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Nawara Concession

Updating of Environmental Impact Assessment for Nawara Concession Development Project - Central Processing Facility

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Project : Updating of Environmental Impact Assessment for Nawara Concession Development Project – Central Processing Facility

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ACRONYMS AND ABBREVIATIONS

ANGed	Agence Nationale de Gestion des Déchets
ANPE	Agence Nationale de Protection de l'Environnement
bbl	barrel
bcm	billion cubic meter
boe	barrel of oil equivalent
CI	Continental Intercalaire
CPF	Central Processing Facility
CRDA	Commissariat Régional de Développement Agricole
DGRE	Direction Générale des Ressources en Eaux
EAM	Environmental Assessment and Management
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
ETAP	Entreprise Tunisienne d'Activités Pétrolières
GHG	Greenhouse Gas
GIS	Geographic Information System
GWP	Global Warming Potential
HSE	Health, Safety & Environment
HSEQ	Health, Safety, Environment, & Quality
IMS	Integrated Management System
INM	Institut National de la Météorologie
ME	Ministry of Environment
MMSCMD	Million Metric Standard Cubic Meter Per Day
NGL	Natural Gas Liquid
ODS	Office de Développement du Sud
ONAS	Office National de l'Assainissement
SCMD	Standard Cubic Meter Per Day
SCFM	Standard Cubic Feet Per Minute
SOTULUB	Société Tunisienne de Lubrifiants
SPC	Spill Prevention and Control
STGP	South Tunisia Gas Pipeline
SVOCs	Semi-Volatile Organic Compounds
TD	Total Depth
TEG	Tri Ethylene Glycol
TRAPSA	Trans Saharan Pipeline Company
TSP	Total Suspended Particles
UTM	Universal Transverse Mercator
VOCs	Volatile Organic Compounds

EXECUTIVE SUMMARY

Introduction

The presence of hydrocarbons (gas and condensate) has been proven in the following exploration wells: Nawara-1, Khouloud-1, Fella-1, Rytma-1, Benefsej-1, Benefsej Sud-1, Souroure-1, Ahlem-1 and Ahlem-2. These wells were drilled between 2006 and 2012 in the Nawara area. In this regard, OMV (Tunesien) Production GmbH., referred hereafter to as OMV, intends to develop these structures to produce gas and condensate.

With reference to the Decree no. 2005-1991 of July 11th, 2005, related to the Environmental Impact Assessment (EIA), the planned project falls within Annex 1 (*Categories A 6-Oil and natural gas exploration and production projects*). As such, it requires an EIA which intends to:

- ✓ Describe the project;
- ✓ Analyse the relevant features of the existing environment;
- ✓ Identify and assess possible environmental impacts of the project;
- ✓ Propose mitigating measures to reduce or avoid adverse environmental impacts of the project;
- ✓ Outline the Environmental Management Plan for the proposed project.

Environmental Assessment & Management "EAM s.a." was contracted by OMV to prepare an environmental impact assessment for the proposed development project in line with the relevant reference terms established by ANPE.

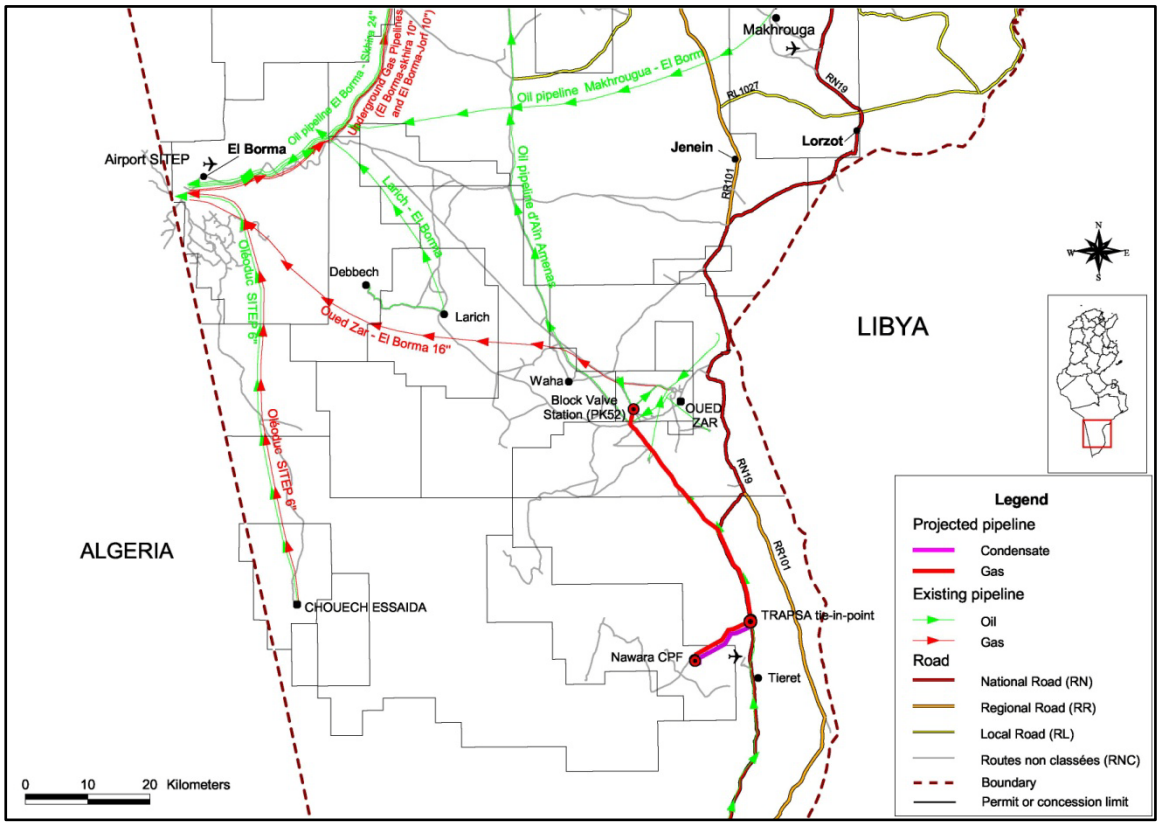
This introductive section consists of a contextual presentation for the Nawara concession Development Project. It explains in detail the framework, the objectives and the necessity to undertake an EIA. It also provides an overview of the organization of the document and presents the policy and strategies adopted by OMV for the management and the protection of the environment.

Project Overview

The Nawara concession development project will include:

- ✓ A Central Processing Facility (CPF) adjacent to the Nawara-1 well location ;
- ✓ An in-field production 6" flowline system connecting each of the producing wells Nawara-1, Khouloud-1, Fella-1, Rytma-1, Benefsej-1, Benefsej Sud-1, Souroure-1, Ahlem-1 and Ahlem-2 to the CPF ;
- ✓ A condensate export pipeline running from the CPF to TRAPSA pipeline;

- ✓ A gas export pipeline running from the CPF to STGP tie-in point from where it will be transported to Gabes.



Processing facilities at the CPF are made up of:

- ✓ An in-field production flowline system connecting each of the producing well to the CPF;
- ✓ A system of gas, condensate and water separation;
- ✓ A condensate stabilization unit ;
- ✓ A 5,000 bbl fixed roof tank ;
- ✓ A gas compression unit ;
- ✓ A TEG Dehydration Unit ;
- ✓ A propane chilling unit ;
- ✓ An oily water recovery station ;
- ✓ Two 5 MW gas turbines ;
- ✓ All necessary utilities for the operation of the CPF (power, water, compressed air, etc.);
- ✓ A Gas sweetening unit;
- ✓ A permanent operating base.

The CPF is designed to provide separation, treatment and stabilization of the well fluids at a production rate of 2.7 MSCMD of gas and 7000 SBPD of condensate. Stabilized

condensate will be routed by pipeline to the TRAPSA pipeline, while a gas pipeline will carry gas to GTP at Ghannouch.

The CPF will be installed on a 2.25 hectares area immediately adjacent to the Nawara-1 well. Two 5 MW gas turbines will provide the required power for the needs of the base camp and equipment.

The Nawara base camp will be used to accommodate the plant operating workforce consisting of about 10 people.

Constructing the facilities at Nawara area and installing the flowlines and export pipelines will involve four construction steps:

- ✓ Civil engineering works to level the sites and install concrete foundations ;
- ✓ Erection and connection of buildings, pipelines and equipment;
- ✓ Lay out, connection and testing of flowlines and pipelines; and
- ✓ Commissioning of the facilities.

The CPF construction works will last about two years and is expected to provide employment for up to 300 people. OMV will develop a separate construction camp to accommodate the contractors workforce engaged in construction activities.

Diesel supply will be made by truck. It will be stored in accordance with health, safety, security and environment rules to be used for the power need of base camp and equipment.

During the production phase, fuel gas from the dehydration unit gas outlet line or from the stabilizer column overhead gas line will be used for power generation. Estimated fuel gas consumption is around 0.1 MMSCMD.

All necessary and efficient communication means will be available for work needs and workforce safety.

Liquid, gaseous and solid wastes generated due to project activities will be managed in accordance with Environmental Management Plan.

Baseline Environment

The baseline analysis of the study area has been developed based on literature and collected data from field survey.

For the needs of environmental analyses, all the biophysical and socioeconomic sensitivities were set in their geographical context by a Geographic Information System (GIS).

(i) Physical Environment

The average annual temperature in the area is 22.6°C and the average minimum temperature is 4.3°C in January and the average maximum temperature is 41.7°C in July. Rainfall is very irregular with an annual average of approximately 51.4 mm.

The wind regime is mainly from the West and East during the winter and from the East, North-east and South-east during the autumn.

The annual average number of days of sandstorms is 30 days. The highest number of windy days was recorded during the spring season (March-April-May) with 19 sandstorm days.

The Nawara concession development project area is composed of mobile dunes of the Great Oriental Erg and outcrops of the Dahar plateau. Altitudes in the region vary between 200 and 450 m.

A complex dune field, made up of transverse dunes, occupies part of the western edge of the field with plateaus, buttes and mesas occupying the remainder.

The regional geology is characterized by upper Cretaceous sedimentary rocks underlying a calcaro-sandstone forming the major Dahar plateau of the Cenomanian and Turonian periods. Soils in the study area are fragile.

Surface waters are scarce or even negligible. Any surface flow that is present constitutes a closed system which does not discharge to a permanent surface water body. There are no known shallow aquifers within the project area. There is only one main aquifer, the Continental Intercalaire, which is found at a depth of approximately 600 m.

(ii) Biological Environment

Preliminary desk-based investigations suggest that the vegetation cover in the region is generally limited due to the high temperatures and scarce rainfall.

At least 33 species of flora were identified in the Nawara field area and which have Mediterranean and saharosindian origin. These species are listed in details in the present report.

The phyto-ecological inventory as well as a detailed description of the main identified species within the study area during the environmental field survey carried out by EAM, from 22 to 25 April 2009 are included in the present EIA.

The region is characterized by diverse Saharan fauna. The species that occur are physiologically adapted to the various environmental stresses associated with the desert

environment. No protected natural zones or National Parks are present within the study area.

(iii) Human Environment

The study area is located in the sector of Borj El Khadra, delegation of Remada within the Governorate of Tataouine. The Remada delegation has 9977 inhabitants with a population density of approximately 0.25 inhabitant per km^2.

The Borj El Khadra sector mainly consists of military personnel and shepherds who are found in the area on a seasonal basis. Generally, there are no agricultural activities of importance in the study area.

Transhumance is a very old practice in the Dahar. It extends over a period of six months each year. It begins after the first autumn rainfalls and lasts to late spring. Watering locations determine the destination of transhumance and nomadic pastoral activities.

The most valuable natural resources within the area are its oil and gas reservoirs.

Infrastructure is also very limited within the study area. A 24" oil pipeline as well as the National Road RN-19 and the Regional Road RR-101 and a number of tracks joining them from the West, pass eastern the Nawara field.

Based on the archaeological field survey, carried out by EAM from 22 to 25 April 2009, Nawara field immediate surroundings did not reveal any significant traces of ancient culture.

Expected Effects

The impact assessment of the proposed development project is based on the significance of the impact. This indicator assesses the gains and losses for the natural and human components of the environment associated to the project. It integrates the intensity, the extent and the duration of the impact.

The most significant sources of impact are the routine atmospheric emissions from the CPF exhaust gases. The operating specification for this equipment is well within the emission limit values fixed by the Decree no. 2010-2519 dated 28 September 2010, fixing the maximum concentration of air pollutants from stationary sources. Therefore, the maximum pollutants concentration will be considerably lower than the Tunisian ambient air quality threshold (NT 106.04).

The CPF will be equipped with compressors, pumps, turbines and compressor piping which are potential sources of high noise. High noise levels are mitigated by acoustic

insulation on compressor piping, shelters on compressors and pumps, and enclosures on turbines. During project design every effort will be made to reduce operational noise to an acceptable level that is as low as practicably feasible by practicing good engineering design in the context of the overall needs of the project. The design goal is to limit the noise level at the CPF limits to below 70 dB(A) and the interior noise levels at sensitive noise receptors such as medical facilities and sleeping accommodations at base camp to below 45 dB(A).

Production water will be evacuated to watertight evaporation pits. Black and sewage waters will be temporarily generated from the construction camp. These effluents will be properly drained and completely contained in septic pits before being transported to Tataouine wastewater treatment plant. The system will be correctly sized according to the number of workforce. Sanitary waters from the permanent operating base will be treated on-site in a sewage treatment plant for possible use as green spaces irrigation water or injection into a filtering well.

The CPF and base camp will include dikes in areas used to store and transfer oil and chemicals, so that any spillage will be contained and recovered. OMV will implement a waste management system.

During the construction phase, the project will be beneficial to local service companies. Throughout the operation phase, the transportation of the CPF production will reinforce the country's autonomy in energy and improve the balance payment and foreign currency reserves.

However, potential accidental events may give rise to some environmental interactions. Among these, the most damaging may occur from a hydrocarbon spill from a pipeline or following a gas leak or explosion. Though it is unlikely, in the event that this happens, the environmental impact will be non negligible.

Environmental Management Plan

The environmental management plan prepared by OMV to manage any activity which could be a source of potential environmental risk includes the following:

- ✓ Mitigation Measures: Mitigation measures are established by OMV in order to avoid, reduce or eliminate the adverse consequences of the project on the biophysic and socioeconomic environment.

  The primary measures for avoiding and mitigating the potential impacts of the project on the environment are listed in the table below:

Environmental Impacts Register

Project Phase	Potential Negative Impacts	Mitigation Measures	Responsibility	Cost ($)
Construction Phase	Air pollution: dust and engine exhaust fumes Noise nuisance Traffic accidents: increased risk	✓ Impose speed limits. ✓ Use covers for dusty loads. ✓ Use water sprays to prevent airborne dust (maximizing recycling opportunities). ✓ Use wheel washers to prevent transfer of mud to public roads. ✓ Prevent "black smokes": ensure all vehicles engines are well maintained. ✓ Limit the work area to flowlines ROW. ✓ Use a safety barrier to separate pedestrians and vehicles in high-risk areas. ✓ Switch off engines when not in use. ✓ Schedule road traffic movements to avoid noise sensitive periods, periods of high pedestrian risk and maximum background traffic movement. ✓ Install temporary road signage and lighting.	EPC Contractor	Included in the project cost
	Public security hazards	✓ Do not store pipes outside designated lay down areas. ✓ Erect perimeter security fence and appropriate warning notices. ✓ Forbid access to unauthorized people.	EPC Contractor	Included in the project cost
	Impact on Health, Safety & environment	✓ Elaboration of Health and safety procedures for project site ✓ Elaboration of an "Emergency Response Plan" ✓ Provision of medical (first aid, medical equipment, medecins, etc.), and communication and transportation means ✓ Provision of firefighting equipment ✓ Provision of Oil spill response equipment ✓ Staff training in the Health, Safety & Environment aspects ✓ Display of instructions and markup of the project area	OMV	100 000
	Permanent damage to natural landscape Ecological disturbance Interference with other land users	✓ Where appropriate, plough to break-up and loosen all compacted soil when the construction work is finished. ✓ Use existing tracks and follow the defined flowlines ROW as closely as possible. ✓ Abandon the flowlines ROW in order to discourage their use after the proposed activities. ✓ Take all reasonable measures to reinstate disturbed areas to the original condition. ✓ Where required, install drainage system with the aim of reducing soil erosion by rain water runoff.	EPC Contractor	Included in the project cost

