

A full breakdown of the zooplankton species found at SW02 is detailed in *Table 8.13*:

Table 8.13: SW02 Total Number of Individuals/ml and Percentage of Zooplankton		
Species	**Individuals per ml**	**% of Population**
COPEPODA		
CALANOIDA		
Acartia (Acartilla) faoensis	12	3.45
Acartia(Odontacartia) pacifica	76	21.9
Bestiolina Arabica	33	9.51
Paracalanus sp.	24	6.91
Parvocalanus sp.	20	5.76
Eucalanus sp.	24	6.91
Temora sp.	0	0
Labidocera sp.	3	0.86
Nauplii – Copepoda	25	7.2
Copepodite Stages	68	19.59
Harpacticoid	8	2.3

Table 8.13: SW02 Total Number of Individuals/ml and Percentage of Zooplankton		
Species	**Individuals per ml**	**% of Population**
Microsetella sp.	15	4.32
Cyclopoid	18	5.18
Oithiona spp.	4	1.15
Total of Copepoda	330	95.1
Total of Calanoida	285	82.13
Other Zooplankton		
Oikopleura sp.	4	1.15
Sagitta sp.	1	0.288
Isopoda	0	0
Megalop larvae	0	0
Polychaeta adult	0	0
Polychaeta lavae	6	1.72
Mysids	2	0.57
Ostracoda	1	0.288
Cirripedia larvae	3	0.86
Total of others	17	4.899
Final total	**347**	

A full breakdown of the zooplankton species found at SW03 is detailed in *Table 8.14*:

Table 8.14: SW03 Total Number of Individuals/ml and Percentage of Zooplankton		
Species	**Individuals per ml**	**% of Population**
COPEPODA		
CALANOIDA		

Table 8.14: SW03 Total Number of Individuals/ml and Percentage of Zooplankton

Species	Individuals per ml	% of Population
Acartia (Acartilla) faoensis	32	8.39
Acartia(Odontacartia) pacifica	100	26.24
Bestiolina Arabica	45	11.81
Paracalanus sp.	12	3.14
Parvocalanus sp.	5	1.31
Eucalanus sp.	15	3.93
Temora sp.	8	2.0
Labidocera sp.	5	1.31
Nauplii – Copepoda	38	9.97
Copepodite Stages	44	11.54
Harpacticoid	9	
Microsetella sp.	15	0.49
Cyclopoid	7	
Oithiona spp.	0	12.37
Total of Copepoda	335	87.92
Total of Calanoida	304	79.79
Other Zooplankton		
Oikopleura sp.	9	2.36
Sagitta sp.	0	0
Shrimp larvae	8	2.0
Isopoda	1	0.26
Megalop larvae	0	0
Polychaeta adult	1	0.26
Polychaeta lavae	8	2.0
Mysids	1	0.26

Table 8.14: SW03 Total Number of Individuals/ml and Percentage of Zooplankton		
Species	**Individuals per ml**	**% of Population**
Ostracoda	6	1.57
Cirripedia larvae	12	3.14
Total of others	46	
Final total	**381**	

A full breakdown of the zooplankton species found at SW04 is detailed in *Table 8.15*:

Table 8.15: SW04 Total Number of Individuals/ml and percentage of Zooplankton		
Species	**Individuals per ml**	**% of Population**
COPEPODA		
CALANOIDA		
Acartia (Acartilla) faoensis	25	8.65
Acartia (Odontacartia) pacifica	52	17.99
Bestiolina Arabica	39	13.49
Paracalanus sp.	17	5.88
Parvocalanus sp.	11	3.81
Eucalanus sp.	13	4.50
Temora sp.	9	3.11
Labidocera sp.	0	0
Nauplii – Copepoda	21	7.27
Copepodite Stages	42	14.53
Harpacticoid	0	0
Microsetella sp.	8	2.77
Cyclopoid	3	1.04
Oithiona spp.	7	2.42

Table 8.15: SW04 Total Number of Individuals/ml and percentage of Zooplankton		
Species	**Individuals per ml**	**% of Population**
Total of Copepoda	247	85.47
Total of Calanoida	229	79.23
Other Zooplankton		
Oikopleura sp.	7	2.42
Sagitta sp.	2	0.69
Isopoda	0	0.00
Megalop larvae	14	4.84
Polychaeta adult	0	0.00
Polychaeta lavae	7	2.42
Mysids	1	0.35
Ostracoda	0	0
Cirripedia larvae	11	3.81
Total of others	42	14.53
Final total	**289**	

A full breakdown of the zooplankton species found at SW05 is detailed in *Table 8.16*:

Table 8.16: SW05 Total Number of Individuals/ml and Percentage of Zooplankton		
Species	**Individuals per ml**	**% of Population**
COPEPODA		
CALANOIDA		
Acartia (Acartilla) faoensis	15	8.08
Acartia (Odontacartia) pacifica	40	21.5
Bestiolina Arabica	25	13.44
Paracalanus sp.	10	5.37

Table 8.16: SW05 Total Number of Individuals/ml and Percentage of Zooplankton		
Species	**Individuals per ml**	**% of Population**
Parvocalanus sp.	5	2.68
Eucalanus sp.	5	2.68
Temora sp.	4	2.15
Labidocera sp.	0	0
Nauplii – Copepoda	12	6.45
Copepodite Stages	20	10.75
Harpacticoid	0	0
Microsetella sp.	5	2.68
Cyclopoid	1	0.537
Oithiona spp.	5	2.68
Total of Copepoda	147	79.032
Total of Calanoida	136	73.118
Other Zooplankton		
Oikopleura sp.	5	2.68
Sagitta sp.	1	0.537
Isopoda	0	0
Megalop larvae	10	5.37
Polychaeta adult	1	0.537
Polychaeta lavae	8	4.3
Mysids	1	0.537
Ostracoda	0	0
Cirripedia larvae	13	6.98
Total of others	39	20.967
Final total	**186**	

The populations of Zooplankton are typical of seawater in this locality (*c.f. JICA Sealine Project – Environmental Baseline Survey 2011*). The high turbidity levels in the water body here (and especially closer to the shore) will limit productivity and species diversity as light penetration (and hence energy source) is poor in these waters. Also there is little in the way of agricultural runoff in this area which would provide nutrients to the water body. There is no notable difference between the sample locations, which is not surprising given the strong tidal currents and associated mixing of water. No stratification was identified during the water quality survey supporting this view.

Benthic Animals

The results of the analysis of benthic samples are presented in *Table 8.17* below.

Table 8.17: Benthic Species Present at Each Location

Groups	SW01	SW02	SW03	SW04	SW05
Gastropoda	*Priinella conica*		X	X	X
		Cerithium scabridum			
Scaphopoda	*Dentalium octangulatum*	*Dentalium octangulatum*			
Bivalve	*Paphia gallus*	*Paphia gallus*			
	Diplodonta globosa				
	Gari roseus				
	Meretrix				
	Brachidontes emarginatus	*Brachidontes emarginatus*			
	Brachidontes variabilis				
	Trapezium sublaevigatum				
	Aspidopholas cf. ovum				

Table 8.17: Benthic Species Present at Each Location

Groups	SW01	SW02	SW03	SW04	SW05
	Abra cadabra	*Abra cadabra*			
	Angulus sp.				
		Marcia hiantina			

In each case a decent volume of sample was returned, however, only samples SW01 and SW02 contained any identifiable species, indicating that the biomass within the benthic sediments is low. This again is to be expected as the area is subjected to strong tidal currents with heavy sediment loads and a fluid sediment bed. It is also close to the main navigation channel where dredging takes place and so is a disturbed environment.

8.6 Project Site Conservation Value Assessment

Habitat Conservation Value

The habitats identified within the site boundaries have all been significantly affected by anthropogenic activities. The limited vegetative cover afforded by the hyper-saline Sabkha habitat provides limited support for species of fauna on land and the intertidal area is similarly sparsely vegetated and disturbed by debris that has accumulated on the beach or been deposited there as part of the wreck clearance activities.

Where vegetation is present, it is primarily dominated by a small range of species. As a result of the significant disturbance throughout the area, the habitats support limited floristic cover, with those species identified during the September survey comprising of common halophytic species. As a result of the highly disturbed habitat and limited species coverage, the conservation value of habitats within the proposed development area are identified as **Low to Negligible**.

The marine environment is similarly of **Low to Negligible** conservation value in terms of the benthic communities which comprise mainly silty substrate with no reefs, corals, mangroves, etc. The marine environment itself if highly dynamic and could support a wide range of fish, mammal and plankton species, although shipping, dredging and high turbidity levels will limit this compared to the more open waters of the Arabian Gulf and less turbid coastal zones of some of the Gulf states. Nonetheless, this is the most ecologically interesting and sensitive aspect of the project area natural environment and would have a conservation value of **Low**.

Terrestrial and Intertidal Flora

A total of four plant species were identified during the baseline survey. *Table* **8.18***8.18* provides a list of the flora species recorded during the baseline surveys and the assigned conservation values.

Table 8.18: Floristic Species Conservation Value

Family	Species Recorded	Conservation Value
Chenopodiaceae	*Arthrocnemum macrostachyum*	Low
	Atriplex leucoclada	Low
	Bienertia cycloptera	Low
	Salsola sp	Low

All species recorded are considered common throughout the region and across hyper-saline coastal environments. The species identified are quick to colonise disturbed habitats. The wide distribution of the above species throughout coastal, intertidal and sabkha habitats in the Gulf accompanied by the limited distribution within the survey area results in an ecological conservation value of **Low** being applied.

Land Mammals

The survey recorded the presence of two mammal species within the proposed development area. *Table 8.19* provides a list of the mammal recorded along with their IUCN Red List Status and Conservation Value.

Table 8.19: Mammal Species Conservation Value

Common Name	Latin Name	IUCN 2014 status	Conservation Value
Feral Dog	*Canis lupus*	Not Listed	Negligible
Camel	*Camelus sp.*	Not Listed	Negligible
Source: IUCN Red List 2012: www.iucnredlist.org			

Feral dog is not listed on the IUCN Red List and are the likely result of abandoned pets. The increase in feral dog populations throughout the Middle East is of serious concern due to the potential spread of disease and safety concerns for human where interactions are inevitable. The diet of feral dogs is highly variable, where it is known to forage within rubbish dumps, predate on native species or take livestock. The size of population in any given area is wholly reliant on its surroundings. However, the expansion of human settlements, a lack of natural predators and an increase in available food items has assisted in populations of feral dog growing.

Camels are primarily associated with animal husbandry in the Middle East, where they are farmed for milk, meat and activities inclusive of racing. As a result of being utilized for animal husbandry purposes, populations of this species have exploded in the past 30 years with an improvement of agricultural areas and availability of clean water.

Both feral dog and camel are not listed on the IUCN Red List due to populations primarily resulting from escaped, domesticated animals. As a result, both these species are recognized as mammals of **Negligible Conservation Value**.

Birds

A total of three bird species were recorded during the baseline survey for the proposed port development. *Table 8.20* provides a list of all birds recorded indicating their local and international status along with their Conservation Value.

The bird species recorded during the baseline survey are all considered to be common resident, common breeding resident and/or common migratory species in Iraq. Similarly, all species are listed as Birds of Least Concern on the BirdLife International Database.

Populations of both Black-winged Stilt and Western Reef Egret are recognized as increasing and stable respectively. Populations of both species have benefitted from development of landscape and agricultural activities in the region, especially activities such as irrigation of crops. Both species have large global ranges and this accompanied with stable to growing populations, the species are listed as Least Concern by BirdLife International.

However, populations of Purple Heron on a global scale are decreasing, with habitat destruction recognized as the key threat to breeding grounds. Key areas of habitat include reed beds, where Purple Heron will construct nests and also predate on fish species. However, as a result of the species large range and whilst recognizing a decline in population, it is not considered to be rapidly approaching the threshold of Vulnerable, this species is listed as Least Concern by BirdLife International.

The expansive range of these species in Iraq and globally, accompanied by stable to growing populations results in a **Low Conservation Value** being applied.

Table 8.20: Bird Species Conservation Value

Common Name	Latin Name	BirdLife 2012 International Value	Conservation Value
Purple Heron	*Ardea purpurea*	Least Concern	Low
Western Reef Egret	*Egretta gularis*	Least Concern	Low
Black-winged Stilt	*Himantopus*	Least Concern	Low

Source: BirdLife International: www.birdlife.org

Marine Flora and Fauna

The marine environment clearly displays populations of zooplankton and phytoplankton that in turn will provide an important food and energy sources for fish, crustacean and in turn marine mammals. EAME interviewed several fishermen working in the area about marine mammals and they said that in their living memory that had not seen or caught any in their nets in Khor Al-Zubair, but they have been observed out in the open gulf on rare occasions. Similar findings have arisen in other Iraqi coastal studies EAME has undertaken and it seems reasonable to conclude that there is not a significant presence of marine mammals in the Khor Al-Zubair. As such given the relatively low abundance and diversity of plankton species and the river only being able to support a small artisanal (drift net and shore net) fishing community, the habitat conservation value in this regard is similarly deemed as **Low**.

8.6.1 Ecological Baseline Summary

Considering all of the above observed and inferred components of the natural environment around the project site, the overall conclusion is that the area has a negligible to low conservation value and the ecological sensitivity of the site in terms of species, habitat and regional importance is **low**.

8.7 Impact Assessment

Introduction

The following ecological impact assessment of the proposed development is focused on the terrestrial, intertidal and marine components of the project site collectively.

Construction Impacts

The construction activities that could have an impact on the ecology within the proposed development site include:

- Earthworks – clearing and levelling of the site;
- Installation of the temporary construction facilities (e.g. offices, parking areas);
- Installation of the security fence/barrier;
- Construction of Material Laydown Areas;
- Construction of roads;
- Movement of construction vehicles and operation of machinery;
- Provision of a fully functioning temporary residential accommodation;
- Piling (onshore and off-shore);
- Noise and vibration disturbance;
- Debris clearance; and
- Increase in Dust, Light and Pollution.

These activities have been assessed against the baseline ecological features identified during the surveys to assess the potential impacts on the ecology of the area.

Terrestrial Habitats

Construction works will require the levelling and clearing of an already highly disturbed area of habitat. The habitats identified within the survey area support limited, common species of flora and fauna, all of which are recognized as Low Conservation Value. Whilst the activities will involve the clearing and modification of the habitat within the survey area, the existing anthropogenic impacts and low value of the habitat result in a **Negligible Impact** during construction.

Terrestrial Flora

Direct impacts of the proposed port construction are related to the clearing process that will take place within the survey area. As recognized within the baseline survey, the existing habitats within the survey area support limited, common and widespread species of flora which is sparsely present on the site. It is therefore expected that a **Low Impact** will occur from construction.

Land Mammals

Both feral dogs and camels are highly mobile, adaptive species found throughout disturbed habitats in close proximity to human settlements within Iraq. Populations of both species have benefitted greatly from an increase in urbanization and agricultural activities within the country. Whilst it is expected that the construction works will displace the species from the immediate area, such displacement will have a very minor, localised effect on the population. Populations of both species are recognized as introduced and of negligible conservation value. As a result, the effects of the construction activities are expected to have a **No Significant Impact** on the population present.

Birds

All bird species recorded during the terrestrial ecology survey are considered to be of Low Conservation Value. The species identified within this area are recognized as common resident, breeding species with stable to growing populations globally. Species inclusive of Black-winged Stilt and Western Reef Egret have benefited considerably from the increase in urban landscaping and provision of irrigation agricultural areas within the Middle East.

Whilst construction activities are likely to result in temporary displacement of the above mentioned species, it is highly unlikely that such activities will have detrimental effects on the populations of these birds within Iraq and on a global level.

Given the stable, growing populations of the bird species identified and the low conservation values of the species, the proposed construction works for the port project will result in a **Low Impact** on the identified bird species.

Land Reptiles

Whilst the survey did not identify any reptile species, it is possible that small diurnal lizards occur within the survey area. However, even if reptiles occurred, it is expected that the populations within the survey area are very low. As a result of the anticipated low populations and small construction area within a highly disturbed habitat, it is concluded that the development will result in a **Low Impact** on reptile populations.

Marine Flora and Fauna

The piling and associated construction works will inevitably disturb the river bed and cause mobilisation of sediments as well as displace the sediment where they interact. The environment is already highly turbid with a high suspended sediment load. The temporary construction activities are not likely to make a notable contribution to the sediment load that already exists. Furthermore, the sediments that will be directly impacted by the piles have already been established as having negligible benthic communities present. The species that have been found in any sort of abundance in the marine environment are phytoplankton and zooplankton which are mobile and move with the water body (as would any fish species). These would thus not be physically impacted by the construction activities in or on the water line. The mudskipper colonies directly in the piling zones would be displaced and disturbed and the existing burrows destroyed, but relatively speaking the percentage of these burrows lost is small in surface area terms and the entire inter-tidal area is colonised so will readily adapt to the zones between the piles. The only impact scenario would be if water quality itself was impaired by the construction works, but as has already been established the construction impact will be physical. Consequently the construction impact on marine flora and fauna is considered to be a **Low Impact**.

In conclusion, the construction phase of the project is not expected to have any adverse ecological impact.

Operational Impacts

The operational activities that could impact on the terrestrial ecology within the proposed development area include:

- Increased road traffic resulting in road kill accidents;
- Artificial lighting and light pollution of the area;
- Noise and vibration disturbance associated with plant, equipment and vessels;
- Vehicle Emissions reducing air quality; and
- Physical barriers resulting in habitat fragmentation.

These activities have been assessed against the baseline ecological features identified during the surveys to assess the potential impacts on the ecology of the area from operational activities.

Terrestrial Habitats

During operation, it is unlikely that any further impacts will be associated with surrounding habitats as there are no notable species present to be disturbed. Furthermore, the area identified for the development will only result in the loss of an already highly disturbed habitat. Whilst it is recognized that the operation of the port will result in a permanent barrier restricting the movement of species, given the findings of the baseline surveys, the site supports limited species of flora and fauna all of which are recognized as common. It is anticipated that the operational impacts of the port development will be **Negligible**.

Terrestrial Flora

Any clearance of flora will take place during the construction phase. During operation, the terrestrial component of the port facility will comprise of hardstanding, limiting the establishment of species of flora. However, opportunistic species may colonise road side verges or bare patches of soil left undeveloped. The significant lack of species coverage and recognized as common species of negligible conservation value, the operational impacts of the port on flora in the area is considered to be **Negligible**.

Land Mammals

The greatest impact to those species identified within the sites boundary during the operation of the port will be caused by a barrier effect of the establishment of new roads, fences and associated infrastructure. However, the use of the land is very sporadic and it does not represent a significant habitat or colony. An increase in traffic the surrounding area is likely to result in an increase in road kill accidents, but the species abundance is so low that this too will be of very low impact. Whilst both feral dog and camel will tend to avoid the road, occasional road kill accidents are expected to occur. The impact of such accidental mortality is considered to have a **Negligible Impact** on the population of both species in the area.

A result of increased noise and light pollution on the development is expected to impact the populations of both species within the operational area. An increase in noise and light is likely to cause an initial displacement, however, it is noted that feral dogs are highly adaptable and likely to become habituated to such conditions. It is expected that they will return to the area resulting in a **Low Impact** on the mammals along the route. Similarly, the ongoing activities within the area are likely to displace camels to other areas near the site. It should also be remembered that no species of conservation value were observed.

Birds

As a result of the project, species that congregate near man-made developments i.e. port facilities inclusive of doves, sparrows and gulls are likely to inhabit the area. All have stable, increasing populations throughout the Middle East and species of dove and sparrow can be recognized as pest species. As a result, it is concluded that an increase in road traffic and potential road kills will have **Negligible Impacts** on the bird species and populations identified.

Impacts from noise and air pollution can affect birds, however as the baseline survey results indicate, the majority of species identified throughout the survey area are considered to be common breeding species that are widespread throughout the country and region. It is concluded that the operation of the facility will have a **Low Impact** on the bird population in the surrounding area.

An increase in lighting throughout the proposed development will result in illuminated conditions during the night time periods. As noted during the survey, species composition during the survey was limited. It is expected that the increase in light pollution will have a **Low Impact** on the bird population in the surrounding area.

Land Reptiles

Similarly to mammals, the greatest impact that will be experienced by reptiles during the operational phase will be the creation of a new ecological barrier to movement between habitats used for shelter, breeding and feeding.

Impacts on populations of lizards primarily associated with coastal fringe habitats are expected to increase as vehicle activities increase in the area. However, it is highly likely that the existing populations are limited, and as a result of the significant disturbance in the area, comprise of common species. The development of the road is not envisaged to cause any adverse impacts on populations within the area.

An increase in noise and light during the operational phase of the road project, due to increased vehicle movements and artificial lighting will result in possible displacement, altered behaviour and potentially affect breeding of reptile species. An increase of light throughout the road corridor is likely to affect nocturnal species of reptile, primarily gecko. However, it has been noted in certain studies that an increase in light on road side habitats ultimately led to an increase in invertebrates, the primary source for many gecko populations. As a result of an increase in food source, species have become habituated to conditions where non-natural light sources provide favourable foraging habitats, such as road side verges.

The effects of road and highway noise on reptiles is an unknown factor. Whilst it is recognized that vibrations and noise may have an impact on the movements of reptiles, those studies undertaken on roads indicate that species are unlikely to be affected by an increase in volumes. Studies undertaken in the USA indicate that a variety of reptile species happily coexist in close proximity to major highways and transport infrastructure schemes. Findings of the studies indicate that lack of reptiles in close proximity to roads is possibly attributed to road kills, rather than a noise barrier effect primarily owing to their lack of hearing. As a result, it is recognized that an increase in noise on the surrounding reptile populations during operation will result in a **Low Impact**.