	Unsuitable storage of wastes causing diseases Risks to health and safety and the environment as a result of poor control of hazardous waste Odour nuisance	✓ Post-installation, clear surrounds of all rubbish, debris, and surplus/defective construction materials. ✓ Make appropriate provisions for the collection of wastes from the construction site, with the fundamental objective of keeping hazardous, inert industrial and domestic wastes separate. ✓ After use, the radioactive source will be returned in the same conditions of storage and transport than those for imports to the country of origin. ✓ Establish a general policy of "waste minimisation" in the following order of priority: - Reduce production at source; - Reuse in the same process; - Recycle for use elsewhere. ✓ Only use disposal as the final option, and by incineration with energy recovery if feasible. ✓ Establish a "consignment notes" system to ensure wastes transferred to subcontractors are properly transported and disposed of off-site in the manner intended by company. ✓ Provide suitable waste containers (with lids) at all major points of waste production. ✓ Forbid disposal of wastes by any other method than this on-site service. ✓ Provide suitable sanitary facilities for workers during construction phase.	OMV	125 000
Operational Phase	Operational Noise	✓ Facilities are equipped with acoustic enclosures and silencers. ✓ Establishing a system to monitor noise levels at the site and surrounding areas. ✓ OMV plans to carry out a noise monitoring within Nawara CPF by a specialized company	OMV	30,000
	Soil Contamination	✓ Storage of chemical products in containers or on pallets equipped with plastic dust cover against severe weather. ✓ Construction of diked storage areas for the storage of oil and hazardous substances. ✓ Storage of used oil and oil filters in metal drums to be delivered to SOTULUB. ✓ Recovery and transport of flowlines scraping products in order to be treated by a specialist company authorized by the Ministry of Environment ✓ Managing waste in conformity with Law no. 96-41 of 10 June 1996 relating to waste and the control of its management and disposal.	OMV	20,000

	Impact on Air Quality	✓ Adequate regulation and control of combustion process and parameters (excess air, residence/stay time, gas recirculation, etc.) in order to maximize energy efficiency and save fuel consumption and hence reduce emissions. ✓ Development and implementation of maintenance procedures for equipment, accessories and filters used for emissions reduction. ✓ Establishing a system for monitoring gas emissions in the CPF. ✓ Regular maintenance of equipment to avoid excessive fuel-gas consumption and minimize volatilization of unburnt components. ✓ Promotion of renewable energy (solar, wind, etc.). ✓ Gas will be flared in a Low Pressure flare assuring a perfect combustion of gases.	OMV	50,000
	Impact on Groundwater	✓ Disposal of the produced water in watertight evaporation pits ✓ Monitoring program of groundwater quality	OMV	Included in the initial project cost
	Impact on Health and Safety	✓ The establishment of safety and health instructions within the project area. ✓ The establishment of a specific emergency response plan predicting the actions to be taken in case of accidental situations. ✓ Existence of a medical service on site (rescuers, equipment care, medicines, etc.), Means of communication and transport. ✓ The organization of training and awareness sessions, at the beginning of the works, relating to personnel safety. ✓ The use of visible signs with instructions to mark out the CPF area.	OMV	50,000
Decommissioning	Soil and Groundwater Contamination	✓ Removal of installations according to the best practices so as to prevent air and soil pollution. ✓ Following procedural guidelines while cleaning up and treating any pollution discovered during decommissioning. ✓ Site restoration as near as possible to its original aspect. ✓ Information and meetings with relevant regional and national authorities.	OMV	100,000

- ✓ Waste Management Plan: Waste management plan will be drafted in accordance with Law no. 96-41 of June 10th, 1996 relating to waste and the control of its management and disposal. Particularly:
  - sludge as well as oily wastes such as oily rags are entrusted to an authorized company for treatment and disposal;
  - process oils, engine oils, hydraulic oils and gears lubricants which result from the systematic maintenance of the equipment and engines will be stored in metallic containers and delivered to the SOTULUB for reprocessing;
  - medical waste are recovered by a specialized company and should in no case left on the site;
  - sanitary waters would represent about 3 m^3/day. They will be evacuated to a sanitary watertight pit of approximately 24 m^3 located near the base camp. These effluents, which meet the public discharge requirements of the Tunisian Standard NT 106.02 will be removed by a vacuum truck on a regular basis and transported towards the ONAS wastewater treatment plant in Tataouine;
  - organic waste (estimated at 10 kg/day) which is collected and entrusted to Eco Waste Management company for disposal in a controlled landfill;
  - plastic bottles and metallic cans are collected by an authorized company and delivered to the nearest ECO-Lef center;
  - plastic films used for packaging are delivered to ECO-Lef center of Tataouine;
  - wood pallets as well as scrap metal are sorted and delivered to companies authorized by the ministry of environment for waste collection and recycling;
  - package of milk and juice as well as yoghurt cups are transported to a controlled landfill;
  - catalysts will be regenerated for reuse;
  - metallic drums, used batteries and filters are entrusted to an specialized company for treatment and recycling.
- ✓ Emergency Response Plan: For emergency response, OMV should have on site sufficient quantities of products and equipment as well as medicines and emergency facilities to fight against pollution and fire. Moreover, OMV will work out safety and emergency response plan covering any exceptional situation that may arise on the working site.

- ✓ Environmental Monitoring Program: Environmental monitoring is necessary to gauge the operating impacts on the site. By implementing plans with sufficient detail, it is possible to minimize and control waste generation, limit physical disturbances, and operate in a responsible manner. The environmental monitoring program will be implemented by the field crew in accordance with the Environmental Management Plan and includes:
  - The decennial check of the tightness of oil tanks in conformity with the regulation in force ;
  - Monitoring of the management system of wastes generated by the project and holding of a waste tracking register;
  - Bi-annual monitoring of groundwater quality in a water well located in the vicinity of the project area (Nawara water well) during the exploitation phase. This monitoring program will include the analysis of the following elements: hydrocarbons, salinity and mineral salts ;
  - Hazardous waste treatment by companies authorized by the ME;
  - Commitment to submit, during the production phase, a periodic report on the management system of hazardous waste.

- ✓ Competence Building & Staff Training Plan: Although people who are hired by OMV for the CPF operations are skilled professionals, it is necessary to provide them with training sessions designed to increase their operational efficiency. Training is divided into technical, theoretical and practical and supervised by OMV HSSE responsible.

- ✓ Local Recruitment Plan : The local recruitment plan will aim to identify and maximize the profile of positions that can be filled by local population. It consists in defining the system and places of recruitment and develop a staff monitoring system.

- ✓ Documentation & Environmental Communication : The success of the environmental management system of OMV requires a good communication with stakeholders about its environmental aspects.

  The following table outlines the different stakeholders' responsibilities in the preparation of documents and communications.

Guidelines for Communication

Author	Addressee	Frequency	Situations' Description
EPC Contractor	OMV	Start of work	Presentation of training and HSE programs for review and approval
EPC Contractor	OMV	Weekly	Waste Management Report
OMV	ANPE	Quarterly (During the production phase)	Environmental Report
OMV	ANPE	Bi-annual	Underwater quality monitoring report
OMV	ANPE	Before decommissioning	Environmental Impact Assessment for Nawara production facilities Abandonment
OMV	ANPE	After decommissioning	Reclamation Report for Nawara Production Facility

The cost of the Nawara production facility development project is estimated at 330 MM$.

The cost related to the Environmental Management Plan is estimated at 330 000 dollars.

1.0 INTRODUCTION /JUSTIFICATION OF THE PROJECT

1.1 Introduction

1.1.1 Purpose of the Report

This report is prepared for OMV who intends to develop the Nawara concession in the Tunisian desert to produce gas and condensate.

With reference to the Decree no. 2005-1991 of July 11th, 2005, related to the Environmental Impact Assessment, the planned project falls within Annex 1 (*Categories A-6. Oil and natural gas exploration and extraction projects*). As such, it requires an EIA (*Article 2*) which aims at supporting OMV in considering the environment in the proposed project. For this purpose, the operator has to comply with legal, regulatory and administrative requirements in force along with environmental standards and best practices in the oil and gas industry.

This report presents the results of an EIA, a study intended to:

- ✓ Describe the project;
- ✓ Analyse the relevant features of the existing environment;
- ✓ Identify and assess potential environmental impacts of the project;
- ✓ Propose mitigating measures to reduce or avoid adverse environmental impacts of the project;
- ✓ Outline the Environmental Management Plan for the proposed project.

1.1.2 Scope of the Report

The report describes the features of the proposed development project which may potentially give rise to environmental impacts. The significance of the potential impacts is assessed against defined criteria. Measures are also described to mitigate significant impacts.

The scope of this report is based on the following texts:

- ✓ Decree no. 2005-1991 of July 11th, 2005 relating to the Environmental Impact Assessment;
- ✓ The relevant terms of reference established by the “Agence Nationale de Protection de l’Environnement”;
- ✓ Contract between OMV and Environmental Assessment & Management for the development of the present Environmental Impact Assessment.

In the context of these specifications, environmental impacts have been considered for the biophysical environment and socio-economic conditions.

1.1.3 Structure of the Report

The remainder of the report is set out as follows:

Chapter 2 : summarizes the main regulatory texts relating to the environment and the petroleum activity in Tunisia,

Chapter 3 : introduces the involved parties;

Chapter 4 : defines the study area;

Chapter 5 : presents a detailed description of the project;

Chapter 6 : provides an analysis of the existing environment focusing on most likely elements to be affected by the project;

Chapter 7 : explains the impact assessment methodology;

Chapter 8 : identifies and assesses the potential impacts which could arise as a result of the installation and the operation of the proposed facilities;

Chapter 9 : describes the proposed measures to prevent, reduce or offset adverse project effects;

Chapter 10 : outlines the Project Environmental Management Plan.

1.2 Justification of the Project

This justification deals with the following aspects:

- ✓ Technical;
- ✓ Environmental;
- ✓ Socio-economic.

1.2.1 Technical Justification

The treatment process is based on a technology that has proved its effectiveness and reliability. In addition, this type of facilities and equipment meets the conditions of safety precautions.

1.2.2 Environmental Justification

The proposed development will be carried out in a remote and non developed area that does not present any particular environmental concerns. However, the proposed facilities will be designed, installed and operated with due respect and safeguard of the environment. With the good practices in the oil and gas industry, the generation of pollution is limited to the accidental situations that are managed by specific Emergency Response Plans established for this purpose.

1.2.3 Economic Justification

The proposed project allows, at the same time, to make use of the existing infrastructures, such as the existing wells and the TRAPSA pipeline, and to increase the potential of exploitation of country energy resources.

The project falls within Tunisia's policy which encourages the development of natural resources especially in the energy sector.

Spread on at least 20 years, the Nawara concession development project will positively impact directly and indirectly the national and regional economy. This project will allow to:

- ✓ Develop country natural resources;
- ✓ Contribute to satisfy the country energy demand;
- ✓ Improve the foreign currency balance;
- ✓ Develop, generally, the industrial sector.

2.0 REGULATORY COMPLIANCE

In addition to its Corporate Environmental Policy and Oil and Gas Industry Best Practices, OMV is committed to conduct its operations in line with national regulations and international agreements to which Tunisia is a signatory.

2.1 Tunisian Legislation and Standards

The main regulatory texts governing the environment and the petroleum sector in Tunisia are the following:

- ✓ Law no. 66-27 of April 30th, 1966 relating to the promulgation of the Labor Code, mainly the articles 293 to 324, as amended and completed by the Law no. 96-62 of July 15th, 1996 and the Law no. 2007-19 of April 2nd, 2007.
- ✓ Law no. 75-16 of March 31st, 1975, relating to the promulgation of the Water Code, as amended by Law no.2001-116 dated 26 November 2001. The Water Code contains various dispositions managing, safeguarding and valorizing the public hydraulic domain. According to the terms of article 109 of this code, it is illegal to let flow, discharge or throw away into the public hydraulic domain any residual waters as well as waste or substances susceptible of affecting the public health or the good use of these waters for potential usage.
- ✓ Law no. 82-60 of June 30th, 1982, relating to the works of establishment, laying and operation of pipelines of public interest intended to the transportation of gaseous, liquid or liquefied hydrocarbons as amended and completed by the Law no. 95-50 of June 12th, 1995.
- ✓ Decree no. 84-1556 of 29th December, 1984, relating to industrial lots. According to the terms of article 26 of this decree, the noise level measured at the nearest residence during the day time should not exceed 50 decibels. Supplementary precautions should be taken in order to avoid any discomfort to residents during the night.
- ✓ Decree no. 85-56 of January 2nd, 1985, relating to the organization of waste disposal into the receiving environment. It fixes the conditions regarding the regulated or illegal waste disposal into public sites.
- ✓ Order of the Minister of the Industry and the Commerce of September 17th, 1987 enacting the Tunisian standard NT 109.02 related to the transportation of liquid hydrocarbons by pipelines.
- ✓ Law no. 88-20 of April 13th, 1988 as modified by the Law no.2005-13 of January

26th, 2005, relating to revision of recasting the Forest Code, which includes the set of special rules applying to forests, esparto surfaces, pasture land, forest occupied land, national parks and reserves, wild fauna and flora, in an effort to ensure their protection, conservation and rational exploitation as well as to guarantee that the users legally exercise their rights.

- ✓ Law no. 88-91 of August 2nd, 1988, relating to the creation of the "Agence Nationale de Protection de l'Environnement" (ANPE) as amended and completed by the Law no. 92-115 of November 30th, 1992, the Law no. 93-120 of December 27th, 1993 and the Law no. 2001-14 of January 30th, 2001. According to the terms of article 8 of this law, the operators who impact the environment or whose activities cause environmental pollution through solid, liquid or gaseous waste are required to eliminate, reduce or eventually recuperate the discharged matters as well as to repair the resulting damages. The National Environmental Protection Agency (ANPE) is allowed to go to court and defend any case in order to restore any damages to the public properties.
- ✓ Order of the Minister of National Economy "Ministre de l'Economie Nationale" of July 20th, 1989, enacting the Tunisian standard NT 106.02 which defines the conditions for discharging waste effluents into the water system (marine public domain, hydraulic public domain and public pipe network).
- ✓ Law no. 90-56 of 18 June 1990, regarding the encouragement of exploration and production of liquid and gaseous hydrocarbons.
- ✓ Decree no. 90-2273 of December 25th, 1990 defining the internal regulation of the ANPE inspectors.
- ✓ Law no. 94-35 of February 24th, 1994, relating to the Patrimony Code of Archaeology, History and Traditional Arts. In case of accidental discovery of sites, concerning prehistoric or historic ages, arts or traditions, the developer is required to immediately inform the corresponding services of the Ministry in charge of Patrimony or the closest regional authorities in order to inform the concerned services, within a period not exceeding five days. The specialized authorities will take all the necessary measures of preservation by themselves or if needed the supervision of the ongoing works.
- ✓ Order of the Minister of National Economy of December 28th, 1994, enacting the

Tunisian standard NT 106.04 concerning the limit values and guideline values of pollutants into the ambient air.

- ✓ Order of the Minister of National Economy of August 15th, 1995, enacting the Tunisian standard NT 109.01 relating to safety procedures for construction of combustible gas transport pipelines.
- ✓ Law no. 96-41 of June 10th, 1996, relating to waste and the control of its management and elimination as amended by the Law no. 2001-14 of January 30th, 2001. The waste products are classified according to their origin as domestic waste or industrial waste and according to their characteristics as hazardous, non-hazardous or inert waste. The management mode of the hazardous waste is regulated. The list of hazardous waste is fixed by the Decree no. 2000-2339 of 10 October 2000.
- ✓ Law no. 97-37 of June 2nd, 1997 instituting the rules relating to the transport by road of hazardous materials to avoid risks and damages likely to affect people, goods, and the environment. Hazardous materials are divided into 9 classes. The list and definition of materials of each class that could be transported by road are determined by decree.
- ✓ Law no. 99-93 of August 17th, 1999 relating to the promulgation of Hydrocarbons Code, as amended and completed by law no.2002-23 dated 14 February 2002, and Law no.2004-61 dated 27 July 2004, and Law no.2008-15 dated 18 February 2008. The Hydrocarbons Code defines the judicial regime of preliminary exploration activities, exploration, the search and the exploration for hydrocarbons, as well as the equipment and the installations pertaining to the execution of these activities namely its articles 76 to 89.

  "The Holder of a Prospecting Permit, an Exploration Permit and/or an Exploitation Concession is required to carry out his exploration and exploitation activities in compliance with the applicable legislation and regulations relating to the technical sector, security, protection of the environment, agriculture land, forests and water in the public domain".

  In the absence of an applicable legislation, the Holder shall comply with the rules, criteria, and safe practices in use in the petroleum industry in similar environment.

  The Holder is also required to:

  - Carry out an environmental impact study in compliance with the applicable legislation and regulations and which shall be agreed upon, prior to any

exploration and exploitation phase;

- Take all the measures in order to protect the environment and to respect the commitments taken in the impact study as agreed upon by the Granting Authority.

The Holder of an Exploration Permit, a Prospecting Permit or an Exploitation Concession is required to restore the rendered area and the working sites to their initial condition so that no prejudice shall occur on short or long term basis to the people's safety, the environment, the resources, in compliance with the applicable legislation and regulations".

- ✓ Decree no. 2000-967 of May 2nd, 2000, fixing the geographical coordinates and the summits reference numbers of the elementary perimeters constituting the hydrocarbons blocks.
- ✓ Law no. 2001-14 of January 30th, 2001, stating simplification of administrative procedures in relation with the authorizations delivered by the Ministry of Environment and Land Use in the domain of its competence.
- ✓ Decree no. 2002-335 of February 14th, 2002, fixing the threshold value beyond which the waters consumption becomes subject to mandatory periodic technical diagnosis of the equipment, works and production modes linked to water usage, the conditions of appointing the experts, the nature and the periodicity of the diagnosis. By reference to Article 1 of this decree, industries and activities whose water consumption exceeds 5000m^3/year are subject to mandatory periodic technical diagnosis.
- ✓ Decree no. 2002-693 of 1st of April 2002, fixing the conditions and modalities for lubricants and used filters recovery, in an effort to ensure their rational management and to avoid any discharge to the environment.
- ✓ Law no. 2004-72 of August 2nd, 2004 related to energy consumption control as amended by the Law no. 2009-7 of February 9th, 2009.
- ✓ Decree no. 2004-2144, dated 2 September 2004, setting the conditions for energy consuming companies' liability to be subject to compulsory periodic energy audit. Under Article 13, new energy consuming projects with a total erected power intended for electricity-supplied industrial equipment equal or higher than a megawatt are subject to the compulsory consultation of the national energy control agency prior to the commencement of the execution of such projects, with a view of ensuring the project energy efficiency.