Marine Flora and Fauna

Once developed the berth facilities will be a fixed feature and the marine ecology will adapt around them. The species present in the area are also adapted to anthropogenic noise and vibration from the existing port facilities and will quickly adapt to the new facilities. Similarly the presence of large vessels and the running of engines, etc is already a feature of the baseline environment and the shipping associated with the new berth will not alter this environment substantially. Consequently, the operational aspects of the development are considered to have a **Low Impact** on the marine environment.

8.7.1 Mitigation Measures

In order to minimise the impacts previously described, albeit of low significance, the following mitigation measures are recommended:

- Landscaping to comprise of native species and no irrigated vegetation;
- Clearing activities restricted to the construction corridor only;
- Minimisation of construction working area and activities, especially in the inter-tidal zone;
- A strict no approach policy to wildlife;
- Management of feral dog populations in accordance with suitable animal control procedures;

- Fencing of the construction area and no activities inclusive of driving or walking outside of the area to take place; and
- Compilation of a Construction Environmental Management Plan (CEMP) to set out pollution prevention and environmental protection measures associated with the construction activities.

8.7.2 Residual Impacts

Following the implication of the above mitigation measures, the findings of the report indicate that the proposed Terminal construction will have a **Negligible Impact** on the terrestrial, intertidal and marine ecology within the development and immediate surrounding area.

It is recognized that a loss of habitat will still occur throughout the development site, however the habitat being directly impacted is considered to be of Low Ecological Value. Additionally, the floristic species impacted are common and widespread throughout the area.

Earth & Marine Environmental Consultants

Chapter 9 – Socio-economic Conditions

Contents

9 Socio Economic Conditions

9.1 Introduction

It is normal practice in an ESIA to consider the impact on social (or socio-economic) conditions of a project where the project has the potential to influence these conditions either positively or negatively. This is particularly important where the project has a direct interaction with occupied areas and residential or business communities.

In the context of the Terminal Project, the land itself upon which the berth and associated infrastructure will be developed, is unoccupied and unused and in that respect there is no community to be directly affected by the development proposals in terms of their physical extent. From a wider perspective though there are a number of stakeholders and interested parties that could be affected by the development proposals. These include:

- Local people that access the area for fishing;
- General Company for Ports of Iraq (GCPI);
- Road Users;
- Commercial Shipping operators; and
- Local Suppliers and Contractors

That is notwithstanding the wider national issue of the facility providing an import/export hub for petroleum products and an associated contribution to the hydrocarbon economy of Iraq.

The Scoping Report that was sent out at the onset of this ESIA project to numerous stakeholders, received only a very limited response with no substantial opinions or additional information coming forward.

9.2 Methodology

In order to assess both the baseline conditions and potential impacts of the project proposals a number of consultations and surveys were undertaken as follows:

- Reconnaissance of project area and surroundings to identify potential residents and land users;
- Scoping report consultation with stakeholders;

- Interviews with local fishermen;
- Land traffic impact assessment;
- Marine traffic impact assessment;
- Interviews with "local" residents; and
- Review of published data from the area.

The information obtained from these studies and research was then used to identify:

- Communities that could be affected by or interact with the development;
- Current socio-economic conditions of those communities;
- Qualitative assessment of impacts of the proposed development on these communities; and
- Identification of mitigation and control measures where significant impacts are identified.

These issues are discussed in more detail below.

9.3 Socio-Economic Conditions

The project area is unoccupied and effectively unused. The land is effectively owned by the Ministry of Finance (MoF) (*i.e.* state owned) and under the control of GCPI. The nearest residential premises are over 5km from the project site and the land in between the project site and nearest residential properties is similarly unused and unoccupied. Consequently, there are no residential communities likely to directly interact with the project activities and site development.

The main settlement in the area is the town of Zubair or Az Zubayr as it is often referred to on maps. The population here and in the surrounding regions is made up of a number of different tribes. These include:

- Abaddah Tribe;
- Al Busalh Tribe;
- Banyscain Tribe;

- Al Sadoon Tribe;
- Shrifat Tribe;
- Sraya Tribe; and
- Tamim Tribe.

There is a lot of intermarriage between the tribes and between Sunni and Shia Muslims in this area, however, the predominant religion in the region is Shia Islam.

The other main town some way south of As Zubayr is Umm Qasr. This is similarly a mixed Sunni/Shia settlement but with Shia predominate in the area generally.

The land in between these towns is sparsely populated with some small farms and sheep rearing taking place, however, no substantive agriculture or industry (other than the fertiliser plant close to Khor Al-Zubair Port (KZP)) operates in this area.

There is no potable supply network in the area with locals tending to obtain their water from shallow wells (*circa* 20m deep). One such well, closest to the project site, is illustrated in *Photograph 9.1*:

Photograph 9.1: *Local groundwater abstraction (well and pump) 5km from project site*

There is no productive activity on the site itself, however, it does neighbour the Freezone and KZP. These are described in the desk study[1] and a discussion of such is not repeated here.

[1] WTPS Iraq Oil Terminal Desk Study, Earth & Marine Environmental Consultants, August 2014, REF: 014-1287 REV00

The other key consideration in terms of economic activity is that presently the site provides no employment opportunities and is not a purchaser of goods and services so there is no net contribution to the local economy or employment status.

The main activity that takes place in the vicinity of the project site and which could potentially be affected by it is artisanal fishing.

9.4 Fishing Activity

During the ESIA survey works fishermen were regularly observed working from the shore on the project site and the in the river from small fishing boats (see photographs below).

Photograph 9.2: *Fishermen operating along the Khor Al-Zubair western bank and river*

As part of the stakeholder engagement and socio-economic field works. EAME identified the fishermen as a key social group to focus on as being the most likely to be affected by the development proposals. Consequently, EAME engaged in the following stakeholder engagement activities:

- Interview with Basra Fishing Union Leader; and
- Interviews with boat owners and fishermen at the fishing port, on site and at the fish sellers stalls.

The fishing "Port" is an officially registered site for boats and fishermen (built in an ad-hoc fashion by locals). The boats observed on the Khor Al-Zubair operate from this port (see *Photograph 9.3*):

Photograph 9.3: *KAZ Fishing Port near Umm Qasr*

The port (which is nothing more than a concrete jetty/ramp and beach area) is approved by Basra Municipality and The Ministry of Finance (land owner) for the local fishermen to use.

The fishermen are allowed to use small fishing vessels inside the Khor Al-Zubair channel, however, large vessels (wooden and iron Dhows) can only be used on the open sea beyond Khor Abdullah.

Photograph 9.4: *Dhows (left – not permitted in KAZ) and small fishing craft (Right - Permitted on KAZ)*

All fishermen have official letters issued from central Government which entitle them to fish inside any Iraqi territorial waters (except military exclusion zones) and the river police and GCPI cannot prevent the fishermen working the river.

Small catches are sold locally, either on the water to Kuwaiti fishermen (who cannot enter Iraqi waters), or at small roadside stalls in Umm Qasr and Zubair. If they land a large catch they call a fishing agent in Basra and sell them in the markets in Basra via an agent.

The proposed project site was not a concern to the fishermen as they say that area is seldom used and they can work outside of that area from their small boats or from land further south. They are more concerned about planned development works in the small ad-hoc port they use for accessing their vessels and the waterway. Concerns have been raised by the local fishermen about plans for a new berth there which they fear will prevent them accessing this area in the future. They have said that they will insist on compensation or will demonstrate and protest if the proposed development affects their access. This site is close to Umm Qasr north and is well outside the project area.

The other main activities in the area which could interact with the project activities are land traffic and marine traffic. These are described in more detail in *Sections 9.5* and *9.6*.

9.5 Land Traffic and Transport

9.5.1 Introduction

Given the proposed truck access and road tanker loading/off-loading depot and the known congestion and long lorry queues that already occur on the main access road to KZP, it was felt prudent that a baseline traffic assessment was undertaken. The land traffic assessment encompassed the following scope of work:

- Review of base traffic data (where available);
- Collection of sample traffic data (via manual counting) at key intersections that would be used by traffic accessing the site;
- Assessment of construction related impacts (if necessary);
- Identification of traffic related mitigation measures (if necessary); and
- Identification of residual effects.

The results of the survey are discussed below.

9.5.2 Information from Desktop Study

The road network in Iraq includes motorways, highways, main or national roads, secondary or regional roads. Iraq generally has a good network of roads, notably within and running between main towns and cities, however the condition of many of these roads is poor, mainly as a result of over thirty years of war and a lack of investment in road infrastructure. A report by the World Health Organisation[2] states that in 2006 there were 2,242,269 registered vehicles in Iraq, comprising 35% cars, 53% minibuses, vans, etc. (seating <20), 7%

[2] Global Status Report on Road Safety, Time for Action, World Health Organisation, 2009

trucks and 5% buses. This total number is likely to have increased substantially since that time

The site will be connected to Highway 26 (via the KZP/Freezone access road), which runs from Umm Qasr before joining Highway 8 at to the south of the town of Zubair. Highway 26 is an asphalted dual carriageway with no central reservation. The highway has been undergoing subject to improvements since 2012, and, sections of the dual carriageway are closed. As such, these closures and the lack of central reservations mean that in many places, traffic from both ways use one side of the dual carriageway. The access road to KZP is frequently clogged with tankers waiting to load up and can lead to congestion on Highway 26. Furthermore, this is exacerbated by heavy traffic congestion (often with double parking on both carriageways) by HGVs at Umm Qasr or travelling to and from the Safwan Kuwaiti border crossing.

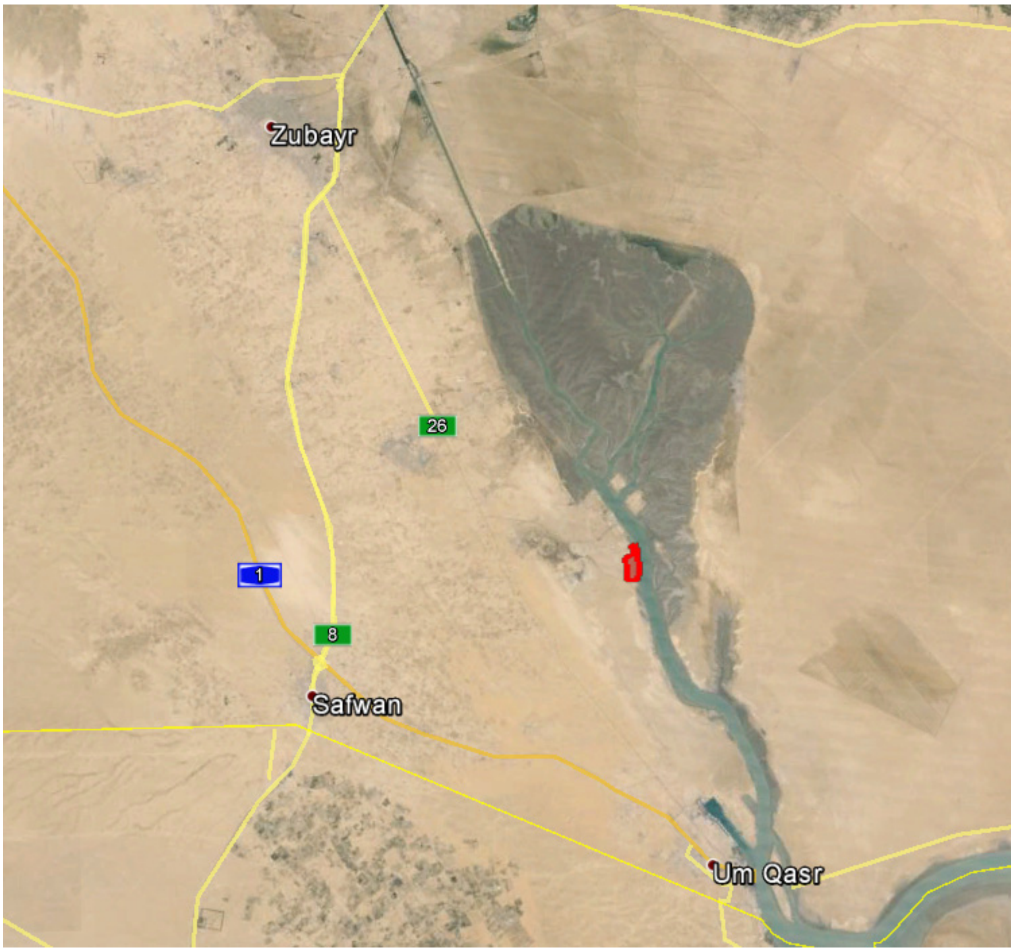

Figure 9.1: *Major road network within and around the Project Area*

Google Earth Imaging with the permission of Google – Licensed to Earth and Marine Environmental Consultants Limited

9.5.3 Field Survey Methodology

The traffic data was obtained by field surveys using local EAME staff who undertook manual counts over a three 8-hour periods over three days. The manual count of vehicles involved observers counting the number of vehicles passing a given point on a road and classifying these vehicles according to the vehicle type. In addition, any pedestrians on foot were also recorded. Traffic data was recorded onto proforma tally sheets.

The survey point is a 3-way junction. Consequently, there are six potential traffic flows that could occur at the junction at any given time (see *Figure 9.2*).

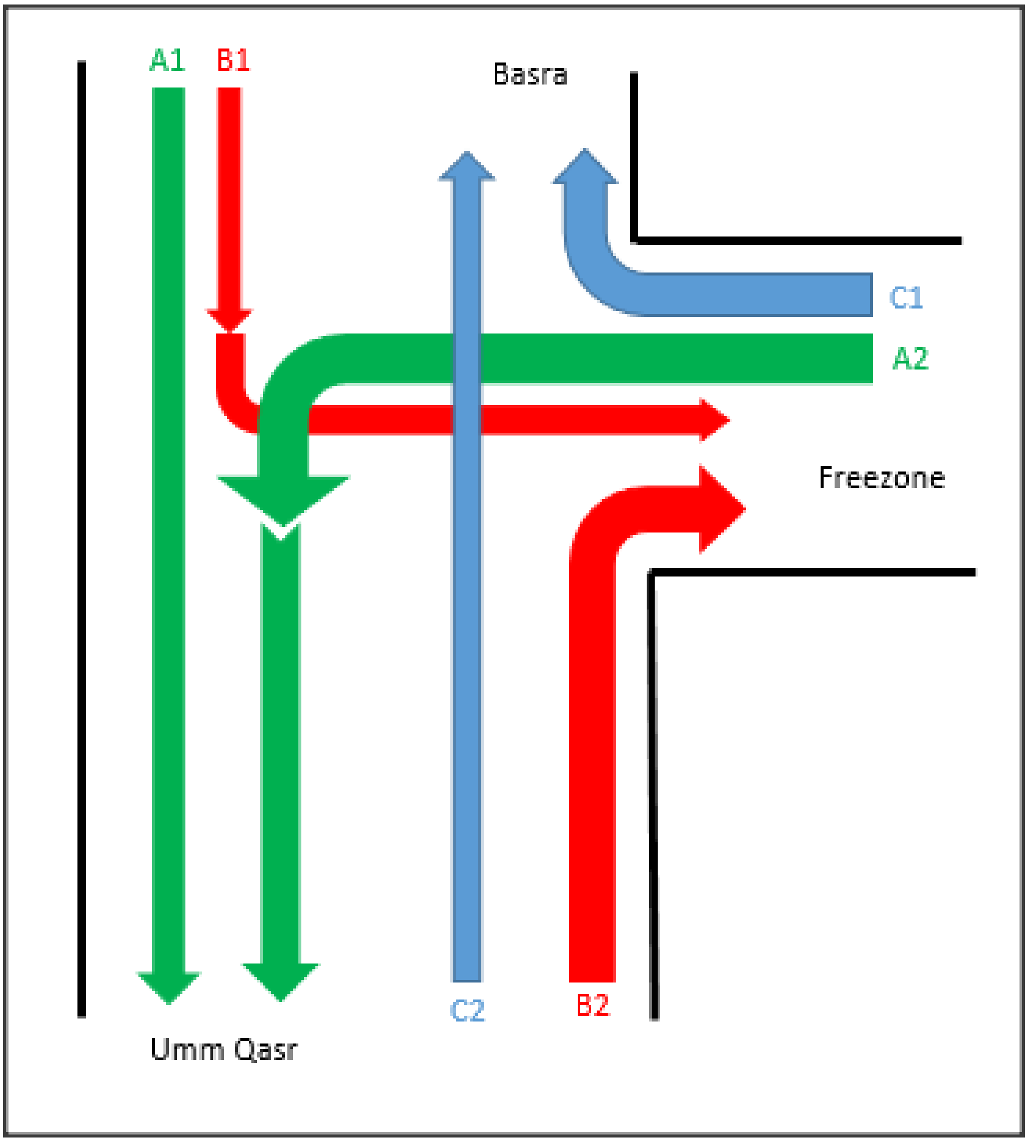

Figure 9.2: *Traffic flow directions*

The traffic flow directions are summarised in *Table 9.1:*

Table 9.1: Traffic Flow Directions

Traffic Flow Reference	Traffic Flow Direction
A1	Traffic travelling from the direction of Basrah/Zubair to Umm Qasr
A2	Traffic travelling from Khor Al-Zubair Port Freezone towards Umm Qasr
B1	Traffic travelling from the direction of Basrah/Zubair towards Freezone
B2	Traffic travelling from Umm Qasr towards Freezone
C1	Traffic travelling from Freezone in the direction of Basrah/Zubair
C2	Traffic travelling from Umm Qasr in the direction of Basrah/Zubair

9.5.4 Field Survey Location

The location of the survey was at a junction of the access road from the Khor Al-Zubair Freezone and Highway 26. The co-ordinates of the location are detailed in *Table 9.2* and the approximate location of the traffic survey point in *Figure 9.3*.

Table 9.2: Survey Location

Latitude, Longitude	Easting, Northing
30° 9'52.90"N, 47°49'45.47"E	772472E, 3340429N

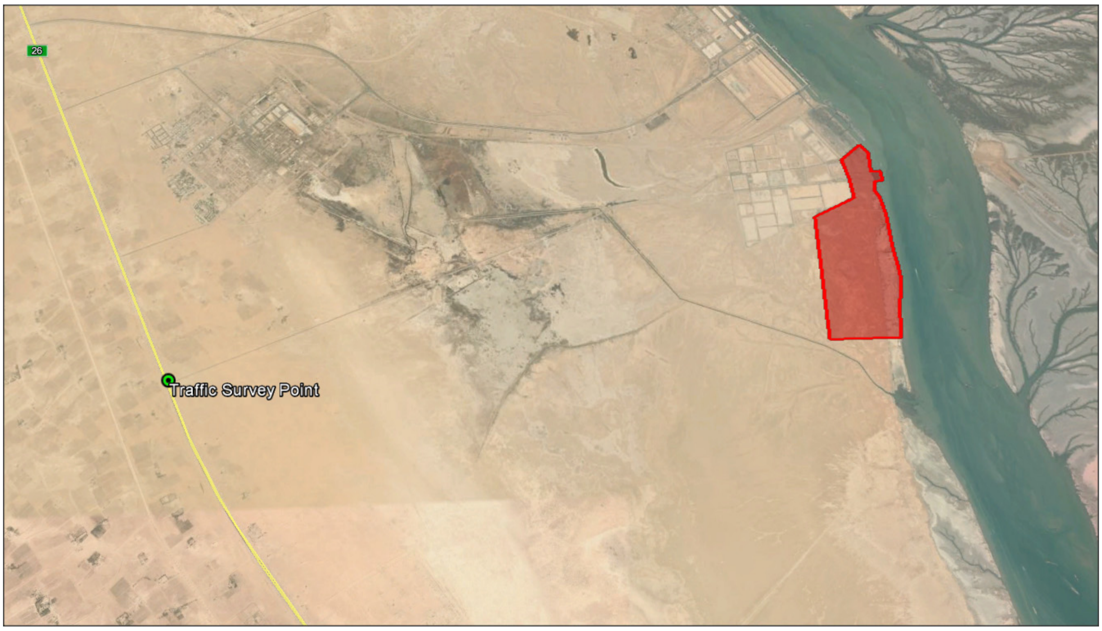

Figure 9.3: *Location of the traffic survey point*

Google Earth Imaging with the permission of Google – Licensed to Earth and Marine Environmental Consultants Limited

9.5.5 Field Survey Period

The survey was undertaken over a three day period, 27th – 29th August 2014.

9.5.6 Weather Conditions

During the traffic survey the weather conditions were considered to be favourable with relatively low wind speeds and good visibility.

9.5.7 Survey Results and Analysis

The results of the traffic surveys were recorded manually on the traffic survey tally sheets. The data from the traffic counts has been inputted to Microsoft Excel spreadsheets to allow for analysis of the information.

Table 9.3: Total Number of Vehicles per Route

Total Number	A1	A2	B1	B2	C1	C2
Vehicles	2,480	108	84	147	120	2,190
Car	1,534	26	40	25	35	1,266

Table 9.3: Total Number of Vehicles per Route

Total Number	A1	A2	B1	B2	C1	C2
Bus	344	9	11	9	14	359
Truck	401	22	17	10	28	369
Petrol Tanker	201	51	16	104	43	196

Unsurprisingly, Routes A1 and C2, the main highway between Basrah/Zubair and Umm Qasr, were the two routes with the highest number of vehicles. Route B1, from Basrah/Zubair towards the Freezone, was observed to have the lowest number of vehicles (eighty four) during the survey period.

Overall, cars were the dominant vehicle type, accounting for 57% of all vehicles observed, however, for routes A2, B2 and C1, petrol tankers were recorded more than any other vehicle type. These are the vehicles accessing the present port facilities for fuel loading. At times several hundred tankers can be seen queuing on the access road to the port.

Route A1 was found to have the highest number of vehicles for a single one hour increment with 293 vehicles noted between 08:00 – 08:59. For C2, the same time period was also noted to have the highest number of vehicles. With regards to A1 and C2, the busiest routes, the data indicates that a peak in traffic activity between 07:00 – 09:00 and then again in the evening between 17:00 – 18:00.