- ✓ Decree no. 2005-1991 of July 11th, 2005 relating to the Environmental Impact Study which abrogated the Decree no. 91-362 of March 13th, 1991. According to this decree, projects are classified in two categories:
  - Annexe 1: Units subject to the EIA listed in Category A (Units subject to an opinion within twenty-one working days) or in Category B (Units subject to an opinion within three working months).
  - Annexe 2: Units subject to the Book of Specifications (BOS) approved by a decree of the Minister in charge of the environment and that defines the environmental measures to be followed by the promoter or the applicant.

  The EIA must be performed by specialized consulting companies or experts in environment. Its contents must reflect the foreseeable impact of the unit on the environment and, as a minimum, comprise the following elements:

  1. Detailed description of the unit.
  2. Analysis of the initial state of the site and its environment, notably the elements and the natural resources to be, likely, affected by the project.
  3. An analysis of the foreseeable, direct and indirect consequences, of the unit on the environment, and in particular the natural resources, different species of fauna and flora and zones benefiting from a legal protection, notably the forests, the natural or historic zones and scenery, the sensitive areas, the protected spaces, and the national and urban parks.
  4. The measures planned by the promoter or the applicant to eliminate, reduce and, if possible, indemnify the negative environmental impacts of the unit and an estimation of the associated cost.
  5. A detailed environmental management plan for the unit.

- ✓ Decree no. 2005-2317 of August 22nd, 2005, relating to the creation of the National Waste Management Agency "Agence Nationale de Gestion des Déchets", ANGed. With reference to the article 8 of this decree, the Agency prepares the specifications and the authorizations files relating to waste management in accordance with the regulation in force and follows up their execution. Besides, the Agency is assigned to keep an eye on the registers and the notebooks that must be hold by the professional establishments and the enterprises in charge of the collection, the transportation, the elimination and the recovery of wastes for their account or for the account of others.

- ✓ Decree no. 2005-2933 of November 1st, 2005, establishing the remit of the Ministry of the Environment and Sustainable Development (Ministère de l'Environnement et du Développement Durable, MEDD), which includes the requirement that the Tunisian government respects international environmental agreements.
- ✓ Order of the Ministry of Industry, Energy and Small and Medium-Sized Enterprises dated November 15th, 2005 setting the list of Hazardous Establishments. With reference to the heading **2511** of this list, the CPF is classified in the 1st category.
- ✓ Decree no. 2005-3079 of November 29th, 2005, fixing the list of the hazardous substances which are transported by road inevitably under the control and with the accompaniment of the security units.
- ✓ Decree no. 2005-3395 of December 26th, 2005, fixing the conditions and the modalities for collecting used accumulators and batteries.
- ✓ Order of the Minister of the Environment and Sustainable Development of March 23rd, 2006, relating to the creation of a hazardous waste treatment unit and reception, storage and transfer centres.
- ✓ Order of the Minister of Agriculture and Hydraulic Resources of July 19th, 2006 fixing the list of rare and endangered wild fauna and flora.
- ✓ Decree no. 2006-2687 of October 9th, 2006, defining the conditions for opening and operation of Hazardous Establishments.
- ✓ Law no. 2007-34 dated June 4th, 2007 relating to the air quality.
- ✓ Decree no. 2010-2519 dated 28 September 2010, fixing the maximum concentration of air pollutants from stationary sources.
- ✓ Order of the Minister of Agriculture of September 11th, 2012, relating to the organization of hunting for the season 2012-2013.

The described regulating texts cover most of the environmental issues. According to the nature of the questions, we can refer to the following information sources:

- ✓ The Hydrocarbons Code ;
- ✓ The Labor Code ;
- ✓ The Urbanism and Land use Code ;
- ✓ The Archeological, Historical and National Traditional arts Heritage Code ;
- ✓ The international conventions ratified by Tunisia.

2.2 International Regulations

The Tunisian environmental legislation extends to the following international conventions:

- ✓ Convention for the protection of the cultural and natural world heritage, adopted in Paris on October 17th to November 21st, 1972 (ratified by Law no. 74-89 of December 11th, 1974).
- ✓ Convention on the conservation of the migratory species belonging to the wild fauna, adopted in Bonn June 23rd, 1979 (ratified by law no. 86-63 of July 16th, 1986) ;
- ✓ Convention for the protection of the ozone layer, Vienna March 22nd, 1985 (adherence of Tunisia by Law no. 89-54 of March 14th, 1989);
- ✓ Protocol on substances that deplete the ozone layer, Montreal September 16th, 1987 (adherence of Tunisia by Law no. 89-55 of March 14th, 1989);
- ✓ United Nations Framework Convention on Climate Change signed in 1992 in Rio, ratified by Tunisia on July 15th, 1993. Tunisia has the obligation to publish the information related to the national inventory of greenhouse gases and to provide an action plan to combat climate change and mitigate its adverse effects;
- ✓ The United Nations Convention on Biological Diversity signed by Tunisia in Rio de Janeiro on June 13th, 1992 and ratified on May 3rd, 1993;
- ✓ The Kyoto protocol to the United Nations Framework Convention on Climate Change strengthens the international response to climate change, adopted in Kyoto on the 10th of December 1997 (adherence of Tunisia by Law no. 89-54 of June 19th, 2002);
- ✓ The Stockholm Convention on persistent organic pollutants (POPs) adopted on May 22nd, 2001 and approved by Tunisian Law no. 2004-18 of March 15th, 2004.

2.3 International Criteria

In the absence of Tunisian environmental standards, we are inclined to consider North American, European, World Bank, World Health Organisation Guidelines, etc.

3.0 PRESENTATION OF THE INVOLVED PARTIES

3.1 Presentation of the Operator and the Production Concession

3.1.1 Presentation of the Operator

Company	:	OMV (Tunesien) Production GmbH.
General Manager	:	Mr. Oswald Reinhard Josef
Address	:	Immeuble Waterside - Rue du Lac Turkana Les Berges du Lac 1053 Tunis
Phone	:	+ 216 71 162 000
Fax	:	+ 216 71 162 555

OMV is an integrated, international oil and gas company with three core business segments: Gas and Power (G&P), Refining and Marketing (R&M) and Exploration and Production (E&P).

3.1.2 Gas and Power

OMV integrated Gas and Power (G&P) business segment operates across the entire gas value chain. OMV have long-proven partnerships with major gas suppliers to assure stable supply to our markets and also produce gas at our own fields. With 2,000 km gas pipeline network as well as gas storage facilities with a capacity of 2.4 bcm, OMV is a major contributor to security of supply in Austria and beyond. Additionally, it is driving the Nabucco gas pipeline project, which will also increase Europe’s security of supply. The Central European Gas Hub (CEGH) is the most important gas trading platform on the gas routes from East to West and also operates a gas exchange. The gas hub in Baumgarten is Central Europe's largest gas distribution node for Russian gas.

3.1.3 Refining and Marketing including petrochemicals

OMV operates refineries in Schwechat (Austria) and Burghausen (Southern Germany), both with integrated petrochemical complexes. Together with the Petrobrazi refinery (Romania) and 45% stake in Bayernoil (Southern Germany), these give a total annual processing capacity of 22.3 mn t (450,000 bbl/d). The retail network consists of approx. 4,500 filling stations in 13 countries including Turkey. With strong retail brands, high quality non-oil business (VIVA) and an efficient commercial business, we have a leading position in the market.

3.1.4 Exploration and Production

OMV is successfully exploiting its core assets in Romania and Austria and has a well-balanced International portfolio. In 2011, OMV's oil and gas production was 288 kboe/d and its proven reserves were about 1.13 bn boe at year-end. More than two-thirds of its production comes from Romania and Austria –the remainder from a growing international portfolio. Oil and gas account for around 50% each of overall production.

3.1.5 OMV in Tunisia

Tunisia has an important place in the history of OMV, as it was the location of E&P's first international exploration and production project in 1971. Since then, Tunisia has become an important part of the company's North Africa core region with the acquisition of Preussag's international business in 2003, which held seven exploration and production licenses in the country.

Tunisia offers a stable economic climate and excellent growth opportunities, and is a vital source of potential future growth especially in natural gas. OMV's activities are currently focused on drilling and infrastructure development in the Ghadames Basin in the south of the Country and on exploration and field redevelopment in the Gulf of Gabes. Net production in Tunisia is around 12,000 bbl/d.

OMV E&P entered Tunisia in 1971, as a partner in the Marin du Golf d'Hammamet license in which oil was discovered 1977. The Halk el Menzel concession was awarded in 1980 in which OMV acquired Shell's remaining interest in 1990.

In 2003 OMV acquired the international assets of Preussag Energie which were comprised of TPS which operates four concessions and Serept, which operates the Ashtart concession on behalf of OMV and ETAP, the Tunisian state oil Company. In the same year, OMV signed the Jenein Sud Exploration license. In 2005 the Warda-1 exploration was successfully drilled and tested, resulting in the first of a series of gas-condensate discoveries in this license. Since then, OMV has consolidated its portfolio by selling the Chergui and Halk el Menzel concessions and acquiring 80% of the Sidi Mansour exploration block in the Gulf of Gabes.

In terms of further activities, OMV is working on the development of the Nawara concession, which was granted within the Jenein Sud exploration area and contains most of the discoveries.

OMV strives to use its production expertise in Tunisia to maximize recovery from the current oil production facilities in the Gulf of Gabes.

The Ashtart field is located approximately 60 km offshore in the Gulf of Gabes in a water depth of 66 m. The field was developed with a platform complex and an offloading vessel in 1974, which makes it the first offshore development in Tunisia. Current Ashtart production is around 10,000 bbl/d.

The TPS fields, one offshore and 4 onshore, are located in the vicinity of Sfax and Kerkennah Island. The oil production of around 5,000 bbl/d is treated and collected at two stations from where it is transported to storage and offloading facilities in La Skhira.

OMV's exploration activities in Tunisia are presently focused on Sidi Mansour, where seismic data have been gathered in the shallow waters between Sfax and Kerkennah Island to evaluate drilling prospects.

Following completion of successful drilling campaigns, further activities are planned in the Jenein Sud exploration license.

In November 2009, OMV commenced a five-well drilling campaign in Jenein Sud and, early 2010, was granted the Nawara production concession, (50% OMV, 50% ETAP (Tunisian State Oil Company). Development work is on-going and includes the construction of field infrastructure and the STGP, which will facilitate the transportation of gas from the south to Gabes and on to the Tunisian domestic market.

In early 2012 and after Pioneer acquisition, OMV has boosted its activities in South Tunisia

- ✓ Production increased by 55% to 10.1 kboe/d in 2011
- ✓ Nine consecutive successful wells proved >400 bcf gas (>68 mn boe)
- ✓ 2 OMV operated rigs drill for South Tunisian oil development project

The figure below shows OMV Tunisia assets in Tunisia.

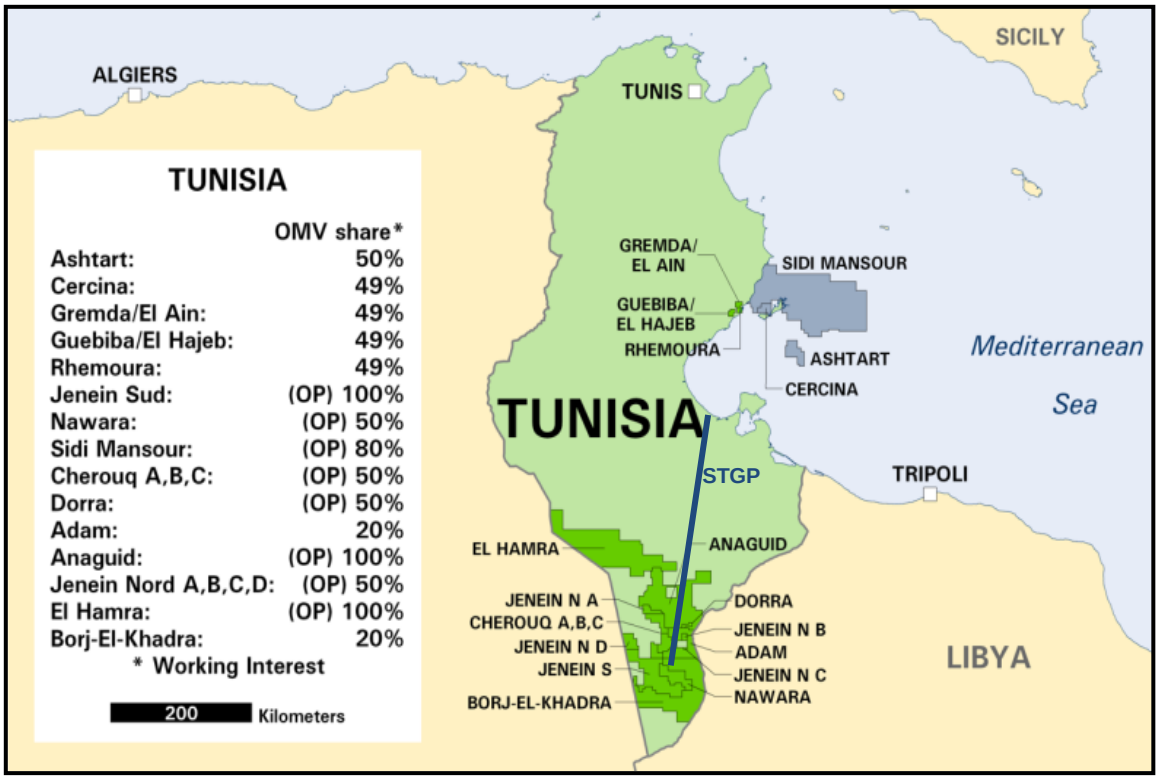


Figure 3.1 OMV Tunisia Assets in Tunisia

OMV applies its group-wide standards and best-practice principles in health, safety, environment and quality on a continuous basis for all activities in Tunisia. OMV strive to engage their neighbors and all stakeholders and to minimize the impact on the environment and to enable sustainability in the sensitive areas of operations.

3.1.6 Presentation of the Production Concession

The Nawara concession which covers a surface of 528 km² is stemmed from Jenein Sud Permit (see Figure 3.2 Nawara Concession Map). It lies within the northern Ghadames Basin, a major oil and gas producing area in the North African countries, Algeria, Tunisia, and Libya.

OMV (Tunesien) Exploration GmbH. and ETAP are partners of the concession since February 20th, 2010 for thirty years (see Appendix I Order of Minister of Industry and Technology establishing the Nawara Concession). Interests in this permit are shared as follows:

- ✓ OMV : 50%
- ✓ ETAP : 50%

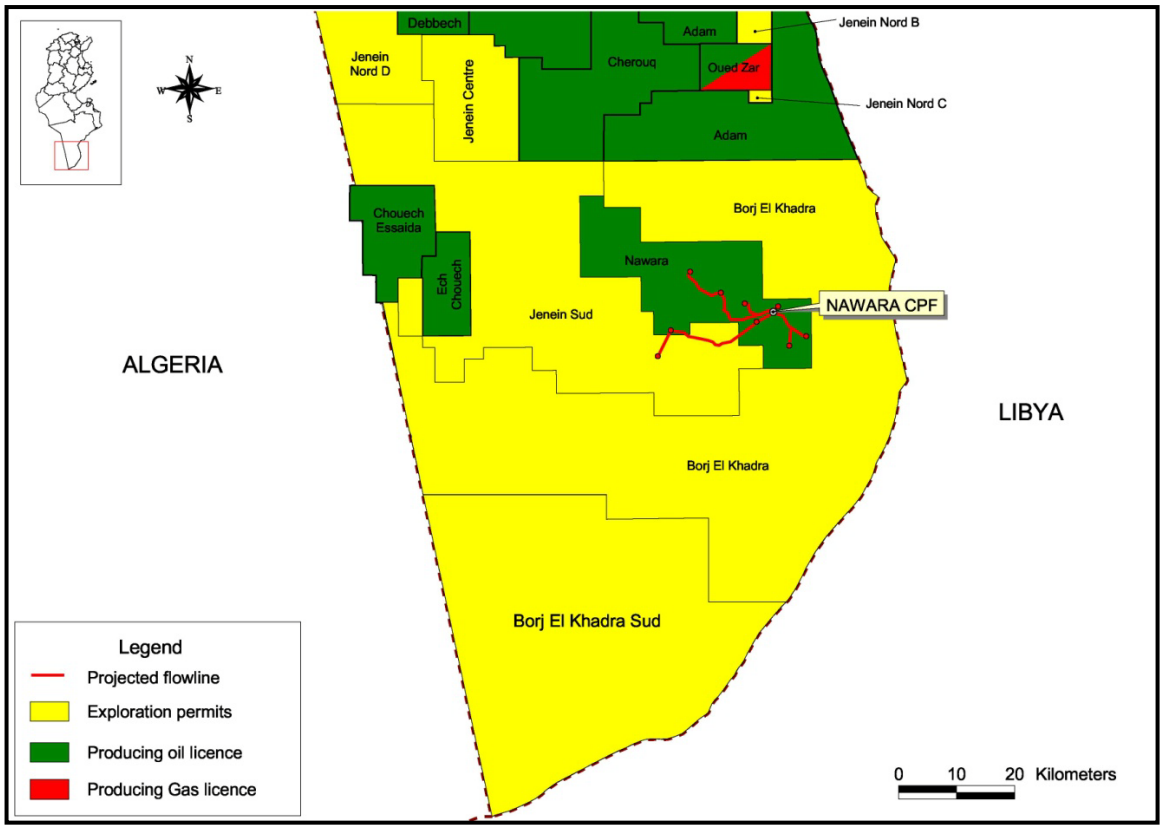


Figure 3.2 Nawara Concession Map

3.2 Presentation of the Contractors

Besides the implication of OMV as project operator, the project requires the intervention of other contractors and service companies for the design, construction and installation, commissioning and start-up of facilities.