Tankers are prohibited from travelling on highways outside of the hours of 4pm to 4am, so their activity in terms of road travel is concentrated through the evening and hours of darkness. Outside of these times the vehicles will be seen queueing.

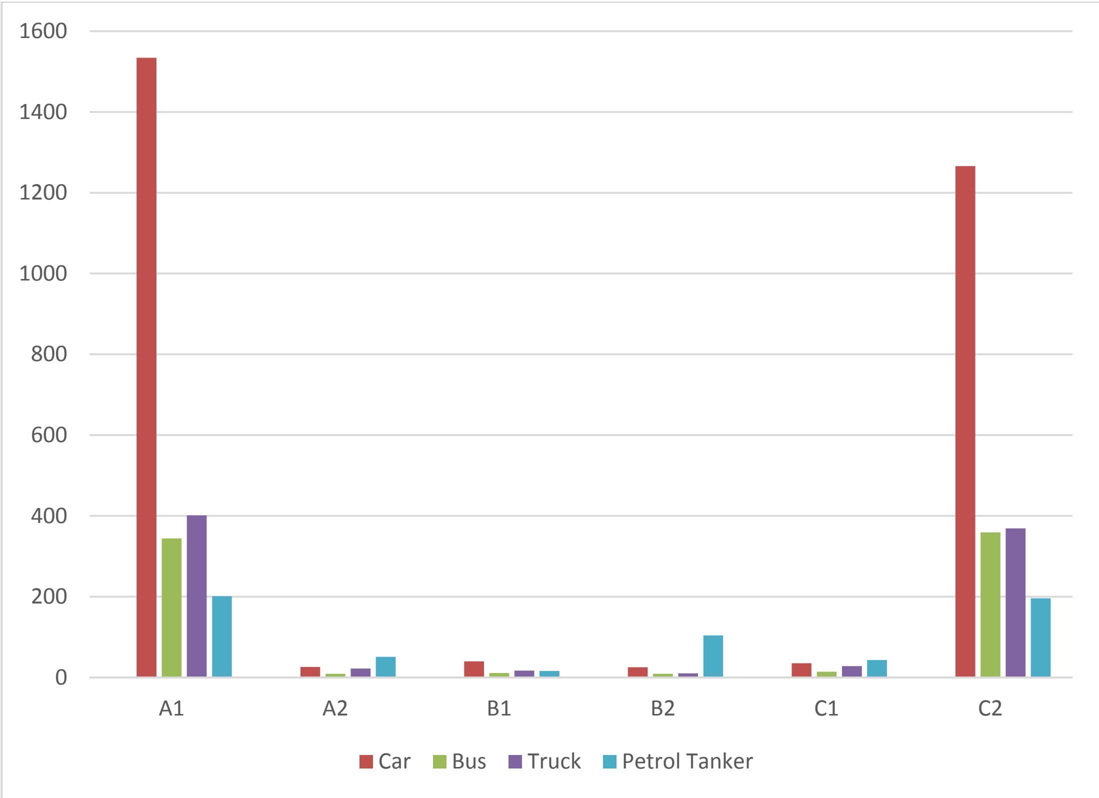

Figure 9.4: *Vehicle breakdown per route*

Figure 9.4 above clearly identifies the predominant route with total tanker numbers in excess of 200. The project is unlikely to lead to an increase in tanker numbers in the short to medium turn as the site is simply providing alternative facilities to those that already exist. In the longer term, however, as the facility develops and becomes both an import and export hub, tanker numbers may increase over those presently observed.

The future implementation of regenerated rail freight infrastructure may have a counter balancing effect and reduce HGV numbers, however, there are no definitive plans for this yet and the port has no rail related connections planned at present.

9.6 Marine Traffic

9.6.1 Introduction

Under a separate contract EAME has been monitoring marine traffic in the Terminal area for WTPS (as a precursor to this ESIA). This was undertaken to give an indication of the nature and volume of shipping traffic passing through or close to the planned terminal operations. This section provides a summary of the marine traffic information obtained to date.

9.6.2 Field Survey Methodology

The marine traffic survey was undertaken for a three month period between December 2013 and March 2014. This primarily involved the installation of AIS receivers at both Khor Al-Zubair and Umm Qasr Ports and liaison with shipping data obtained from shipping agents.

The data from the AIS receivers was plotted on UK Hydrographic Office Chartlet Number 1228 (Umm Qasr, Az Zubayr and Approaches, 2006).

9.6.3 AIS Data

Figure 9.5 overleaf shows the combined vessel tracks over the three month period. Each black line represents a vessel transit as recorded via the AIS system.

The plots appear to indicate that the vessels utilising the Khor Al-Zubair tend to use the middle and the eastern side of the channel rather than the western side. A total 57 vessels were picked up by AIS receivers under the survey period, however, it is likely that a number of these vessels docked more than once.

Photograph 9.5: *Tugs manoeuvring a tanker into a berth*

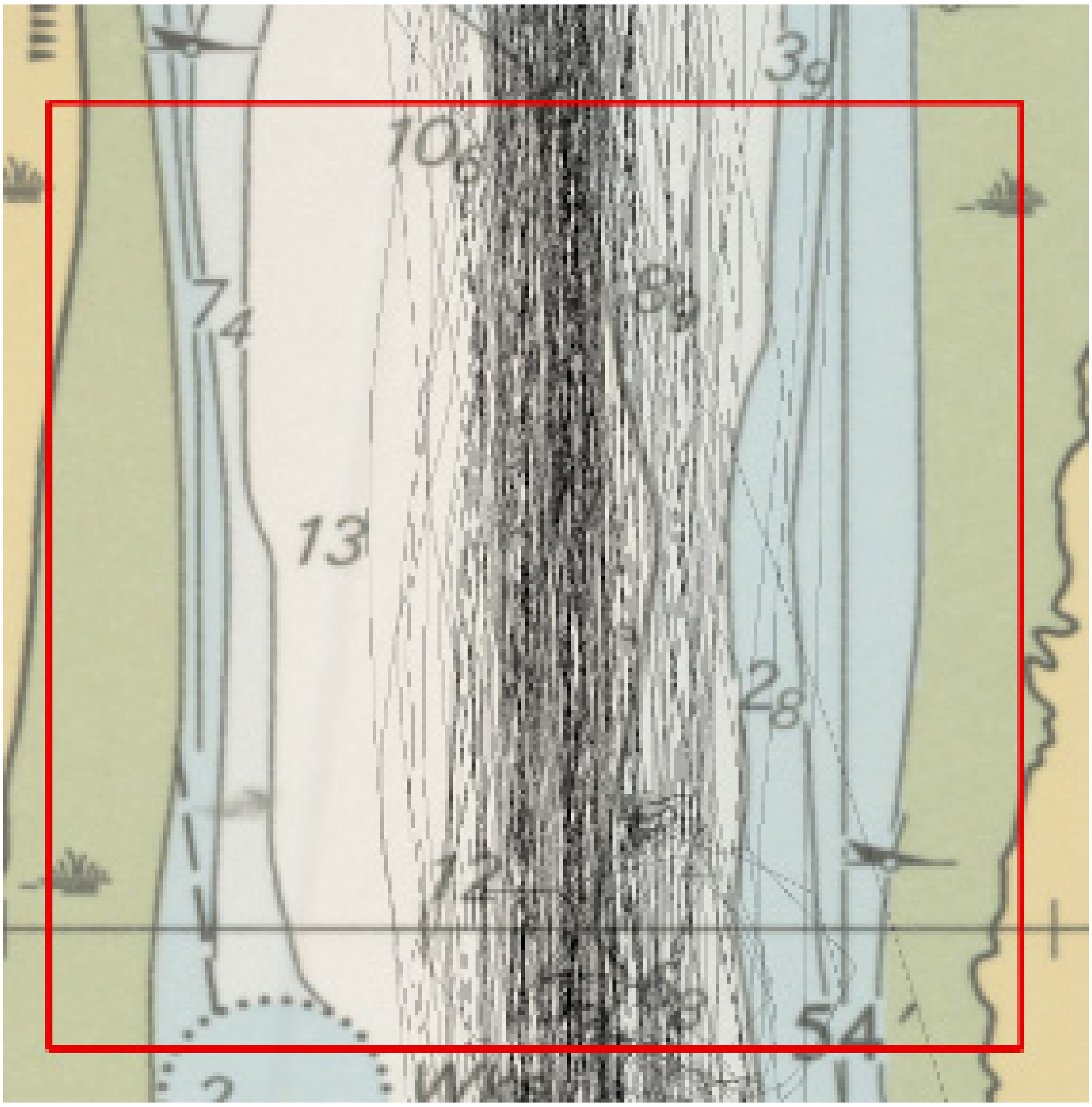

Figure 9.5: *Three month combined AIS tracks (red box denotes the approximate area of the around the proposed DWB)*

9.6.4 Shipping Agent Data

Over the survey period, the shipping agent data indicated that a total of 145 vessels docked at Berths 1 - 11, including 60 cargo vessels, 27 oil products tankers, 40 oil/chemical tankers, 13 crude oil tankers, 1 pontoon, 1 offshore deck cargo barge and 2 unknown. Out of a total of 145 vessels that docked at Berths 1 – 11, 92 individual vessels were noted, with 14 vessels docking three separate times during the monitoring period.

The data indicated that Berth 1 was utilised by the Pontoon Fatima-1, throughout the survey period, and that Berth 5 was described as a service berth. Berth 7 was the most utilised berth with 29 vessels berthing during the survey period, with the exception of Berth 1, Berth 2 was the least used with just eight vessels docking at this location.

Berths 9, 10 and 11 were utilised just for petroleum products, with all the vessels docking at Berth 9 had a cargo of gas oil. Berth 10 was noted to either be gasoline or '*loading fuel/IOTC Parcel*' as a cargo, while the vessels docking at Berth 11 was either noted to have a cargo of either kerosene or gas oil. The remaining berths were used for a mixture of commodities. The most frequent commodity over the survey period was gas oil with 36 vessels docking with such a cargo.

Noor-2 was located at Berth 7 for 60 days, the longest berthing period during the survey period. Berth 2 was found to have the highest mean berthing period (21 days) with Berth 9 the shortest mean (4 days, with the exception of Berth 1).

The mean vessel length during the survey period was 135.2m, with crude oil tankers the largest mean size (182.5m). The vessel with the largest length was the Ance (196m) which docked twice during the survey period, the smallest length vessel was the Tian Wang Xing, 20m in length. Berths 9 and 11 had the highest mean vessel length with 185.6m and 184.2m, respectively, Berth 6 was noted to have the lowest mean vessel length at 91.3m.

The mean vessel draught during the survey period was 8.56m, the vessel with the deepest draught was the High Jupiter with a draught of 13.16m. Corresponding to the mean vessel lengths, the highest mean draught was noted at Berths 9 (185.6m) and 11 (184.2m) and the lowest mean draught was observed at Berth 6 (6.2m).