The construction contractor have not been selected yet.

3.3 Presentation of the Consulting Company

Environmental Assessment & Management "EAM s.a." has been contracted by OMV to prepare an environmental impact assessment for the proposed project in accordance with the relevant terms of reference established by ANPE.

EAM has completed in excess of 400 Environmental Impact Studies for exploration in oil and gas, power and chemicals.

EAM was granted the ISO-9001: 2008, ISO 14001 : 2004 and OHSAS 18001: 2007 certifications (Integrated Management System) for the following activities: Environmental Impact Assessment, Hazard Assessment and Management of contaminated sites. These certifications demonstrate EAM's overall commitment to client satisfaction, provided by the efforts, perseverance and interest of all its personnel, and supported by the initiative and creative impetus of the management officers.

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E-mail	:	eam@planet.tn
Web site	:	www.eamtunisia.com

4.0 STUDY AREA

4.1 Implementation Area

The study area that will undergo the different biophysical impacts of construction and operation phases of the development project is part of the Nawara concession located in southern Tunisia. Administratively, this concession lies in the Borj El Khadra sector, delegation of Remada, governorate of Tataouine (see Figure 4.1 Administrative Map of the Study Area).

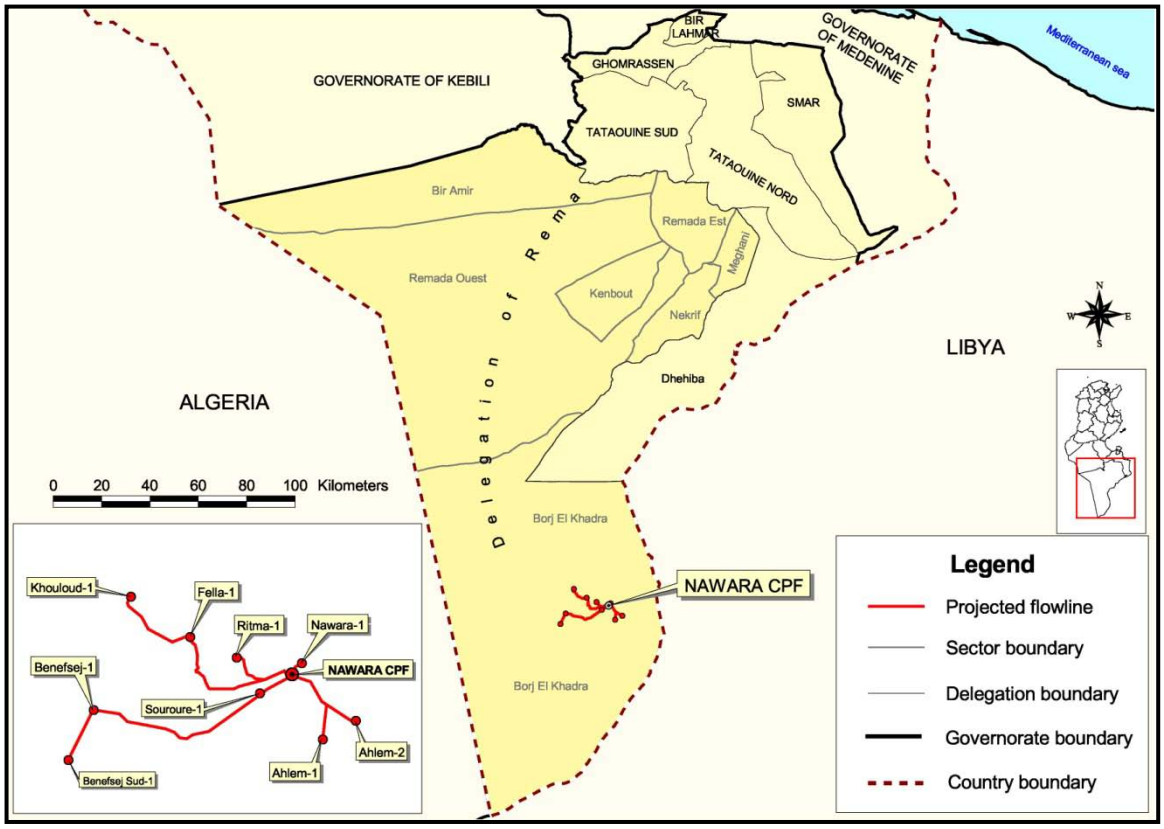


Figure 4.1 Administrative Map of the Study Area

4.2 Sensitivity of the Area

The study area is part of an underpopulated and undeveloped zone. There is no socio-economic equipment, except oil and gas infrastructures. Given their national and regional economic value, these infrastructures are considered as sensitive, in particular during the construction phase of the project.

The natural vegetation and the fauna of the desert are also considered as sensitive because of their rarity.

5.0 PROJECT DESCRIPTION

5.1 Project Location

The project site is located 110 km southeast El Borma and 40 km south Oued Zar. Borj Bourguiba is 132 km north the proposed facilities location.

The project area is accessible through the regional road RR101 leading to Oued Zar. Then, Ain Amenas pipeline route can be followed to the connection point to the track leading to Nawara well site (see Figure 5.1 Road Map of the Study Area).

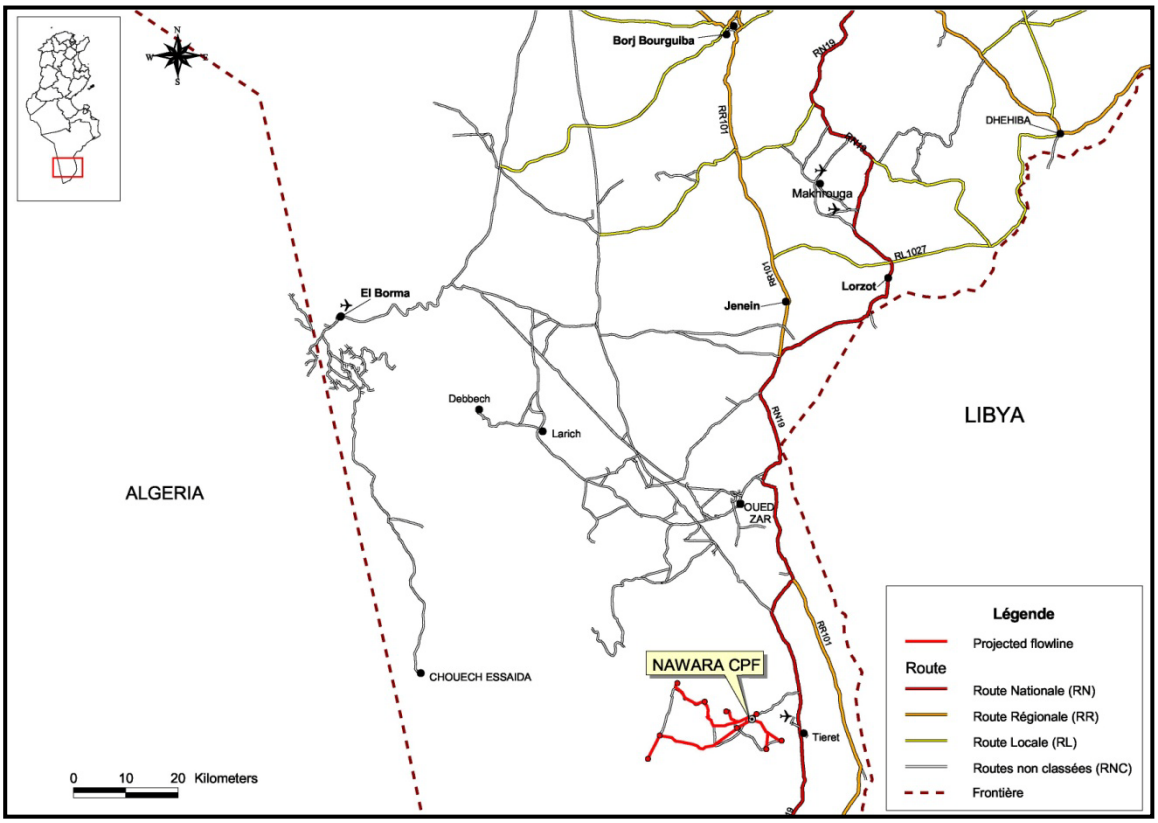


Figure 5.1 Road Map of the Study Area

5.2 Project Framework

The project is part of Nawara concession development project. This project, whose exploitation depends on the development of other infrastructure for the production of oil and gas in the south of Tunisia such as the STGP Project includes the following equipment:

- ✓ A Central Processing Facility (CPF) adjacent to the Nawara-1 well location ;
- ✓ An in-field production 6" flowline system connecting each of the producing wells Nawara-1, Khouloud-1, Fella-1, Rytma-1, Benefsej-1, Benefsej Sud-1, Souroure-1, Ahlem-1 and Ahlem-2 to the CPF ;
- ✓ A condensate export pipeline running from the CPF to TRAPSA pipeline;
- ✓ A gas export pipeline running from the CPF to STGP tie-in point from where it will

be transported to Gabes.

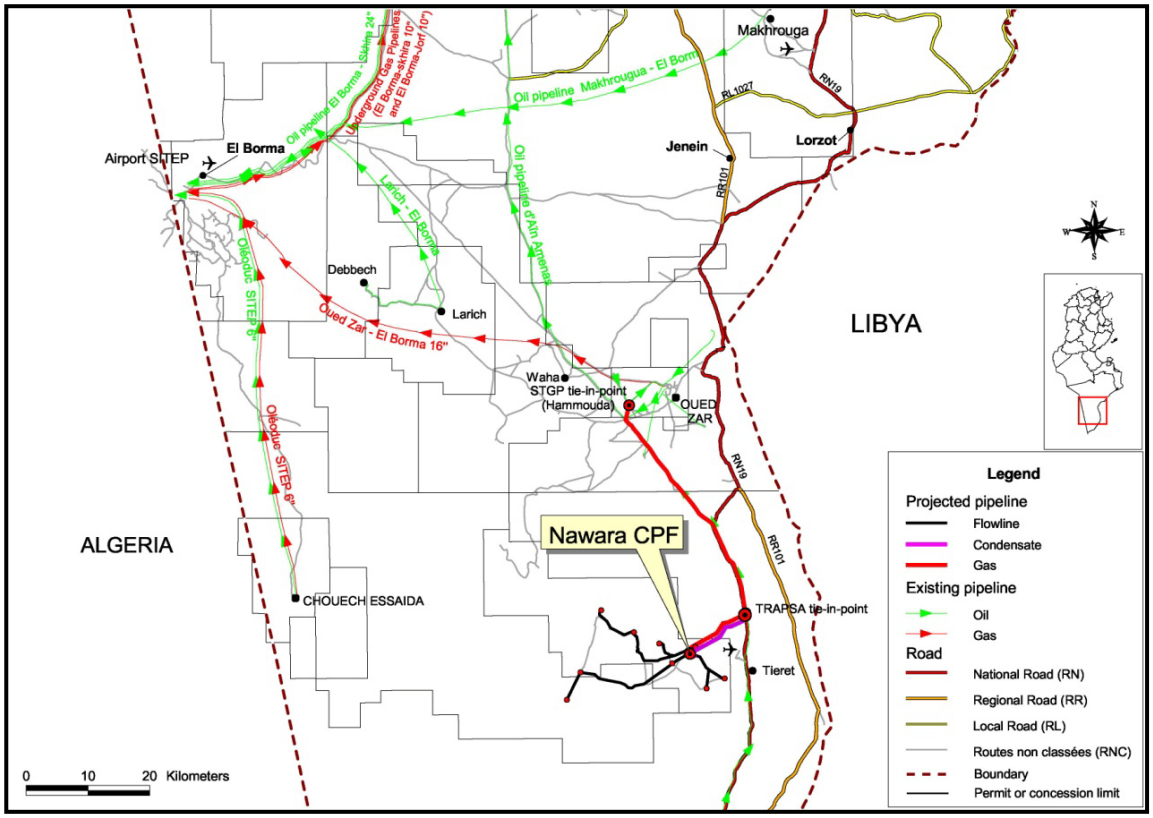


Figure 5.2 Nawara Concession Development Project's Components

5.3 Project Provisional Planning

The construction of the CPF and the associated facilities will start in the third quarter of 2014 and will last approximately two years.

The construction and installation works of new equipments will involve four steps:

- ✓ The civil engineering work to level the site and install the concrete foundations;
- ✓ The assembly and establishment of buildings, flowlines, pipelines and equipment;
- ✓ The setting up, connection and testing of flowlines and pipelines;
- ✓ Commissioning.

Accurate date of the beginning of field work will be communicated in writing to ANPE.

At the end of construction, a period of 60 days will be necessary for the demobilization and rehabilitation of project sites. The development concept is based on STGP-aligned production which is producing gas and liquid once the STGP pipeline in place.

5.4 Production Profile and Design Capacities

The scenario considered for the design of surface facilities is based on the proven volumes of Nawara-1, Khouloud-1, Fella-1, Rytma-1, Benefsej-1, Benefsej Sud-1, Souroure-1, Ahlem-1 and Ahlem-2.

The initial rate should utilise the OMV's share for the planned South Tunisia Gas Pipeline (STGP), which is 2.7 MSCMD.

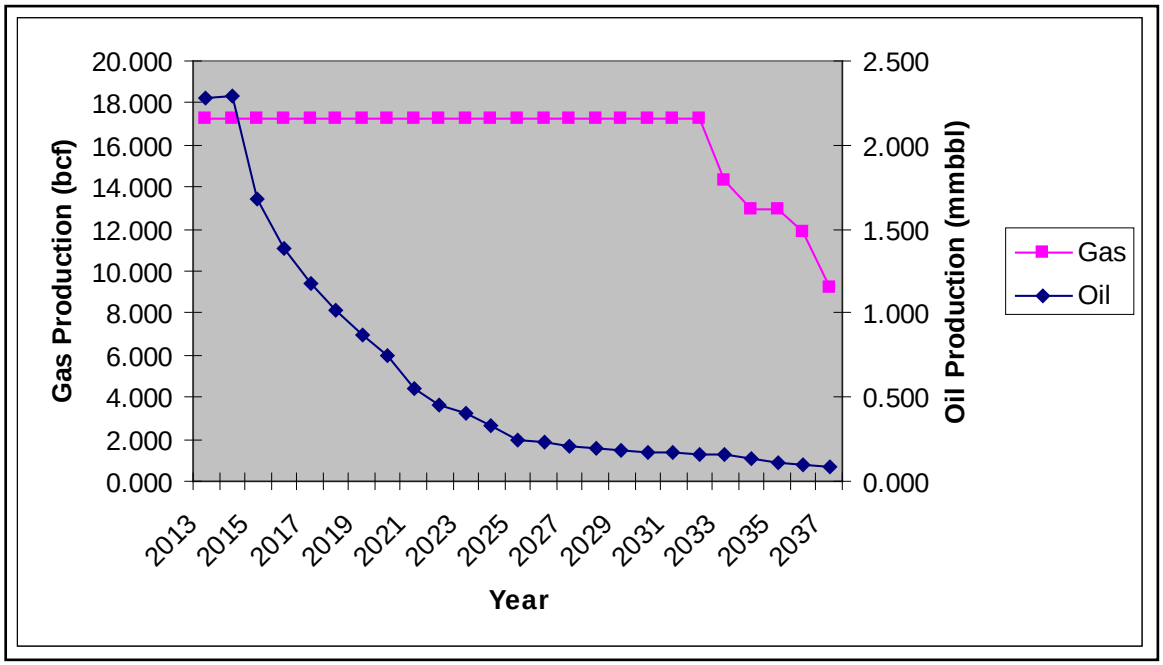


Figure 5.3 Production Profile

Facilities design is based upon the following production data.

Table 5.1 Production and Design Capacities

Parameter	Unit	Operating rate	Design Capacity
Gas max. production	MSCMD	2.8	2.8
Condensate max. production	SBPD	7000	7000
Produced water max quantity	m^3/day	168	168
Gas export	MSCMD	2.7	2.8

The production of water is not expected for the first two years. The estimated quantities of water to be produced later are not currently available. They will be communicated later to ANPE.

However, it is to note that the maximum produced water rate was estimated at 168 m^3/day. This is calculated by the sum of the water condensed from the produced gas and the assumed formation water content equivalent to 10 % vol of the total liquids entering the CPF. These waters will be eliminated in two watertight evaporation pits with a capacity of 9600 m^3 each.

5.4.1 Production Water Composition

The water composition before treatment is presented in table 5.2.

Tableau 5.2 Production Water Analysis before Treatment

	Unit	Sample 1	Sample 2
Depth	m	3930.2	3826
Hydrocarbons	%	30	20
Colour		Yellow, turbid	Colourless, clear
pH		4.9	4
Alkalinity	mmol/l	0.4	-
Total Alkalinity	mmol/l	0.9	0.2
Acidity	mmol/l	32.9	31.6
Total hardness	mmol/l	975	1030
Total hardness	°dH	5466	5775
Chloride	mg Cl/l	165565	168224
Bromide	mg Br/l	1683	1616
Sulphate	mg SO4/l	8	4.3
Lithium	mg Li/l	21.3	19.6
Sodium	mg Na/l	61607	59127
Potassium	mg K/l	1239	1908
Ammonium	mg NH4/l	182	191
Magnesium	mg Mg/l	5063	10980
Calcium	mg Ca/l	30535	23071
Strontium	mg Sr/l	395	217
Iron	mg Fe/l	301	1823
Phenols	mg/l	0.35	0.19
TDS	mg/l	266075	266621
Density @ 20°C	g/cm^3	1.184	1.194

Treated produced water specification is as follow:

- ✓ Total Hydrocarbons : less than 20 ppmv
- ✓ Suspended material : less than 30 ppmv
- ✓ Sulphate reduction bacteria : 10 population / cm^3
- ✓ Oxygen : Not applicable for evaporation pits.

5.4.2 Design of evaporation pits

The design of evaporation pits shall take into account the following requirements:

- ✓ A coating will be installed so that the bottom and sides of the pond pit will have a coefficient of permeability of no greater than 1×10^{-7} cm/sec.
- ✓ The materials for the coating will be selected after evaluation of the water quality to be contained. Coating will be of sufficient strength and thickness to maintain the

integrity of the pit.

- ✓ Adequate installation measures (e.g. implantation site, walls) will be adopted to prevent natural surface drainage from entering the pit or breaching during heavy storms.
- ✓ Measures will be taken to prevent access to people, animals (including birds) to the evaporation pits.
- ✓ At decommissioning, or at the completion of operations, the evaporation pit contents will be disposed of after testing and in accordance with the waste management plan. The pit area will be reinstated to its original state.

Evaporation Pit

5.5 Description of Facilities

5.5.1 The Central Processing Facility CPF

The CPF ensures separation, treatment and stabilization of the wells fluids. The condensate will be exported to a TRAPSA tie-in point via pipelines. The wet gas will be exported to a tie-in point of the joint STGP facilities from where it will be transported to Gabes.

The CPF adjacent to the Nawara-1 well location will comprise:

- ✓ An in-field production flowline system connecting each of the producing wells to the CPF;

- ✓ A system of gas, condensate and water separation;
- ✓ A condensate stabilization unit ;
- ✓ A 5,000 bbl fixed roof tank ;
- ✓ A gas compression unit ;
- ✓ A TEG Dehydration Unit ;
- ✓ A propane chilling unit ;
- ✓ An oily water recovery station ;
- ✓ Two 5 MW gas turbines ;
- ✓ All necessary utilities for the operation of the CPF (power, water, compressed air, etc);
- ✓ A Gas sweetening unit;
- ✓ A permanent control room.

To meet the STGP project contract, the CPF will be operated in full regime. This corresponds to a production of 2.7 MSCMD of gas and 7000 SBPD of stabilized condensate.

It is important to note that the plan of development of Nawara CPF was approved by the General Directorate for Energy (see Appendix II Plan of the Development of Nawara concession and Appendix III Project Approval by General Directorate for Energy).

5.5.2 Gathering System

Each producing well will be connected to the CPF by a flowline. Except the underground sections which cross the tracks, the flowlines will be entirely laid above ground given their short length and the absence of physical constraints.

The flowlines will be fabricated from API 5L X52 material type and tested in conformity with the tunisian standard NT109.01. In addition, a fiber optical cable will be run to each production wellhead to facilitate the flow of relevant data to the CPF and for control of the actuated valves.

When the flowlines are located within the same corridor they will be laid in the same trench. The typical flowline trench configurations are depicted on the figure 5.4.

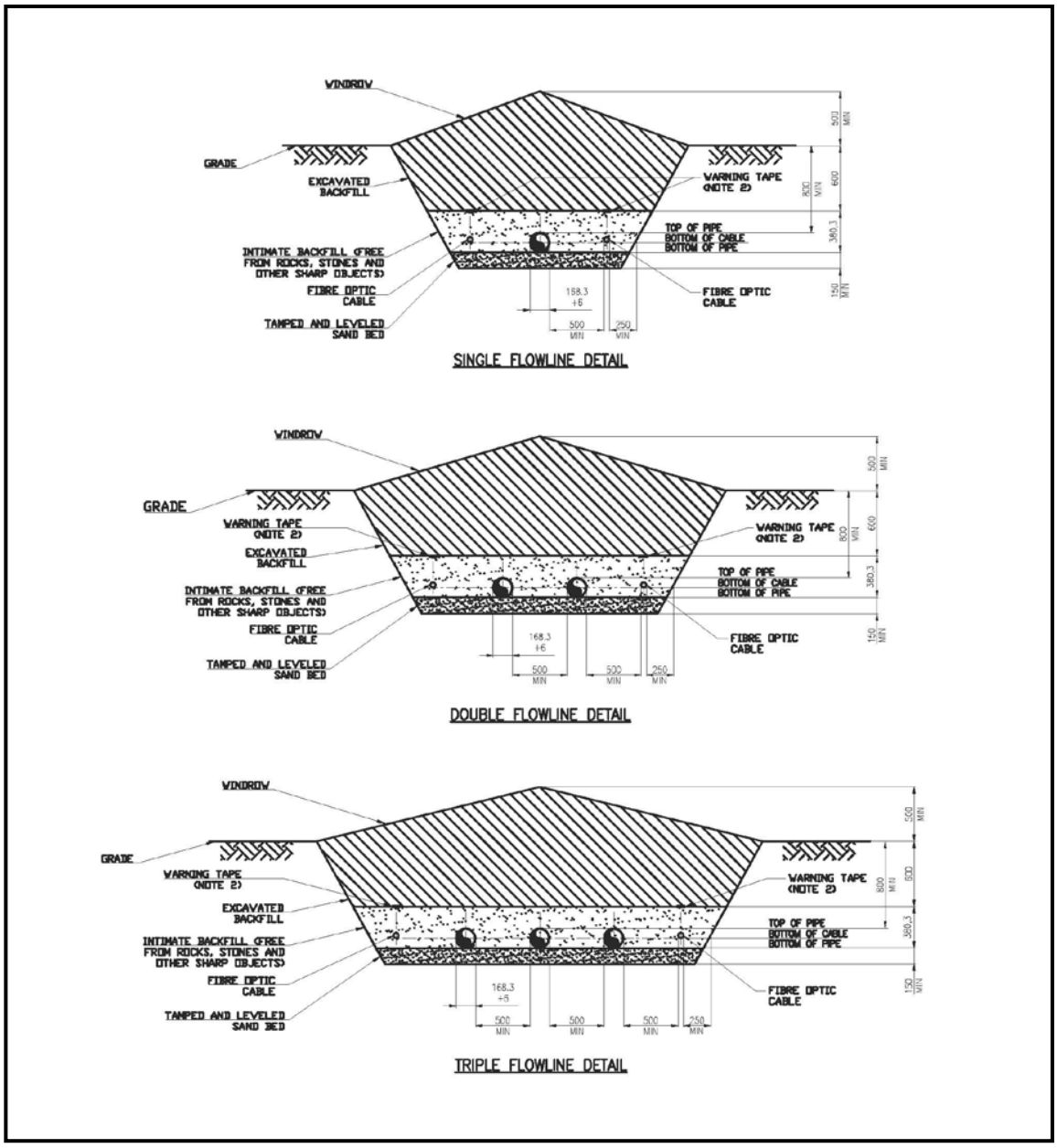


Figure 5.4 Typical Trench Configuration Drawings

5.5.3 Base Camp

The accommodation at Nawara will be designed to cater for an estimated number of 10 personnel for the operating phase.

The base camp will be equipped with specific medicines for treatment of different illnesses and the necessary first aid equipment to handle an emergency. This location is chosen in order to minimize personnel and engines shifting and facilitate supplies.

OMV will develop a separate construction camp to accommodate 300 people for the contractors workforce engaged in construction activities.

5.6 CPF Process Description

The process used for the treatment of production fluids is described in the following diagrams:

5.6.1 Fluids Separation

The composition reaching the CPF will be a mixture of production from each well and may be a combination of rich fluids from one well and lean from another.

The Inlet Separator is sized to separate gas, hydrocarbon liquid and water (i.e. three phase operation) over the full range of flowrates expected from the wells. Vane pack or other demister internals may be used to ensure gas leaving the separator is essentially free from liquid droplets.

The Inlet Separator is required to handle liquid slugs arriving from the flowlines. Flow Assurance studies indicate slug volumes less than 3 m^3 for normal operation, turndown and start-up operations.

5.6.2 Mercury Removal

Mercury removal is not required for the initial operation, however provision is to be made at the CPF for possible installation of a mercury removal unit in the future, if required. It is essential that regular sampling of produced fluids at all wellheads and analysis for mercury takes place from start up. If mercury is detected at a wellhead, further monitoring for mercury at the CPF should be carried out.

5.6.3 CO_2 Removal

An amine based process is selected for removal of CO_2 from the process gas. Bulk removal of CO_2 is achieved most effectively by use of a tertiary amine with a promoter to accelerate the reaction with CO_2. A generic process for gas treating is preferred to allow solvent to be procured competitively.

The CO_2 removal unit will be installed on a slip stream considering the small quantity of CO_2 to be removed from the gas to meet the export gas specification of less than 2 vol %.

5.6.4 Water/Condensate Separator

Liquids from the Inlet Separator drain to the Water / Condensate Separator. The Water / Condensate Separator also receives liquid from the Cold Separator in the hydrocarbon dewpointing system.

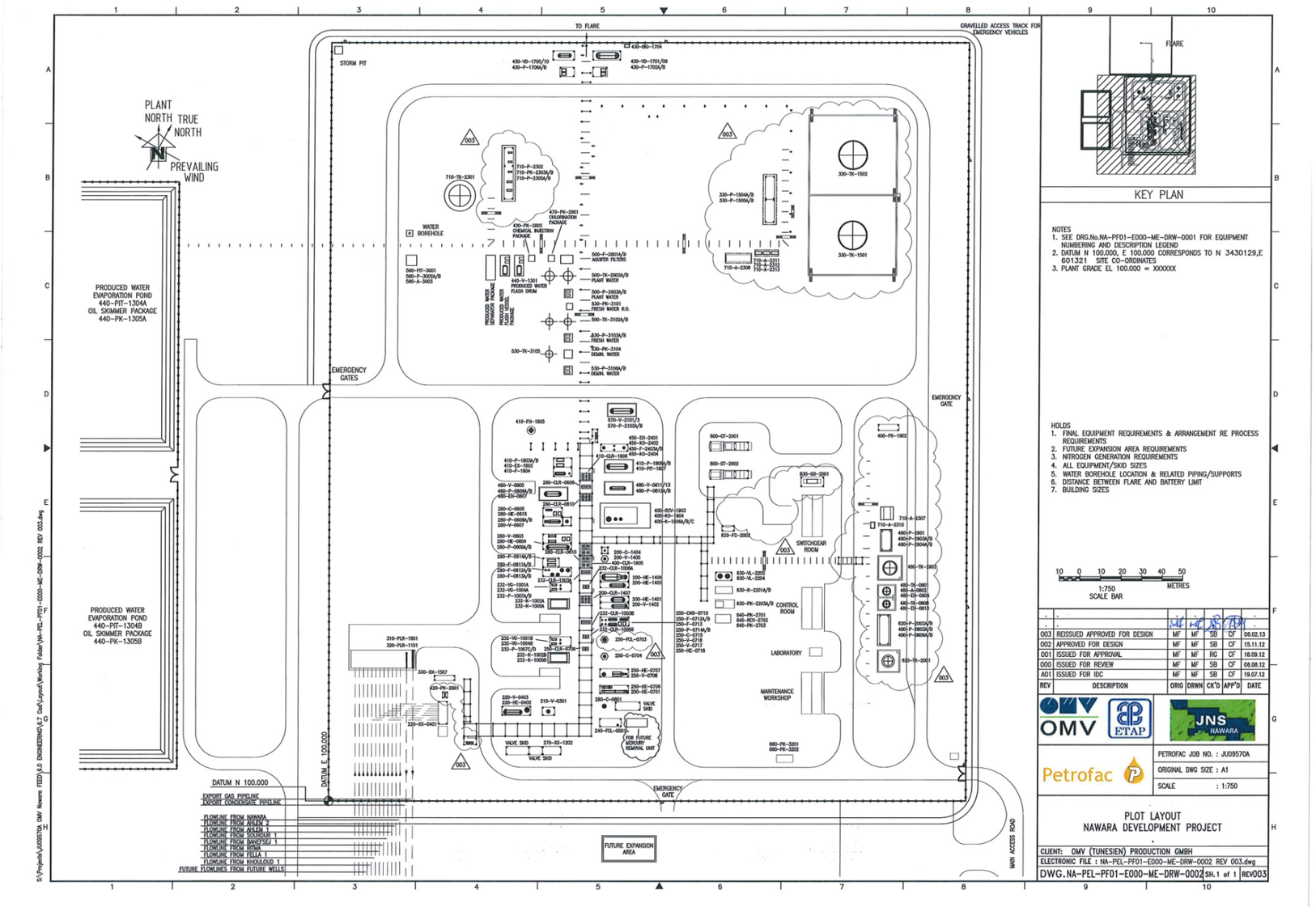


Figure 5.5 CPF Plot Plan

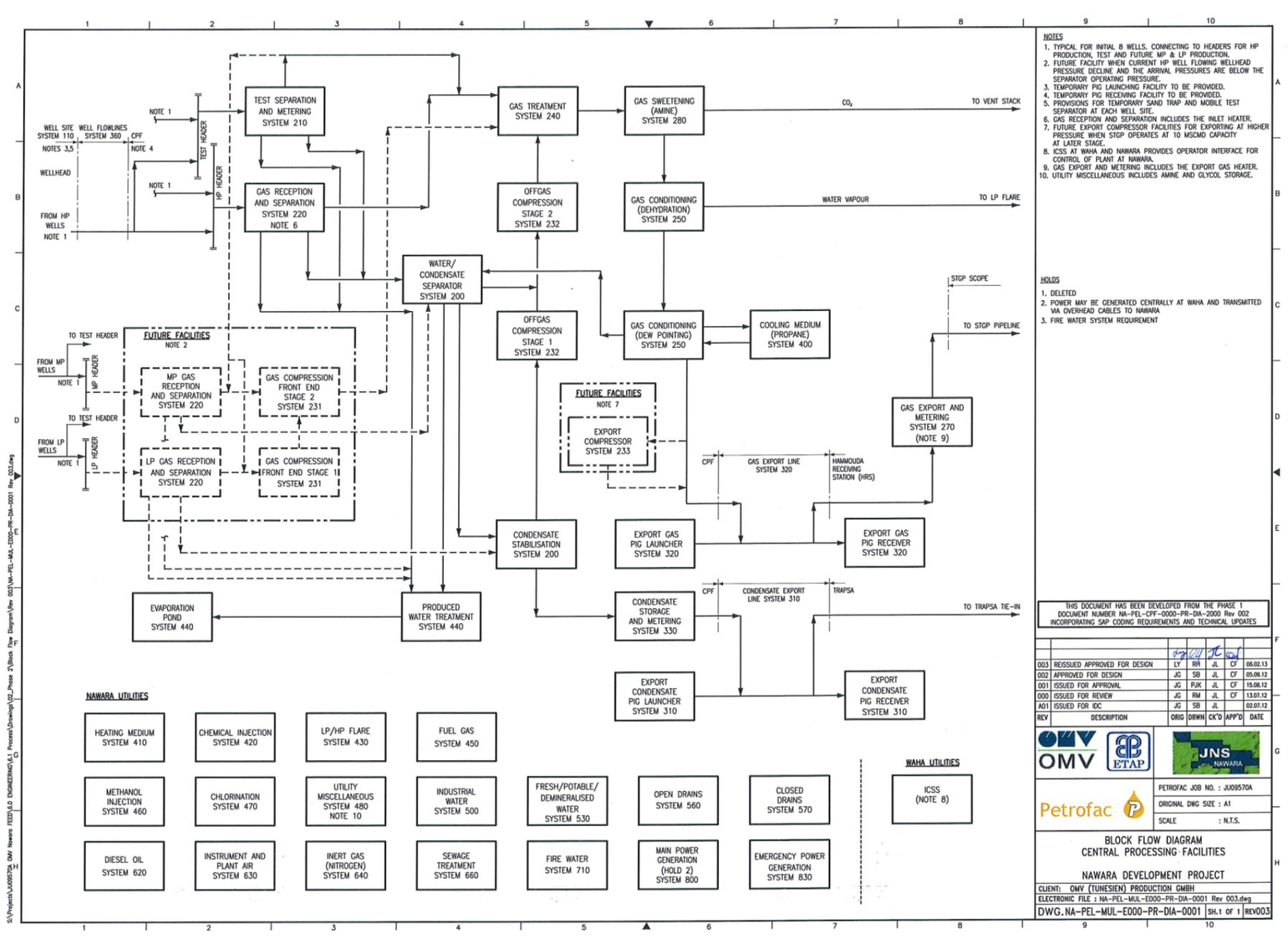


Figure 5.6 Process Flow Diagram

Gas is issued at the reduced pressure and is compressed back to the gas treating pressure and returned upstream of the CO_2 removal unit.