During the monitoring period, the vessel with the largest cargo was the crude oil tanker Tess with 21,359 metric tonnes (mt) of gas oil. Berth 11 had the highest mean cargo quantity, 17,944mt, closely followed by Berth 9 (17516mt) while Berth 6 was noted to have the lowest mean cargo quantity (2,383mt). With regards to cargoes, the most frequent cargo over the survey period was gas oil with 36 vessels docking with such a cargo.

The marine traffic survey report should be consulted for fuller details.

9.7 Summary and Conclusions

The project site and surrounding area is unoccupied by communities or used for any cultural or social activities and as such there are no land based communities or populations that can be directly impacted by the development proposals from a land take perspective. In that respect the impacts of the proposed development are **negligible**.

The project site and activities will coincide with the local fishing community that presently uses the land area for deploying nets or which engages in drift netting in the main channel. These activities are peripatetic and the locations will vary. Given the low numbers of fishermen engaged in these activities, the large expanse of water available to them (all under similar conditions) and the fact that they can operate from numerous alternative locations, the impact of the proposals on this community is **low**.

The main road traffic intersection that will be affected by vehicles accessing the berth facility is already affected by large volumes of heavy goods vehicles (tankers) accessing the present facilities. These will be re-directed to the new facilities but the overall impact at the traffic intersection is unlikely to be significantly altered in the short to medium term. Over the longer term there is expected to be a general increase in commercial (HGV) traffic on the main road associated with the creation of new facilities and expansion of port facilities along the west bank of the Khor Al-Zubair over coming years. It is also expected over this time frame that the road infrastructure and traffic management procedures will be improved to allow them to better accommodate these traffic increases. There is also an expectation that the rail freight systems will be regenerated. Consequently, overall the impact on road traffic is expected to be **Neutral** (no significant change).

The berth will also enable the import and export of a range of petroleum products which will involve marine traffic being active in the project area. However, this is not necessarily substantially more traffic than would otherwise occur initially. It will however attend a new modern run facility designed to handle such materials effectively rather than the current KZP facilities which are older and more difficult to operate and manage. Over time, however, the new facility is likely to lead to an increase in marine traffic (assuming now similar facilities are developed). The overall impact on marine traffic is thus considered to be **Low to Moderate**. The level of marine traffic in the channel is, however, low and congestion and risk of marine collision is low at present.

The final consideration is employment. At present no people are employed on the site as there are no activities taking place there. The development works will, in addition to provide economic benefits from the procurement of goods and materials, employ construction workers, logistics personnel, consultants, engineers, surveyors and security staff associated with the construction programme. Furthermore, the completed development will require a range of staff for technical, maintenance, security, logistics, administration and management functions. The development will thus provide both short term and long-term employment and trainings and skills development opportunities and in that respect the impact is **Positive**.

Chapter 10 – Hazard Analysis and Risk Assessment (Unplanned Events)

Contents

10 Hazard Analysis and Risk Assessment (Unplanned Events)

10.1 Introduction

The technical surveys that have been undertaken to establish baseline conditions and enable impact assessments are dealt with in the previous sections of this report, but these deal with potential impacts under normal construction and operational conditions. They assume that there will be management systems and controls in place and that uncontrolled releases to the environment cannot take place. This section considers the potential impacts of unplanned events such as fires, major spills, etc. Typically, although the likelihood of such events is very low, the potential consequences can be very significant.

10.2 Potential Accidents and Incidents

The potential accidents and incidents that can be reasonably foreseen for a facility such as this are shown in *Figure 10.1* overleaf. It should be noted that these are highly unlikely but potentially possible scenarios and whilst there is not an expectation that they will occur, the impact of such an occurrence needs to be considered. The matrix that follows *Figure 10.1* discusses in more detail each possible scenario and how it might affect the identified media. Where there is the potential for the media to be affected adversely by the described event, the cell is shaded orange. Where there is unlikely to be any notable impact from the incident or occurrence described the cell is not shaded. The shaded cells thus effectively summarise the full range of impacts that could be reasonably foreseen in the event of one of the major incident or abnormal operation scenarios being realised on the site.

UNPLANNED EVENT SCENARIOS

Fire and Explosion

- Terrorist Incident or Criminality
- Plant and Equipment Failure
- ERW/UXO Incident

Spillage and Major Leaks

- Catastophic Tank or vessel failure
- Vessel collision and wrecking
- Breach of pipes, valves or fluid transfer systems

Unplanned Discharge

- Dumping of waste
- Accidental or deliberate discharge of polluting materials
- Failure of pollution prevention plant and equipment

AFFECTED MEDIA AND CONSEQUENCES

Physical Environment

- Air Quality Impacts
- Water Quality Impacts
- Soil Quality Impacts

Human Environment

- Human Health Impacts
- Socio-economic impacts
- Built Environment Damage

Natural Environment

- Habitat Damage
- Species Damage
- Productivity Damage

Figure 10.1: *Potential Unplanned Events and Consequences*

Overleaf the above Events and Consequences are set out in the risk analysis matrix.

Table 10.1: Events and Consequences Risk Matrix

Unplanned Major Event		**Environmental and Social Consequence**								
		Physical Environment			**Human Environment**			**Natural Environment**		
Event	**Scenario**	**Air Quality**	**Water Quality**	**Soil Quality**	**Heath Impact**	**Socio-economic Impact**	**Built Environment Impact**	**Habitat Damage**	**Species Damage**	**Productivity Damage**
Fire/Explosion	Large scale fire releasing plumes of smoke and fume to significant height.	All three media could be impacted by chemicals entrained in the smoke plume grounding and imparting the contaminants to the receiving media. A particular concern would be dioxins in a major hydrocarbon fire.			Any persons inhaling smoke and fume could suffer health impacts (in addition to those directly injured).	The damage to the affected facilities will have a financial impact and could lead to job losses.	Such an event is unlikely to have any notable impact on the off-site built environment.	The grounding of the smoke plume is unlikely to cause habitat damage & any coating effect will be temporary.	Species can evade the plume and are unlikely to be affected.	Biological productivity is unlikely to be affected by such an event.

Table 10.1: Events and Consequences Risk Matrix

Unplanned Major Event		Environmental and Social Consequence								
		Physical Environment			Human Environment			Natural Environment		
Event	**Scenario**	**Air Quality**	**Water Quality**	**Soil Quality**	**Heath Impact**	**Socio-economic Impact**	**Built Environment Impact**	**Habitat Damage**	**Species Damage**	**Productivity Damage**
Large Scale Hydrocarbon Spillage	Major release from vessels & pipes inundating land area.	Air quality may temporarily be impacted by vapours from a major spill.	Groundwater quality can be severely impacted by such an event.	Soil quality could be severely impacted by such an event but contamination is likely to remain localised.	There are unlikely to be any direct health impacts as any persons involved should have PPE.	There could be substantial socio-economic impacts with direct job losses.	This event is unlikely to affect any off-site built environment assets.	The area of spill is likely to be within the project site where there will be no habitat so there is unlikely to be a significant impact.	Species can evade the spill and are unlikely to be present on the site or affected.	Biological productivity is unlikely to be affected by such an event.

Table 10.1: Events and Consequences Risk Matrix

Unplanned Major Event		Environmental and Social Consequence								
		Physical Environment			Human Environment			Natural Environment		
Event	**Scenario**	**Air Quality**	**Water Quality**	**Soil Quality**	**Heath Impact**	**Socio-economic Impact**	**Built Environment Impact**	**Habitat Damage**	**Species Damage**	**Productivity Damage**
	Major release from vessels & pipes inundating water area.	Air quality may temporarily be impacted by vapours from a major spill.	Surface water quality can be severely impacted by such an event and could spread over substantial areas given the tides and wind.	Terrestrial soil quality is unlikely to be affected but sediments and inter-tidal soils could be severely impacted.	There are unlikely to be any direct health impacts as any persons involved should have PPE but people eating contaminated fish could suffer ill health.	There could be substantial socio-economic impacts with direct job losses and elimination of the local fishing industry.	There could be impacts at the ports and other riverside facilities if a large oil slick reaches them, coating facilities and infrastructure.	Habitats that are reached by any spill could be coated and severely impacted.	Benthic and inter-tidal species will be severely impacted where they come into contact with the spill and marine species could be affected by coating & longer term ingestion.	Severe contamination of the water body over a large area could inhibit or damage biological productivity.

Table 10.1: Events and Consequences Risk Matrix										
Unplanned Major Event		**Environmental and Social Consequence**								
		Physical Environment			**Human Environment**			**Natural Environment**		
Event	**Scenario**	**Air Quality**	**Water Quality**	**Soil Quality**	**Heath Impact**	**Socio-economic Impact**	**Built Environment Impact**	**Habitat Damage**	**Species Damage**	**Productivity Damage**
Dumping of Waste	Dumping of solid and liquid waste on the land.	Air quality is unlikely to be affected by such an event.	Groundwater quality could be impacted if pollutants leach out of the wastes into the groundwater.	Soil quality could be directly impacted by such an event	Health impacts could occur if the public have access to the waste areas.	There are unlikely to be any socio-economic impacts from this event	There are unlikely to be any impacts on the built environment from this event.	If the wastes are dumped in a sensitive environment habitats could be damaged.	Species can evade the waste tipping operations and are unlikely to be affected.	Biological productivity is unlikely to be affected by such an event.
	Dumping of solid and liquid waste in water.	Air quality is unlikely to be affected by such an event.	Water quality could be directly impacted by such an event.	Soil quality is unlikely to be affected by such an event.	There are unlikely to be health effects from such an event.	There are unlikely to be any socio-economic impacts from this event	There are unlikely to be any impacts on the built environment from this event.	If the wastes are dumped in a sensitive environment habitats could be damaged e.g. the inter-tidal zone.	Species can evade the waste tipping operations and are unlikely to be affected.	Biological productivity is unlikely to be affected by such an event.

Table 10.1: Events and Consequences Risk Matrix

Unplanned Major Event		Environmental and Social Consequence								
		Physical Environment			Human Environment			Natural Environment		
Event	**Scenario**	**Air Quality**	**Water Quality**	**Soil Quality**	**Heath Impact**	**Socio-economic Impact**	**Built Environment Impact**	**Habitat Damage**	**Species Damage**	**Productivity Damage**
Releases from Equipment Failure	Airborne emissions of pollutants.	Air quality may temporarily be impacted by such releases.	Water quality is unlikely to be impacted by such an event.	Soil quality is unlikely to be affected by such an event.	There are unlikely to be health effects from such an event.	There are unlikely to be any socio-economic impacts from this event	There are unlikely to be any impacts on the built environment from this event.	The grounding of the emissions is unlikely to cause habitat damage & any coating effect will be temporary.	Species are unlikely to be affected by such an event	Biological productivity is unlikely to be affected by such an event.
	Waterborne emissions of pollutants.	Air quality is unlikely to be impacted by such an event.	Water quality may temporarily be impacted by such releases.	Soil quality is unlikely to be affected by such an event.	There are unlikely to be health effects from such an event.	There are unlikely to be any socio-economic impacts from this event	There are unlikely to be any impacts on the built environment from this event.	The releases to water are unlikely to damage habitat.	Species could be impacted by toxic, nutrient rich or otherwise harmful releases.	Biological productivity could be impacted by long term releases of endocrine disrupters or toxins.