Liquids are separated into aqueous and hydrocarbon phases. Water is drained to the evaporation pits whilst condensate is fed to the Stabiliser.

Connections shall be provided downstream of the Water/Condensate Separator for a Desalter (electrostatic coalescer, centrifuge or hydrophobic cartridge filter depending on condensate physical properties and production rate when need for desalting arises) after formation water breakthrough from the reservoir. Note that this is not expected until year 10 of production according to the Pre-Feasibility Study.

5.6.5 Gas Dehydration

Gas separated in the train associated to rich gas will be dehydrated using a Glycol dehydration unit which includes a TEG Column and TEG regeneration unit.

The Glycol dehydration unit, which will be used to dehydrate gas separated in the train associated to lean gas, will include a TEG column, a TEG regeneration unit and posterior compression to meet the STGP specifications.

Wet natural gas flows through an inlet separator or scrubber to remove all liquid and solid impurities. Then, the gas flows into and upward through the contactor where it is contacted counter-currently and dried by glycol. The dried gas finally passes through a gas/glycol heat exchanger and then into the Gas dew Point Control section of the plant.

Reconcentrated or lean glycol enters the top of the contactor where it flows downward from tray to tray and absorbs water from the rising natural gas. The wet or rich glycol leaves the absorber and flows through a coil in the accumulator where it is preheated by hot lean glycol. After the glycol-glycol exchanger, the rich glycol enters the stripping column and flows down the packed bed section into the reboiler. Steam generated in the reboiler strips water from the liquid glycol as it rises up the packed bed. The water vapor and desorbed natural gas are vented from the top of the stripper.

The hot reconcentrated glycol flows out of the reboiler into the accumulator where it is cooled by heat exchange with rich glycol. Finally the lean glycol flows through the glycol/gas exchanger and is pumped back into the top of the contactor.

Gas cooling is to be achieved by installing a Gas / Gas Heat Exchanger downstream of the Amine Absorber Column which cools the wet gas using cold gas from the Cold Separator.

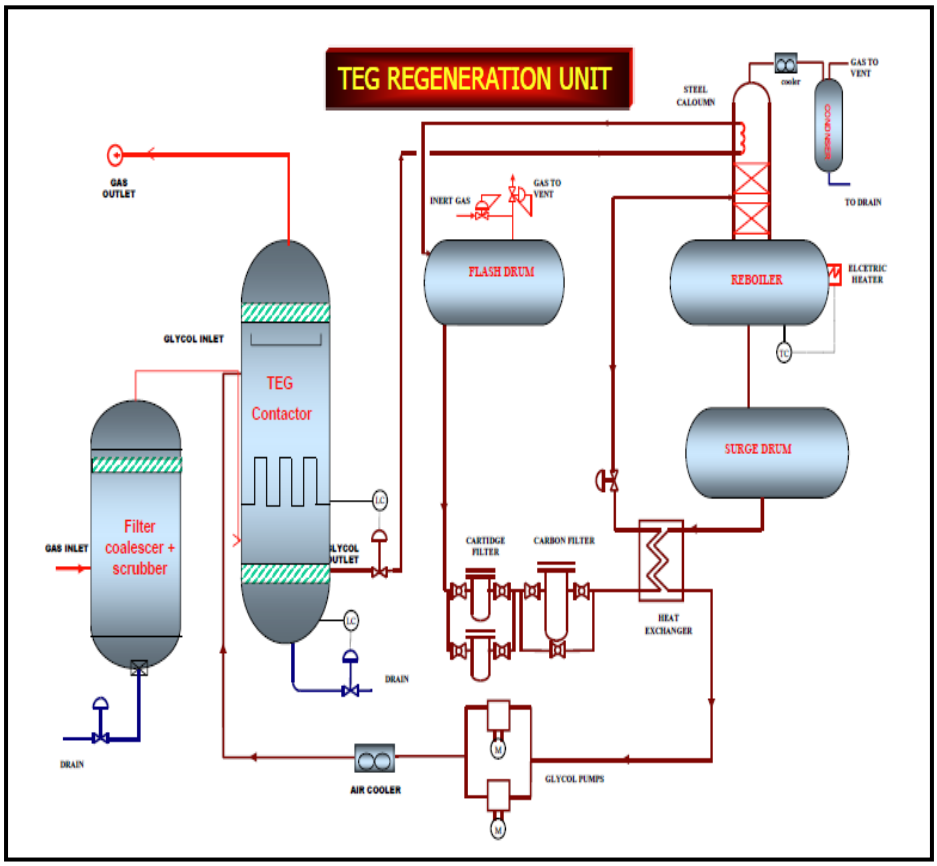


Figure 5.7 Glycol Dehydration Unit

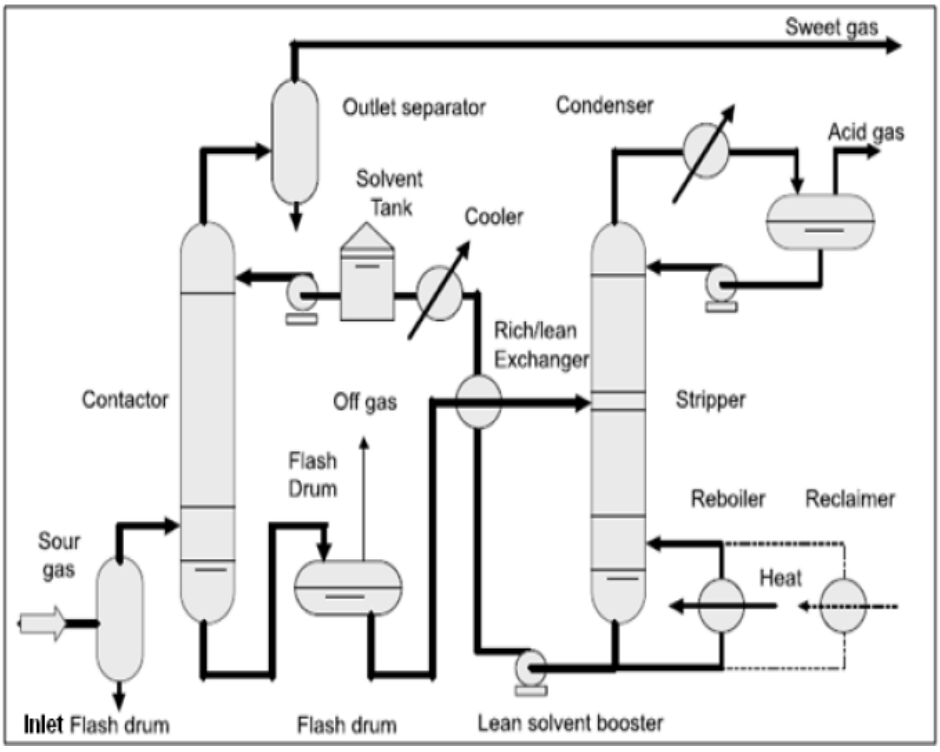


Figure 5.8 Amine Regeneration Unit

5.6.6 Condensate Stabilization

Condensate separated in three-phase separators and NGL recovered in Mechanical Refrigeration Package will be stabilized using two Stabilizer Columns operating in parallel. Stabilized condensate is cooled down to ambient temperature prior to storage. A 5000 bbl storage tank with fixed roof is considered for the purpose.

Condensate will then be pumped at 70 bar through a 6" pipeline to the TRAPSA pipeline using a centrifugal pump. The tie-in point is approximately 11 km from Nawara oilfield.

5.6.7 Produced Water Treatment and Disposal

Produced water is collected from different sources (inlet separators, scrubbers, etc.) and fed to the closed water treatment system with a corrugated plate interceptor (CPI). Treated water (total hydrocarbons less than 20 ppm) will be routed to an evaporation pit whilst recovered condensate is sent back to the inlet separator.

5.7 Construction Program

Construction activities will continue over two years. OMV aims to bring the CPF into operation in the first half of 2016. The project is expected to employ about 300 construction workers. While construction work is in progress, the equipment procurement and construction contractor will establish a construction camp and areas for the secure receipt and storage of equipment requiring to be installed on the project sites and the construction equipment to be used on-site.

An outline of the construction schedule of the proposed development project is presented below.

5.7.1 Site Preparation

On the CPF site, construction will start with civil engineering work to level the site and to install foundations, ducts, pipes and drainage.

Existing site access roads will be upgraded and maintained for ease of logistics, particularly from the existing desert road parallel with the TRAPSA pipeline to the proposed Nawara CPF location and to the accommodation and air strip.

Process equipment at the CPF is to be skid mounted (modularised) to the maximum practicable extent taking into account the constraints of transportation to site and handling during construction.

Utility systems shall also be packaged. Power generation equipment, switch gear etc. may be modularised to assist installation at site.

5.7.2 Equipment Installation

The process vessels and storage tanks for the CPF will be delivered by truck to the Nawara area. Pre-assembly, transport and on-site assembly will involve the use of cranes, scaffolding, generators and welding machines.

Individual items of equipment, such as pumps, compressors and diesel engines, will be brought to the site by truck, lifted into place and connected up. This will particularly involve cranes.

5.7.3 Building Construction

The following buildings are proposed at the CPF at Nawara:

- ✓ Instrument Equipment Room (IER) (Control Room)
- ✓ Laboratory
- ✓ Local Workshop and Store
- ✓ Guard House
- ✓ Electrical Sub Station
- ✓ Shelter for Compressor
- ✓ Sunshades etc. as required
- ✓ Accommodation

Buildings will be of simple yet durable construction for the 25 year design life and shall take into consideration specific climate conditions such as frequent sand storms and high temperatures. Buildings may be of modular prefabricated construction to reduce the requirement for on-site working and personnel.

5.7.4 Pre-commissioning Tests

Inspections and tests will be performed before start-up in order to check the conformity of the plant to the design specifications and requirements. They include:

- ✓ Soil study of the plant implementation site in order to choose the type of foundation required for the civil works;
- ✓ Verification by the inspection companies of the civil engineering;
- ✓ Testing of the material used for the equipment fabrication, which will be justified by adequate material certificates;
- ✓ Inspection at the equipment vendor’s premises, such as pumps, compressors, etc., before their delivery and whose performance such as flow rate, head pressure, noise level, etc., must be verified through bench testing;

- ✓ Hydraulic testing of the pressure equipment, on-site or at the constructor premises;
- ✓ Control of piping welding by dye penetration or radiography, depending on their use;
- ✓ Air or steam cleaning of the equipment and piping in order to eliminate all material debris and deposits (lumber, installation accessories, etc.) remaining from the construction phase;
- ✓ Electrical connection tests of all motors and instruments;
- ✓ Testing of the control loops of the plant;
- ✓ Air drying of the equipment and piping that must not contain water traces before their installation or operation.

5.7.5 Commissioning

During the commissioning of the CPF along with flowlines and export pipelines, their performances will be verified under working conditions close to the nominal operating parameters. In case of discrepancies relative to the technical or environmental performances of the equipment or units, the contractor will introduce the necessary modifications or changes in order to meet these performances.

5.7.6 Performance test

These tests will concern the technical and environmental performances of the project's associated facilities, at nominal operating conditions and different operation configurations. They will be performed over a contractual period of a few days, according to the pre-established procedures between the Contractor and OMV. The temporary acceptance of the facilities and equipment will be announced once all of the expected performances are obtained and no major reserves are detected by OMV.

Once the temporary acceptance of the project's associated facilities is announced, its operation will be ensured by the designated personnel having been pre-trained for the operation of such installations. However, the contractor will guarantee during all the warranty period and until the final acceptance of facilities an assistance to overcome any equipment dysfunctioning or discrepancies relative to the technical and environmental contractual performances. Moreover, the operating personnel will be provided with the necessary documentation for the control of these performances during the whole service life of facilities and for the maintenance or the replacement of the equipment or parts of which that could become dysfunctioning.

5.8 Process Support and Utilities

The construction of the development project needs water, power and fuel. During normal operations, fuel gas will be needed for power generation.

5.8.1 Water

Aquifer water will be supplied from water well drilled local to CPF. A preliminary agreement to drill a new water well was obtained in 2010 with the CRDA of Tataouine (cf. Appendix IV). Acquisition procedures of a ministerial authorization for the drilling were undertaken in July 2013 (cf. Appendix V).

The geographic and UTM co-ordinates of the proposed water well are as follows:

	Geographic co-ordinates Spheroid WGS 84	**UTM co-ordinates, zone 32 (Cent Merid 9°E), Carthage datum**
Proposed water well	Longitude : 10° 04’ 10.76’’ E Latitude : 31° 00’ 47.24’’ N	X = 602270 m Y = 3431090 m

Accordingly, a consumption of 250-300 liters/person/day is assumed as the basis of design for water consumption. This allowance includes drinking water, cooking, personal hygiene and laundry and is for the initial phase of production until the CPF is demanned once the ability to operate with no permanent personnel present at site is established.

A back up supply of aquifer water is available by trucking water from existing wells at Tiaret, 7.5 km East of Nawara-1 well.

5.8.2 Instrument Air and Nitrogen

Compressed air will be supplied by air compressor packages. It will serve for instrument air and plant air purposes. Nitrogen is used for inert gas applications and for pressurization and purging of equipment during the CPF maintenance.

5.8.3 Fuel Gas

Fuel gas is required for power generation, for the fired heater in the Heating Medium package and for blanketing of the Condensate Storage Tanks. Fuel gas will in principle be taken from the export gas pipeline after dehydration and hydrocarbon dew pointing, upstream of the fiscal metering system.

Estimated fuel gas consumption is around 2600 SCFM (0.1 MMSCMD). Supply can be from the dehydration unit gas outlet line or from the stabilizer column overhead gas line.

The fuel storage, transfer and dispensing areas will be bunded to contain any fuel spillage. The bund will be designed to contain 110 % of the storage tanks capacity.

With these measures in place, there should be no discharge of fuel.

5.8.4 Diesel

For cold start-up diesel fuel will be used to start the emergency stand-by diesel generator to provide power to start the main power plant and other emergency loads.

Diesel will be trucked to the base camp by a fuel tanker of 10,000 liters from the existing gas station in Remada and stored in tanks with a total capacity of 30 m^3. Maximal diesel consumption is about 1,000 liters per day.

5.8.5 Chemicals

Facilities for safe storage and handling of production chemicals will be provided, having regard to the nature and particular hazards involved. Chemicals envisaged for use at the CPF comprise:

- ✓ Antifoam (for CO_2 Removal and gas dehydration units)
- ✓ pH Control (for Glycol Regeneration)
- ✓ Antiscale (for Water Treatment)
- ✓ Methanol (for hydrate inhibition)
- ✓ Biocide (for Water Treatment)
- ✓ Demulsifier (for Produced Water Treatment)
- ✓ Oxygen Scavanger (for Demineralised Water)
- ✓ Corrosion Inhibitor (for Inlet Facilities)

Storage requirements for all chemicals shall be based on a minimum of 30 days storage, except for methanol. The methanol unit shall be supplied with seven days storage, based on supply of the maximum methanol requirements at 16°C ambient soil temperature.

5.8.6 Flares

There will be no operational flaring at the CPF. Flaring will only occur during an emergency. The CPF will be provided with a High Pressure (HP) and Low Pressure flare systems to provide safe disposal of emergency release of hydrocarbons from pressure relief valves and control valves on various equipment and piping in hydrocarbon processing units.

5.9 Safety and Fire Fighting System

5.9.1 Communication

All necessary and efficient communication means will be available for work needs and workforce safety.

5.9.2 Medevac

The base camp will be equipped with specific medicines for treatment of different illnesses and the necessary equipment to handle an emergency.

5.9.3 Emergency Plan

Emergency procedures to cover all foreseeable emergency situations will be available, documented and displayed.

The emergency plan includes medevac, fire fighting, man lost search and site evacuation.

5.9.4 Training

A safety meeting will be held at the beginning of the works with all the crews. Work Procedures and first aid training will be explained during this meeting.

5.9.5 Fire Fighting System

The principal safety aim is to minimise the possibility and potential consequences of an incident, hazard or accident and to ensure:

- ✓ Protection of personnel;
- ✓ Avoiding potential pollution of the environment;
- ✓ Protection of the equipment and facilities; and
- ✓ Maintenance of safe operation consistent with production requirements.

A fire and gas detection system will be provided. Active fire protection systems will be designed and installed to provide the best response to:

- ✓ Gas leak
- ✓ Electrical fire, class C fire (extinguishing),
- ✓ Flammable liquid fire, class B fire (extinguishing and cooling),
- ✓ Building fire, class A fire and possible other classes according to their content, (extinguishing).

6.0 DESCRIPTION OF THE EXISTING ENVIRONMENT

Based on literature and the environmental baseline survey conducted in the study area in April 2009, this chapter describes an overview of the regional physical, biological and socio-economic environment and a detailed description of the biological environment (flora and fauna) as well as the archaeological findings within the proposed development project area.

For the needs of environmental analyses, all the environmental and socioeconomic sensitivities were set in their geographical context by a Geographical Information System (GIS).

6.1 Physical Framework

6.1.1 Geomorphology

The geomorphology of the study area is characterized by mobile dunes of the Great Oriental Erg and outcrops of the Dahar plateau (see Figure 6.1 Spatiomap of the Study Area). Altitudes in the region vary between 200 and 450 m.

The southern limit of the Great Oriental Erg coincides with the most southern point of Tunisia. The Great Oriental Erg is a vast depression generally composed of long dune chains aligned North-south and separated by sandy or rocky structures. Dunes within the Erg can reach more than 50 m in height.

The altitude of dunes and dune coverage decrease towards the North. The Dahar plateau rises gradually to the East. The main structure is dissected by a series of valleys and water courses or wadis (mainly dry).

The regional geology is characterized by upper cretaceous sedimentary rocks underlying a limestone-sandstone forming the major Dahar plateau of the Cenomanian and Turonian periods. Soils in the study area are fragile.

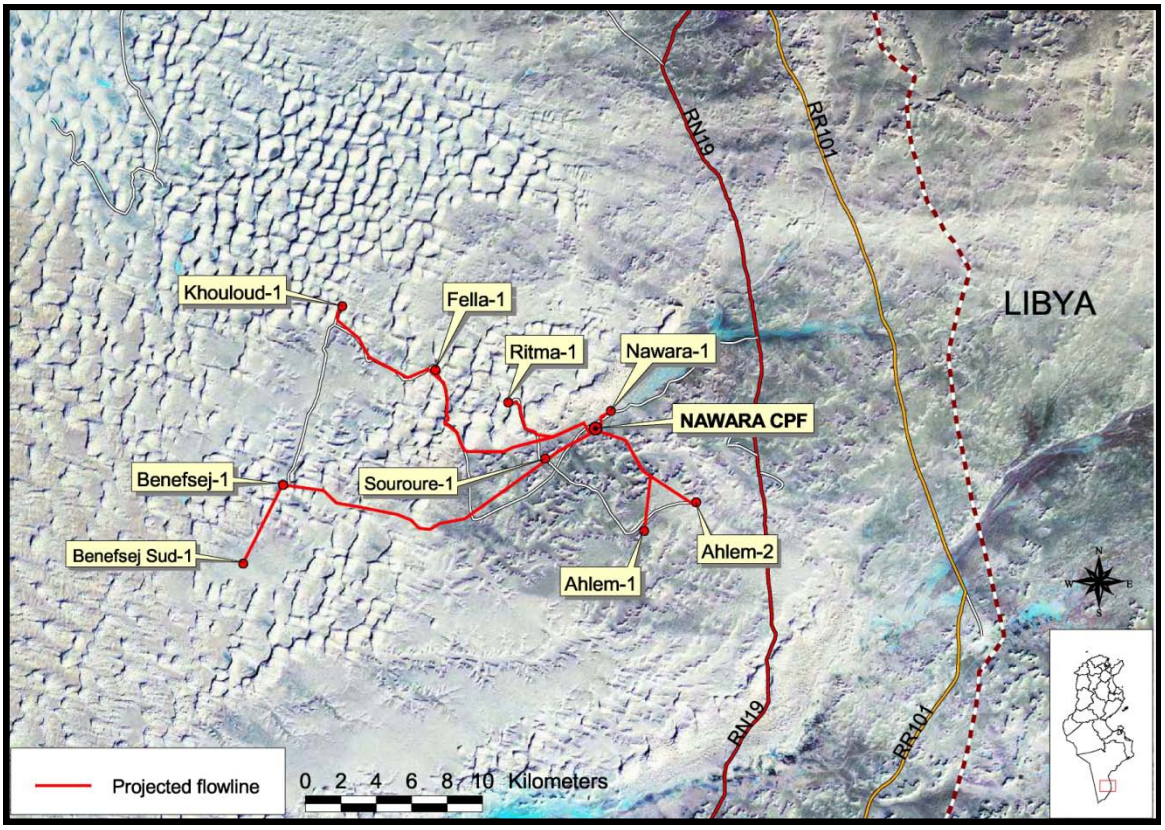


Figure 6.1 Spatiomap of the Study Area

6.1.2 Satellite Image Review

6.1.2.1 Approach to Satellite Image Review

A review of available satellite imagery of the permit area was undertaken.

Landscape features were catalogued on the basis of their characteristics as recorded by the satellite imagery. Desert geomorphological features were identified from a combination of field data and from descriptions and classifications given in *Desert Geomorphology* by Cooke, Warren, and Goudie (1993).

Dune dimensions are referenced to the direction of the prevailing wind, in which dune length lies parallel to the wind and its breadth lies normal to it. This means that geographical lengths may be shorter than breadths.

6.1.2.2 Description of the Spatiomap of Jenein Sud Permit

The western part of the study area is characterized by a complex dune field made up of transverse dunes. Plateaux, buttes, and mesas occupy the remainder. A small area of complex linear dunes occupies the lower left-hand part of this area. Each feature is discussed in turn below.

(i) Dune Field

The eastern edge of the dune field is jagged where it meets the plateaux, and follows an approximate azimuth of 310°. The field contains large numbers of mega-sized transverse dunes (about 60 dunes per 100 km^2) over-ridden by smaller, ephemeral dunes.

Slip faces occur on the dune's north-western edge, and provide an azimuth of 120° for the direction of the dominant wind. Dune aprons, formed where the slip face meets the supporting strata underlying the dune, are not a significant feature of the landscape.

Mega-sized and ephemeral dunes are mobile. Their rate of travel is expressed in terms of geologic time for mega-sized dunes and of about one year for ephemeral dunes. Mobile sand is an important feature of the field's environment. A few hardy plants are likely to exist on the surface of the mega-sized dunes, but these would be regularly covered and uncovered by the passage of smaller dunes.

Mega-sized dunes are between 300 and 600 m in length and between 1.5 and 2 km in breadth. Most are joined end-to-end, making them a significant 'wall' of sand. The smaller dunes formed on their surface are likely to contain fine and medium sand grades. Larger dunes are likely to contain coarse sand intermixed with smaller sizes. Ephemeral dunes are 15–25 m in length and breadth. Their height is probably 8–12 m. Mega-sized dunes are probably 30-60 m high.

Inter-dune valleys are almost all totally enclosed by dunes. There are few lengthy corridors that support easy access within the field. A very few of these register blue tints on the satellite imagery, which result from the presence of evaporites and possibly indicate an evaporative mechanism linked to the underlying groundwater, probably of the Complex Terminal aquifer, which emerges far to the North near Gabes. Inter-dune valleys within the block are between 1 and 2 km wide and up to 3 km long.

In the southern and western limit of the permit, these dunes assume complex shapes, so that towards the South they become disconnected, dome-shaped and linear, with long sayfs (serpentine shaped, linear dunes) extending one km or more eastward of their central mass.

These dunes develop from deflections to the wind stream brought about by large windward dunes, and are thought to result from

counter-rotating vortices capable of throwing tremendous volumes of sand into the atmosphere. Their height diminishes northward, possibly reflecting a variation in sand grade or wind strength and direction. The length of individual dunes is about 3 km. Interconnecting chains can reach 10 km or more. Dune width is about 1 km and their height is between 30-60 m.

(ii) Plateaus

Plateaus occupy the remainder of the eastern part of Jenein Sud permit. Most of these are severely eroded along their scarps, so that their edges become heavily embayed and jagged. Most plateaus are small and so classified as buttes and mesas. Their material has eroded to provide the basic material for the dunes and the somewhat coarser material covering the inter-plateau valleys.

Occasional buttes appear super-imposed on plateaus indicating the presence of a range of geologic ages.

Dark tones cover the northern and eastern areas of the satellite image. These extend across plateau surfaces as well as across valley deposits, and are a possible reflection of plateau geology rather than of surface coverings of desert pavement, which are often associated to anthropological artefacts from the recent geologic past.

Plateaus occupy about 40% of the surface. Valleys, which are in reality plateaus covered by debris from the surrounding landscape, occupy the remainder. These are criss-crossed by a network of dry channels having a dominant direction of flow from East to West. Other directions, such as North to South, also occur.

The channels have no indication of vegetation along their banks.
A long road penetrates from the North, where it lies between 0.5 and 10–15 km west of the Tunisian-Libyan border. Other roads join this track from the West.

Quality natural habitat appears to be sparse. There is no indication of water and vegetation other than the presence of an evaporative mechanism operating in a very few inter-dune valleys. Shelter is present in the embayments and eroded scarps of the plateaus, and some vegetation undoubtedly exists. In general, however, it seems that habitat is poor.

6.1.3 Regional Geology

The regional geology is characterised by upper cretaceous sedimentary rocks underlying a calcaro-sandstone forming the major Dahar plateau of the Cenomanian and Turonian periods (see Figure 6.2 Geological Map of the study area).

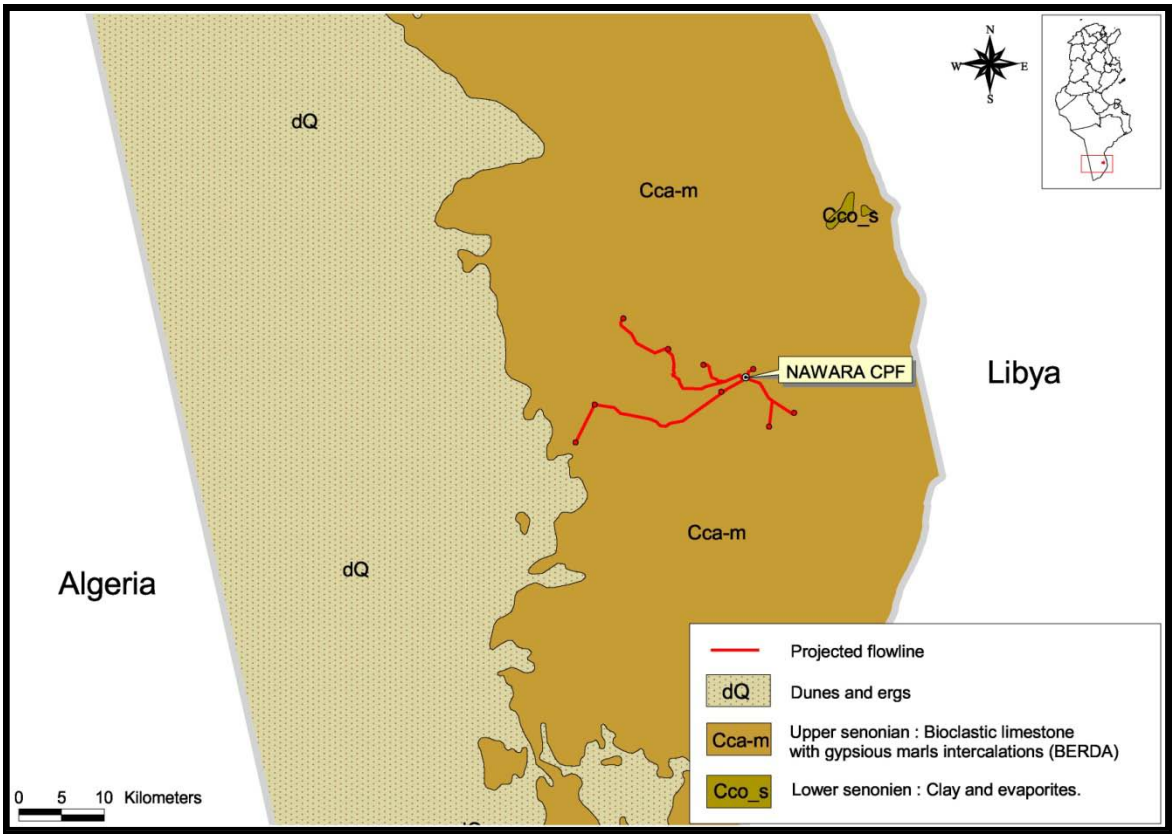


Figure 6.2 Geological Map of the Study Area

6.1.4 Pedology

Three soil classes have been identified on Nawara oilfield site and neighbouring areas:

- ✓ Slightly evolved and shallow eroded lithosol mineral soils with an aeolian mantle over a limestone crust which is sometimes broken up on hills. Outcrops are mostly made of calciferous sedimentary rocks.

  The presence of carbonated or sulphated rocks in such arid climatic conditions led to a relatively limited evolution marked by a decalcification of the surface horizon in favour of deep horizons. Due to an intense aeolian activity in the zone, an Aeolian mantle, a few centimetres thick, can form on the surface. Vegetation may hold quicksand and form in the process micro-nebkas and even nebkats colonized by psammophytes: *Aristida, Retama* and *Cornulaca.*

- ✓ Slightly evolved hydric soils: such soils are found mostly in depressions. They are fairly deep and formed of materials brought from neighbouring slopes and hills.

Annual plants grow there during the rainy season. This slightly boosts the soils, which, nevertheless, remain sensitive to deflation and sand movements once the vegetation disappears, and;

- ✓ Soil complex (see Figure 6.3 Soil Map of the Study Area).

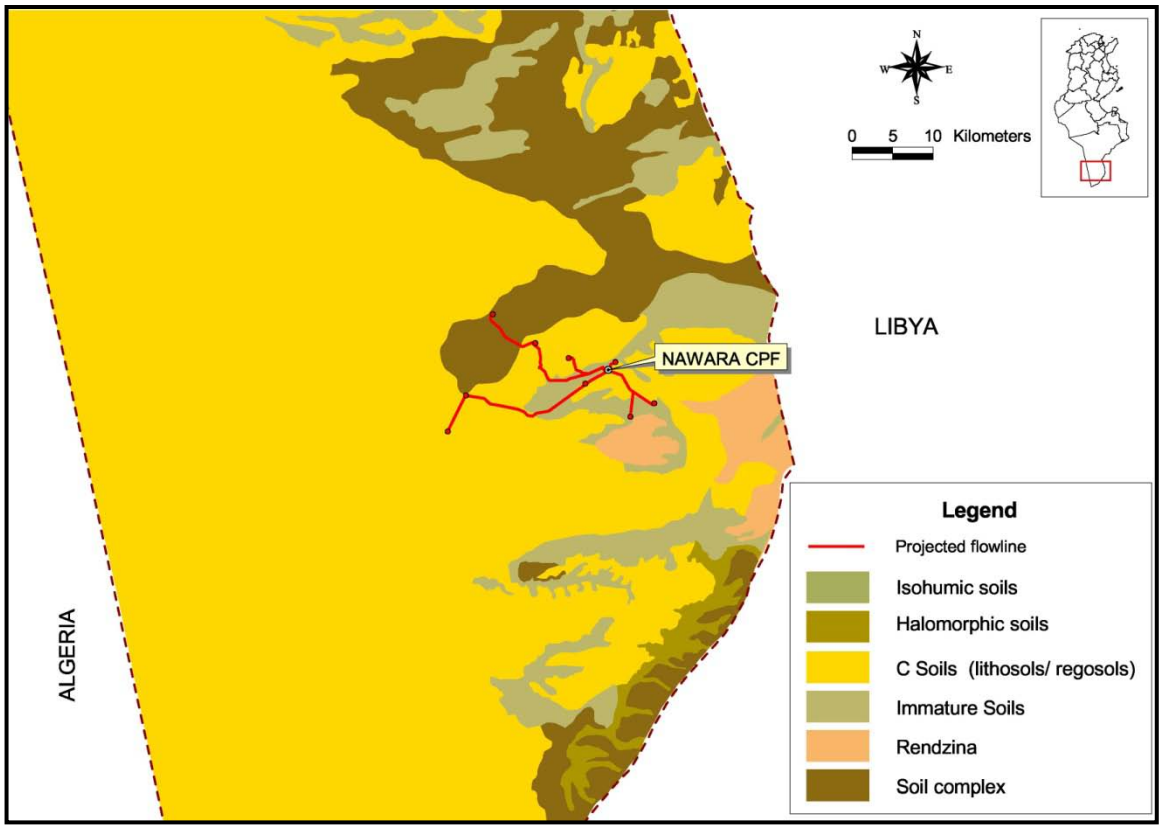


Figure 6.3 Soil Map of the Study Area

6.1.5 Water Resources

Surface waters are scarce or even negligible (cf. Appendix V Core drills in the study area). Any surface flow that is present constitutes a closed system which does not discharge to a permanent surface water body. The only significant water resource within the field is the Continental Intercalaire (see Figure 6.4 Hydrogeological Map within the Study Area). There are no known shallow aquifers within the project area.