Table 10.1: Events and Consequences Risk Matrix

Unplanned Major Event		Environmental and Social Consequence								
		Physical Environment			Human Environment			Natural Environment		
Event	**Scenario**	**Air Quality**	**Water Quality**	**Soil Quality**	**Heath Impact**	**Socio-economic Impact**	**Built Environment Impact**	**Habitat Damage**	**Species Damage**	**Productivity Damage**
Release of debris from facility damage & destruction	Large scale damage to facility.	Air quality is unlikely to be impacted by such an event.	Water quality could be impacted where debris falls into the water.	Soil quality could be affected where debris is left on land.	There are unlikely to be health effects from such an event.	There are likely to be socio economic impacts from long term job loss.	The built environmental will be impacted by the loss of assets.	Habitats are unlikely to be affected as there are none on the established site.	Habitats are unlikely to be affected as there are none on the established site.	Biological productivity is unlikely to be affected by such an event.

Considering the above matrix the foreseeable environmental risk scenarios and consequences are summarised below in *Table 10.2*. This also presents the anticipated mitigation and control scenarios expected to be deployed by the operator to either eliminate or minimise the effects of such scenarios, should they be realised.

<table>
<tr><th colspan="3">Table 10.2: Environmental Risk Scenarios and Mitigation</th></tr>
<tr><th>Incident Scenario</th><th>Affected Environment</th><th>Mitigation Measures</th></tr>
<tr><td>Fire Explosion</td><td>▪ Air, Water and Soil Quality
▪ Human Health impacts
▪ Socio Economic Impacts</td><td rowspan="7">The facility will be a modern materials handling and berthing terminal designed and built to international standards. The design will go through an Engineering design, Procurement and Construction process and will be subjected to HAZOP and HAZID reviews and Construction Quality Assurance programmes. This provides the opportunity to identify and design out many potential incident scenarios and where they cannot be designed out, protection measures will be employed which include:
▪ Total Site Security (controlled access)
▪ Fire Detection and Alarm System
▪ Firefighting Capability
▪ Preventive Maintenance Programme
▪ Modern Equipment
▪ Trained and Experienced Operatives
▪ Certified Management Systems
▪ Monitoring and Audit Programmes
▪ Emergency Response Plan</td></tr>
<tr><td>Large scale hydrocarbon release to land.</td><td>▪ Air, Land and Water Quality
▪ Socio-economic status</td></tr>
<tr><td>Large scale hydrocarbon release to water.</td><td>▪ Air, Land and Water Quality
▪ Socio-economic status
▪ Human health
▪ Built environment
▪ Habitats, species and ecological productivity</td></tr>
<tr><td>Dumping of Waste on Land</td><td>▪ Water and Soil Quality
▪ Human Health Impact
▪ Habitat Impact</td></tr>
<tr><td>Dumping of Waste in Water</td><td>▪ Water Quality Impact
▪ Habitat Impact</td></tr>
<tr><td>Plant & Equipment Failure</td><td>▪ Air Quality Impact
▪ Species Impact
▪ Ecological Productivity Impact</td></tr>
<tr><td>Facility Debris from large scale damage</td><td>▪ Water and Soil Quality
▪ Socio-economic impact
▪ built environment impact</td></tr>
</table>

The design control, management systems and equipment standards being applied should ensure that the facility and all aspects of it under WTPS control are adequately safeguarded against the incident scenarios described above.

Oil Spill Emergency Response Plan

Notwithstanding the control and mitigation measures outlined above, there is still a remote possibility that things can go wrong, such as a terrorist attack breaching the security provisions or a ship or other vehicle colliding with the Terminal (very remote possibility but not completely implausible). Furthermore, one area where the operator will not have any direct control is the vessels approaching the berth. If a vessel has an incident and a major leak of oils or petroleum products occurs on approach to the berth, or one of the incidents above occurs in the storage facility, this could develop into a major water pollution incident. The Khor Al-Zubair is tidal with strong currents and mixing. This means that an oil spill (which will be buoyant and initially float), if not rapidly contained could rapidly spread over a large area upstream and downstream of the incident and possibly extending to both shores. It could also be carried out of the channel into the Khor Abdullah and, ultimately, the Arabian Gulf (contaminating Iraqi and Kuwaiti beaches en-route).

It is essential therefore that there is a robust and competent emergency response plan in place. WTPS will (in conjunction with GCPI) operate an Oil Spill Emergency Response Plan (OSERP). This is both a contingency planning and emergency response plan. It will include:

- the provision of trained rapid response personnel (with a trained response leader always on duty);
- technical response equipment (booms, skimmers, holding tanks, dispersants and monitoring and cleaning equipment);
- deployment vessels for booms, skimmers, personnel, etc;
- trained clean-up teams (manual labour and mechanical plant) for shoreline response (clean-up, wildlife rescue, oil containment, etc); and
- regular training drills including personnel and equipment testing.

The objective of the OSERP will be to firstly contain the oil as close to the source of the spill as possible, to recover as much oil (free product) as possible and decant it to safe storage (land tanks or a vessel/barge) and to monitor and if necessary provide mechanical, chemical and biological intervention at impact sites to promote the assimilation and degradation of residual oil contamination.

10.3 Summary

On an industrial facility such as this where oils and petroleum products are being handled in bulk and transferred to and from ships via pipelines between storage vessels, there is a possibility of leakage or loss from these systems, either in terms of liquid spills or a fire/explosion related incident. Furthermore if environmental management and operational procedures are not followed correctly, there could be unauthorised discharges and disposals that could impact the environment. The mitigation of such events is based upon a three pronged approach:

1. Design out potential problems where possible before constructing and operating the facility;

2. Operate high quality well maintained equipment under formal audited management programmes and standard operating procedures using trained competent personnel; and

3. Provide alarms, monitoring and emergency response teams and equipment to respond rapidly and comprehensively to any incident.

Consequently, whilst such impacts are still possible, they are highly improbable and robust intervention measures should limit the consequences of such incidents should they occur.

The worst case scenario is a major oil release to the water, but one advantage of a long linear channel is that booms can be deployed upstream and downstream of the spill to contain it and prevent tidal spread of the slick, and both shores can be accessed by personnel and equipment to effect clean up. Where impact cannot be avoided by such an incident, the system is highly dynamic (tides and mixing), high environmental temperature (water temps of 35^{o}C+ and air temps of 50^{o}C+, biologically active (bacteria) and has strong persistent winds. These conditions will promote breakdown and degradation of the oil products and recovery of the natural environment. Finally, with the exception of wading birds in the inter-tidal area (which are in very low numbers around the project site), the receiving environment is of low ecological quality and less sensitive to impact than a highly productive ecologically diverse area.

Chapter 11 – Conclusions and Summary

Contents

11 Summary and Conclusions

11.1 Introduction

The ESIA report that is presented in the preceding chapters gives an account of the proposed project and its potential impacts for each aspect of the environment that might be affected by the proposals.

This chapter summarises those findings and draws an overall conclusion on the potential impacts of the proposed development.

11.2 Project Description

The Terminal will provide berthing facilities, storage infrastructure, truck loading/unloading facilities and all associated utility and support systems for multiple berths capable of discharging vessels up to 47,000 deadweight tonnage (DWT). The construction of the terminal will be phased: the first phase being a single Deeper Water Berth (DWB) and associated pipeline connection to the existing SKA Terminal. Subsequent additional phases will include storage tanks and associated utilities, with a potential storage capacity of up to 300,000m^3. The Terminal will be constructed to the appropriate international industry standards using reliable and proven technology and will be operated in accordance with standards and practices generally prevailing in the petroleum marine terminal and storage industry.

An indicative layout of the Terminal is presented in *Figure 11.1*. It should be noted that this is based on current state of knowledge and ground conditions and may be subject to change as more detailed design studies take place. The overall concept is not expected to change significantly any material environmental impact however.

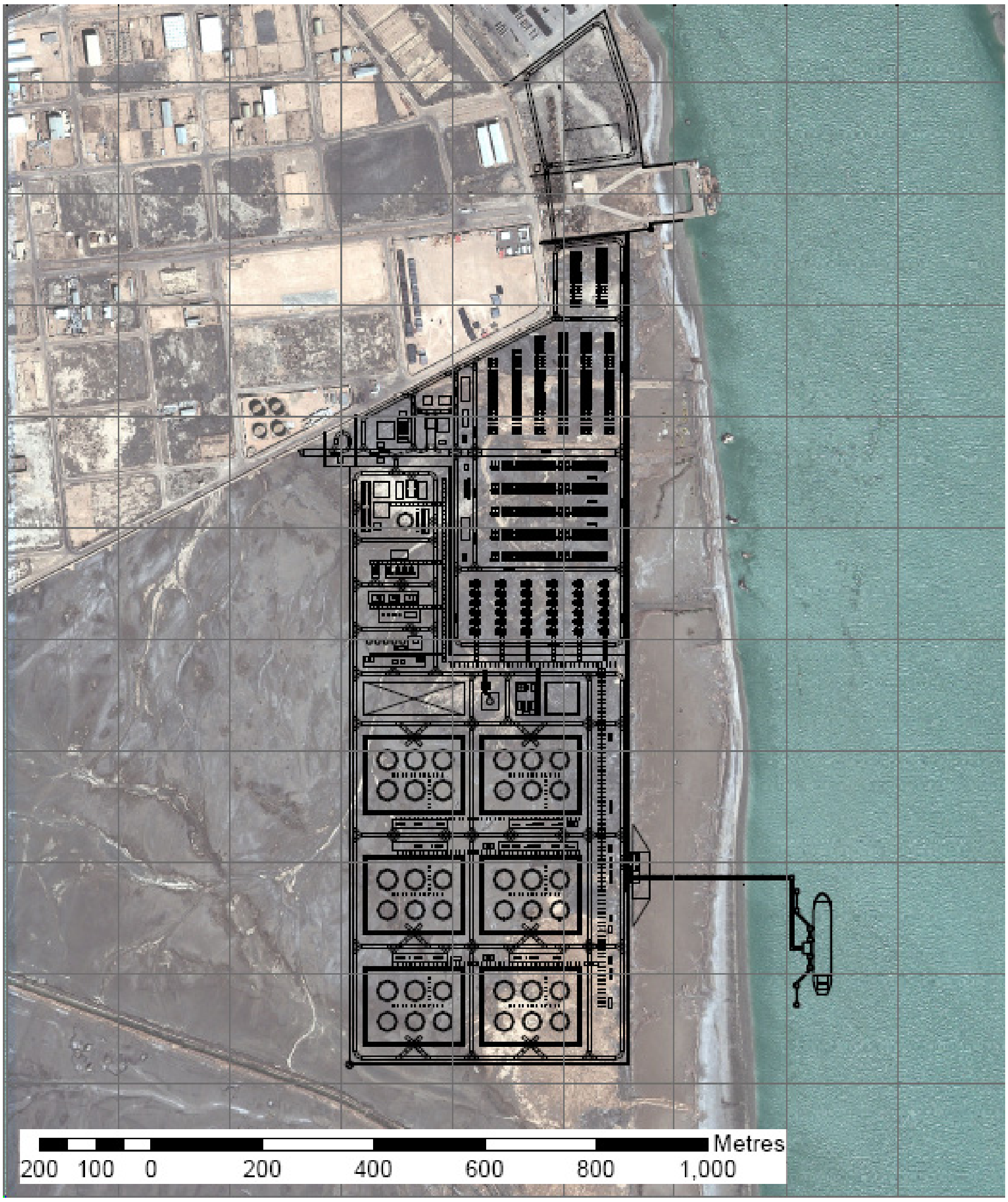

Figure 1.1: *Conceptual Development Layout*

11.3 Current Site Conditions

The majority of the site, approximately 95%, is undeveloped and vacant with sparse halophytic vegetation, unsurfaced access roads and evidence of fly-tipped waste. There is evidence of disturbance of some of the soils by heavy plant and some accumulations of earth mounds from earthworks activities. Also there is an earth bank road running along the site parallel to the shoreline with two smaller earth bank roads extending to the water line.

The northern elevation of the site comprises KAZ Jetty No. 1 and areas of unsurfaced, derelict land with areas used for the storage of scrap metal, much of which appears to be marine-derived (ship wreck clearance). It is understood that the majority of the site has never been developed.

The baseline studies have determined that on the whole the site and its immediate environment in terms of air quality, water quality, sediment quality, etc whilst disturbed is not significantly polluted. It is also true, however, that the site is of low ecological value and sensitivity.

Similarly there are no residential communities or agricultural or fishing communities close to the site or that rely on it for access or economic subsistence.

Overall, therefore, it can be concluded that the site is of low environmental and social significance and sensitivity in its present state.

11.4 Project Impacts Matrix

Table 11.1 presents each of the aspects of the development where potential impacts were predicted during the Scoping Exercise and subsequently assessed during this ESIA. The table provides an overview of the following aspects of each technical area assessed:

- Baseline environmental conditions;
- Predicted environmental impacts for both the construction phase and operational phase;
- Identification of the relative magnitude of the impact for both the construction and operational phases; and
- Identification of whether the predicted impact is positive or negative or whether there is no predicted impact.

The predictions are all based upon a comparison of the conditions that would prevail if the development does not proceed (i.e. the ongoing status of the baseline conditions) against those that will prevail if the development does proceed as described.

Table 11.1: Project Impacts Matrix

Environmental or Socio-economic Issue	Baseline Conditions	Description of Impact (After Mitigation)	Relative Size and Nature of Impact	
			Construction Phase	Operational Phase
Socio-economic Issues	There is presently no employment associated with the site or activity on the site and there are no residential communities or cultural sensitivities associated with the land or surrounding areas. There are occasional visitors to the site, for example, local fishermen use the land to access the Khor Al-Zubair and deploy fishing nets. Adjacent to the site is the Freezone (logistics and SKA Terminal) and KZP.	The Terminal would provide jobs during the construction and operational both directly and in terms of benefits to local businesses. The traffic impact is unlikely to be significant as the volume of required products will be driven by demand and there are no alternative locations for the import of such products so even if this development did not proceed, there would probably be a similar amount of marine and road traffic in the local area and at the same junctions. The fishermen that presently access the shore from the site will no longer be able to do so once it is developed, but there are numerous other locations where this practice can continue unaffected. The local fishermen were interviewed as part of the stakeholder engagement exercise and did not see the development as affecting their activities. Overall the impacts on the socio-economic conditions	+	+++

Table 11.1: Project Impacts Matrix

Environmental or Socio-economic Issue	Baseline Conditions	Description of Impact (After Mitigation)	Relative Size and Nature of Impact	
			Construction Phase	Operational Phase
		would be positive in terms of job creation and support to the general economy of southern Iraq.		
Archaeology and Cultural Heritage	The site does not contain any archaeological or religious relicts and is not culturally significant and there are no dwellings or residential communities in close proximity to the site. The surface of the site has been heavily disturbed in the past by earth moving plant (and possibly dredgings disposal).	As there is effectively no baseline to be affected for this parameter the impact would be neutral.	**o**	**o**
Air Quality	Air quality in the area is generally good with no noted benchmark values exceeded. The main issue with respect to air quality is the increase in breathable dust caused by dust and sand storms, but this affects the whole region and is not a site specific phenomenon.	Impacts of the construction on both nuisance dust and local air quality have been assessed with regards to the location of locally sensitive receptors. Whilst the construction activities (especially earth moving) have the potential to cause local nuisance, this can be controlled and minimised by effective environmental management on the site. The works would be carried out in accordance with a Construction Environmental	**o**	**o**

Table 11.1: Project Impacts Matrix

Environmental or Socio-economic Issue	Baseline Conditions	Description of Impact (After Mitigation)	Relative Size and Nature of Impact	
			Construction Phase	Operational Phase
		Management Plan (CEMP). The impacts during the construction phase are thus predicted to be moderate to minor at all receptors if not adequately controlled but insignificant with the implementation of a CEMP and the associated. Impacts during the operational phase are predicted to be insignificant.		
Noise	The site presently does not contain any activities so in that regard there are no noise sources resulting from human activities on the site. Furthermore, there are no noise sensitive receptors in close proximity to the site.	Noise levels from the construction of the development could arise, although there are no sensitive receptors close by. Nonetheless there will be noise sources on the site that do not exist presently. Impacts are predicted to be of local significance, however with the implementation of mitigation measures and a CEMP, noise and vibration impacts, which will be for short durations only and will not be continuous. They could be noticeable however and are considered to represent a minor negative impact. The noise impacts from road traffic during the	**-**	**o**

Table 11.1: Project Impacts Matrix

Environmental or Socio-economic Issue	Baseline Conditions	Description of Impact (After Mitigation)	Relative Size and Nature of Impact	
			Construction Phase	Operational Phase
		construction are not considered to be significant, with the estimated levels of noise from construction haulage at the nearest noise receptor being well below the respective noise criteria at the nearest residential properties. The impacts from road traffic during the operational phase are considered to be insignificant given that there is very little difference between the vehicle traffic accessing KZP and that accessing the new facilities instead. The road traffic noise that prevails at present will continue to be the road traffic noise that dominates in the future at the closest residential receptor. Once operational, the predicted noise emissions generated within the proposed development from mechanical services, plant and day to day operations is predicted to be insignificant to the nearest residential receptors.		
Ecology and	The development site does not support a wide variety of	There will be a loss of habitat such as it is on the areas	**o**	**o**

Table 11.1: Project Impacts Matrix

Environmental or Socio-economic Issue	Baseline Conditions	Description of Impact (After Mitigation)	Relative Size and Nature of Impact	
			Construction Phase	Operational Phase
Nature Conservation	ecological species and is not so important from a nature conservation perspective. The majority of the site is occupied by disturbed ground and patches of sabkha vegetation. The Inter-tidal area houses mudskipper colonies (which are ubiquitous along the banks of the Khor Al-Zubair). The most interesting feature of the site is its potential as a site for wading birds, although only a handful of birds have been observed on the site during any of the survey visits. The waters of the marine environment are highly turbid are likely to have low biological productivity and species diversity. Overall the project site is considered to be of low ecological value.	where new infrastructure will be developed, but the species affected (sabkha vegetation and mudskippers) are abundant and will rapidly recolonize in adjacent areas so the overall impact will be neutral.		
Water Quality and Hydrology	The water quality in both the surface water and groundwater is relatively un-impacted by human	The site construction activities would be managed under a CEMP and pollution of waters is not anticipated.	o	o

Table 11.1: Project Impacts Matrix

Environmental or Socio-economic Issue	Baseline Conditions	Description of Impact (After Mitigation)	Relative Size and Nature of Impact	
			Construction Phase	Operational Phase
	activities (other than coliforms in the surface water). The groundwater is highly saline due to the marine nature of the environment and land forming processes there and the Khor Al-Zubair is a tidal estuary. Although the area has been a site of armed conflict, there was no development and infrastructure here to be damaged and release pollutants so the set presently does not pose a pollution threat to surface and groundwater resources.	Furthermore, water required for the operational activities will be brought in by tanker and not abstracted locally. Under normal operating conditions, all polluting materials will be within managed and monitored containment systems so pollution from site activities is not anticipated.		
Soils, Geology and Contamination	The site investigation has not identified any significant contamination on the site in either the soils or sediments (although there are some elevated metal species present). This is not unexpected as there have been no polluting activities on the site to date (other than localised storage of vessel scrap which may have led to some localised surface contamination). The geology of the area is relatively consistent	Based on the site investigation findings, specific remedial measures will not be required on the site and the development overall will have a minor positive impact by removing the few contaminants and waste materials that are present to an appropriately authorised facility. Following redevelopment, the site will be under predominantly hard-standing with controlled drainage such that any spillages or releases should be contained	o	+

Table 11.1: Project Impacts Matrix

Environmental or Socio-economic Issue	Baseline Conditions	Description of Impact (After Mitigation)	Relative Size and Nature of Impact	
			Construction Phase	Operational Phase
	comprising sands, silts and clays.	and pollution of the soils avoided.		
Waste Management	The site does not presently generate any wastes from activities per se, but there are large quantities of scrap metal on the site from shipwrecks and debris on the foreshore that has been deposited by tides. There is also evidence of asbestos cement sheet (isolated fragments) amongst the scrap metal waste.	The project would generate wastes. The site works will be covered by a CEMP which, amongst other things, will seek to identify all wastes generated by the construction activities and set out management measures for these. To ensure adequate standards of waste management during the operations, a facility Waste Management Plan would be developed and implemented which will set out the appropriate measures to be employed for the management and disposal of wastes and pollution prevention. Although significant impacts are not expected from waste generating and management activities on the site, the fact that the site does not presently generate any waste but would in the future is a minor negative impact.	-	-

KEY: - Negative Impact, + Positive Impact -/+ Minor Impact - -/++ Moderate Impact - - -/+++ Major Impact o Insignificant Impact

11.5 Conclusions

The Terminal development proposals have been assessed in relation to their potential to impact upon the environmental conditions that currently prevail on the site and in the surrounding area. This assessment has considered the environmental quality and sensitivity of the area around the proposal site.

The environmental impacts of the construction of the project are typically minor and negative and are largely a function of the inevitable disruption caused by a major redevelopment project and especially the initial earthworks phases which are unavoidably intrusive. The long lasting/permanent impacts associated with the development are, on the whole, either neutral (environmentally insignificant) or, more frequently positive.

The most notable impact is the major positive impact related to job creation and contribution to the Iraqi economy. In overall terms then, the principal conclusion of the ESIA is that despite some localised, temporary negative impacts, the overall effect of the development will be positive in terms of socio-economic benefits.

The mitigation and enhancement measures that have been proposed in the ESIA to reduce adverse impacts (and enhance potential benefits) have been captured in a Commitments Register. The commitments that relate to the operating phase of the Terminal will be incorporated into the Environmental and Social Monitoring and Management Plan (ESMMP).