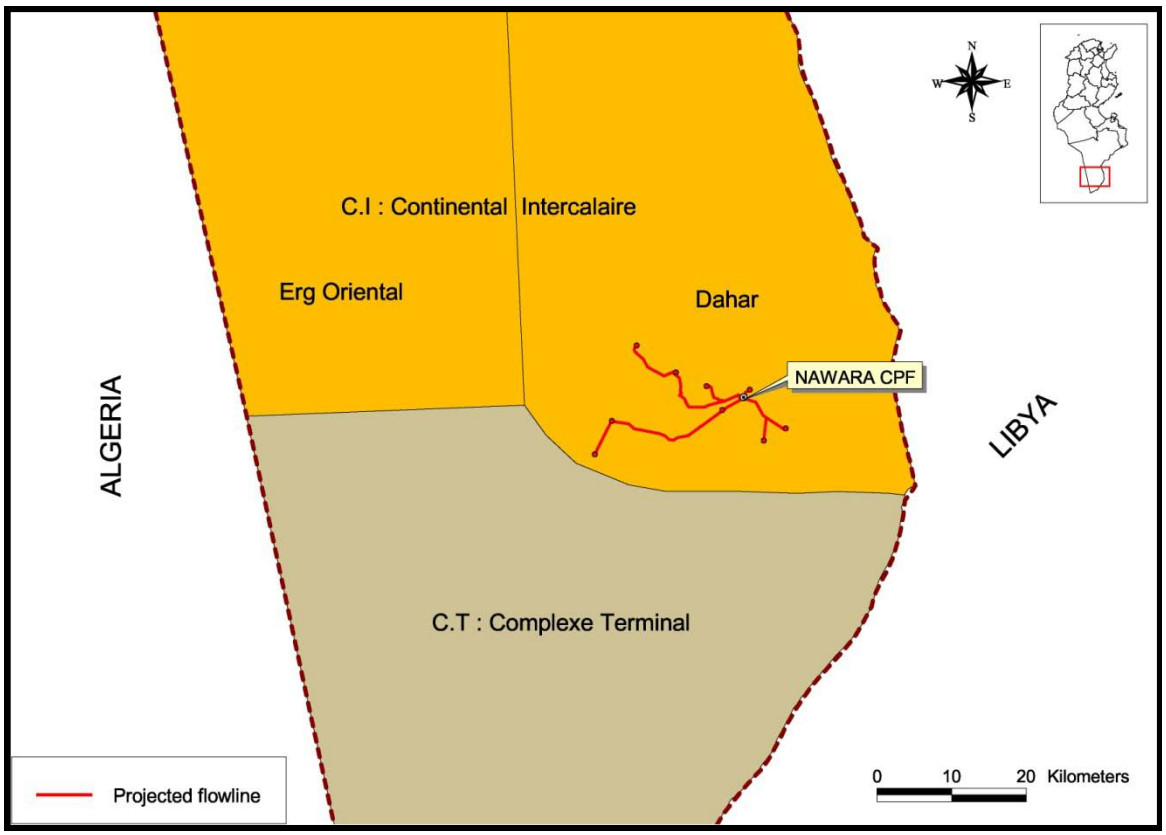


Figure 6.4 Hydrogeological Map within the Study Area

Table 6.1 provides a summary of exploitable and exploited groundwater resources in the study area.

Table 6.1 Summary of Water Resources in the Study Area

	Exploitable water resources (Mm^3)	**Exploited resources (Mm^3) in 1996**
The Continental Intercalaire aquifer of oriental piedmont of Dahar	6.3	3.03
The Continental Intercalaire of occidental piedmont of Dahar	9.5	0.72
The Continental Intercalaire of Oriental Erg	12.6	6.45
S/Total	**28.4**	**10.2**

Source: DGRE., 2003

The Continental Intercalaire is subdivided in three parts: the Dahar eastern piedmont of C.I, the Dahar western piedmont of C.I and the CI of the oriental Erg. It covers an area of 600 000 km^2 extending over the south of Tunisia and the south of Algeria. This aquifer is fed by infiltration of rain waters through the outcrops of the Dahar (Turonian dolomite of the Complexe Terminal). This water is called to nourish two aquifers: the aquifer of the Continental Intercalaire and the aquifer of the Complexe Terminal (Mamou, 1990).

The Continental Intercalaire is found at a depth of approximately 600 m within the study area.

The upper aquifer of the Continental Intercalaire flows towards the West and the Northwest. The piezometric level varies from 320 m in the North to 340 m in the south of the Jenein Sud permit area. Groundwater salinity is in the order of 2g/l.

6.1.6 Weather Conditions

According to the scale of Emberger (1955) and considering its weather characteristics, the study area which belongs to the southern Tunisia, could be classified as Mediterranean bioclimate, of Saharan stage, inferior sub-stage and as a variant cool winter (see Figure 6.5 Bioclimatic Map of the Study Area).

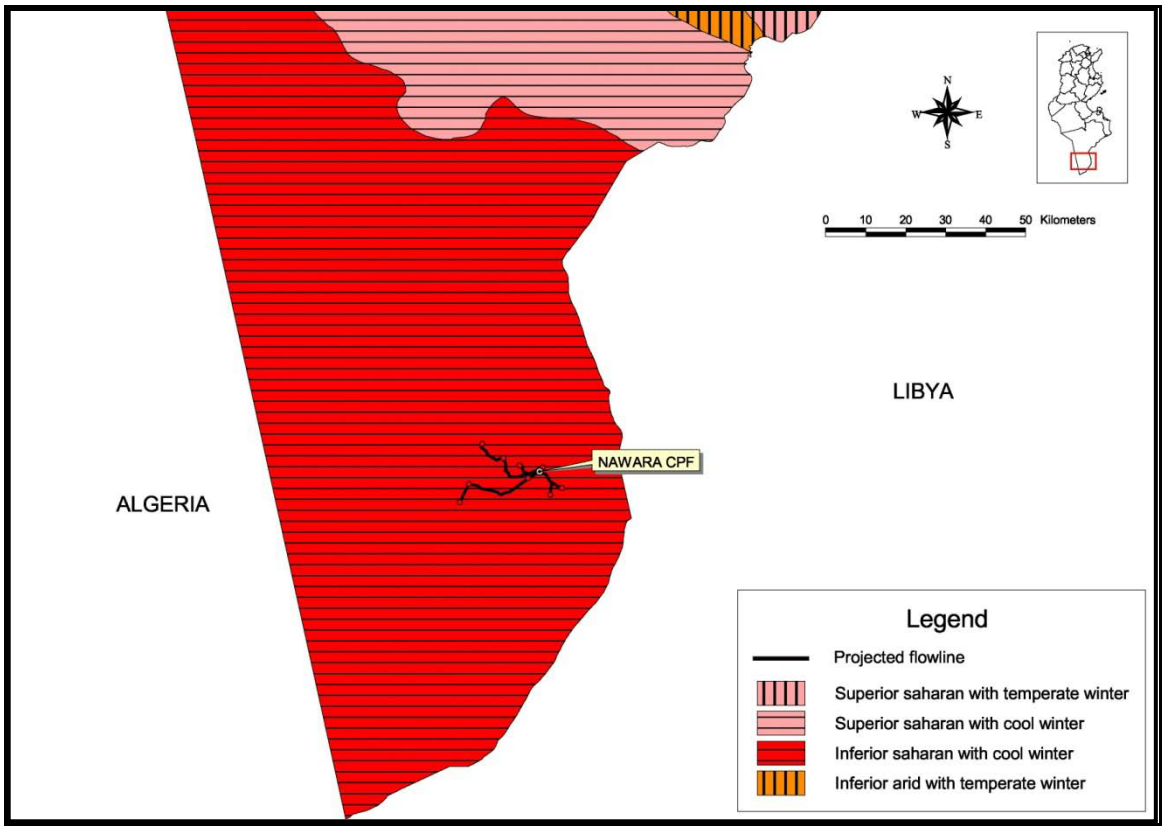


Figure 6.5 Bioclimatic Map of the Study Area

6.1.6.1 Temperature

The temperature, being variable with the season, is characterized by great amplitudes reflecting the continental aspect of the study area. As such, during the summer, July is the hottest month with an absolute maximum temperature of 50.1°C. Whereas, during the winter, January is the coldest month with an absolute minimum temperature of - 2.4°C.

The average annual temperature at El Borma is 22.6°C and the average minimum temperature is 4.3°C in January and the average maximum temperature is 41.7°C in July.

Table 6.2 Average, absolute Minimum and Maximum Temperatures Recorded at the El Borma met station during the Period from 2000 to 2009

Mois	J	F	M	A	M	J	J	A	S	O	N	D
Average Min T°C	4.3	5.7	10.5	14.7	19.5	22.7	25.4	25.3	22.6	18.0	11.1	6.5
Average Max T°C	17.3	19.3	25.3	29.4	33.5	38.5	41.7	40.8	36.6	31.4	23.7	18.5
Average T°C	10.8	12.5	17.9	22.0	26.5	30.6	33.5	33.1	29.6	24.7	17.4	12.5
Absolute min T°C	-2.4	-1.5	2.1	6.0	10.1	12.4	18.5	20.0	14.4	8.2	1.5	-2.2
Absolute max T°C	26.9	31.9	38.7	40.6	44.6	47.2	50.1	47.3	45.8	40.2	37.0	30.6

Source : INM., 2000-2009

The absolute minimum temperature recorded during the period 2000-2009 is -2.4°C, recorded on January 7th, 2005. While, the absolute maximum temperature is 50,1°C and recorded on July 26th, 2005.

6.1.6.2 Rainfall

Rainfall is very irregular with an annual average of approximately 51.4 mm over the period 2000-2009. Rainfalls are occasionally affected by disturbances of Saharan origin related to north-east fluxes. Rainfall is generally characterised by a low intensity events. The highest intensity was 19.6 mm and occurred mainly during autumn. A monthly average rainfall recorded at El Borma met station is presented in table 6.3.

Table 6.3 Monthly Average Rainfall Recorded at the El Borma met station during the Period 20001 -2009

Mois	J	F	M	A	M	J	J	A	S	O	N	D	Total
Pluv. (mm)	5,7	3,4	9,8	3,1	4,9	0,3	0,0	0,0	1,8	14,6	3,2	4,5	51,4

Source: INM., 2000-2009

In El Borma, and during the period 2000-2009, the monthly rainfall recorded was 61.3 mm in October 2006.

6.1.6.3 Winds

Wind roses for the winter and autumn periods at El Borma monitoring station are presented in Figure 6.6. These wind roses show that the dominant winds tend to be from the West and East during the winter period and from the East, North-east and South-east during the autumn.

South-west winds tend to be associated with a significant temperature increase. This warm wind tends to operate as a limiting factor on the occurrence of many plant and animal species in the area.

The south-west and north-east winds, due to the abrasive silicon and quartz grains carried

by these winds, also result in damage to vegetation in the area.

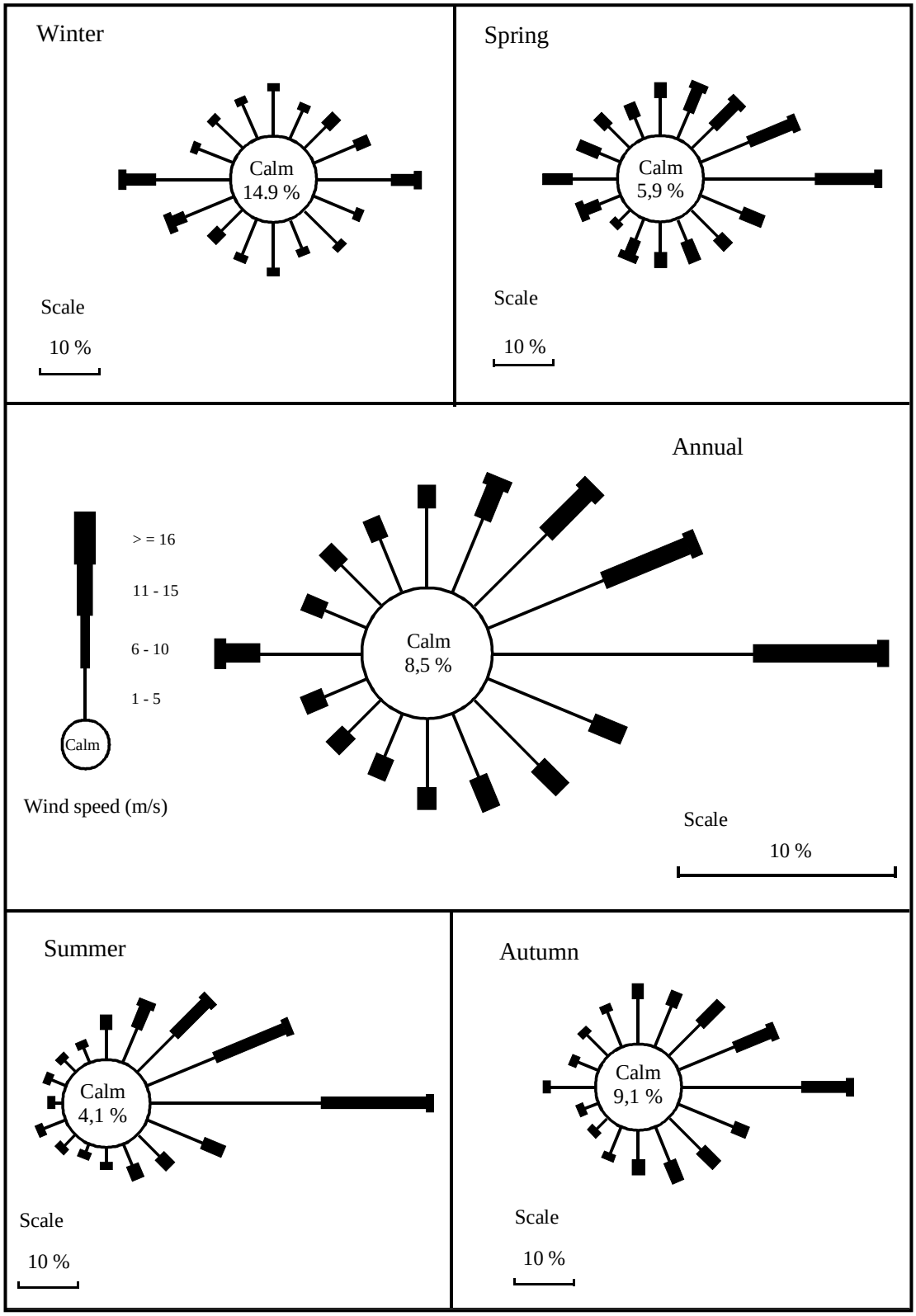


Figure 6.6 Seasonal and Annual Wind Roses within the Study Area

The south-west and north-east winds, due to the abrasive silicon and quartz grains carried by these winds, also result in damage to vegetation in the area.

Table 6.4 Wind Speed at El Borma Station (2000-2009)

DD	1-5 m/s	6-10 m/s	11-15 m/s	>=16 m/s	Total
N	3.0	0.8	+	+	3.8
NNE	3.7	1.3	0.1	+	5.1
NE	3.7	2.1	0.1	0.0	5.9
ENE	4.3	3.2	0.2	0.0	7.7
E	11.4	5.8	0.3	+	17.5
ESE	5.5	1.9	0.1	0.0	7.5
SE	4.8	2.0	0.1	+	6.9
SSE	3.8	1.6	0.1	+	5.6
S	3.6	1.5	0.1	+	5.2
SSW	2.9	1.0	0.1	+	4.0
SW	2.2	0.9	0.1	+	3.2
WSW	2.4	1.4	0.2	+	4.0
W	4.8	2.3	0.2	+	7.3
WNW	2.1	0.7	0.1	+	2.8
NW	2.6	0.6	0.1	+	3.3
NNW	2.1	0.6	+	+	2.7
Total	62.9	27.7	1.9	0.1	92.6

Source: INM., 2000-2009

6.1.6.4 Sandstorms

Sandstorms are very common in the study area. The number of days of sandstorms per month is given in table 6.5.

Table 6.5 Monthly number of sandstorm days in El Borma for the period 2000-2009

Month	J	F	M	A	M	J	J	A	S	O	N	D	Total
Nbr. of days	1	2	5	6	6	2	1	1	2	1	1	2	30

Source: INM., 2000-2009

The annual average number of days of sandstorms for the period 2000-2009 is 30 days. It varies from 1 to 6 days. The highest number of windy days was recorded during the spring season (March-April-May) with 19 days of sandstorms.

6.2 Biological Framework

In order to describe the biological environment, EAM carried out an ecological survey. This survey was based on investigations conducted in April 22 to 24, 2009, during which different ecological systems, each being characterized by an appropriate physiognomy of the natural vegetation, were noted.

The very marked dryness of the climate and the soil prevents the installation of vegetation and animal settling process. This results in a weak biological diversity. The number of animal and vegetation species remains in these situations low compared to the rest of the arid zone.

Concerning the Dahar formations, the geological substrate uprising under the effect of wind, provokes the truncation of the soil, which becomes uncovered (naked) and inadequate for the installation of animals.

6.2.1 Flora

6.2.1.1 Historical Overview

Dahar vegetation has hardly ever been studied, barring Houérou's works (1959-1969). In terms of plant life, the region was classified by Ferchichi (1997) as a transition area between the Mediterranean flora and Saharan-Arabian flora.

In terms of plant communities, the following ones were identified by Houérou (1959):

- ✓ Plant community of *Anthyllis sericea* ssp. *henoniana* and *Gymnocarpos decander;*
- ✓ Plant community of *Arthrophytum schmittianum* var. *prostratum* and *Arthrophytum scoparium* var. *scoparium;*
- ✓ Plant community of *Helianthemum confertum* var. *brachypodum* and *Calligonum comosum;*
- ✓ Plant community of *Calligonum azel* and *Calligonum arich*;
- ✓ Plant community of *Aristida pungens* and *Gensita saharae;*
- ✓ Plant community of *Ephedra* ssp. *alenda* and *Cornulaca monacantha*.

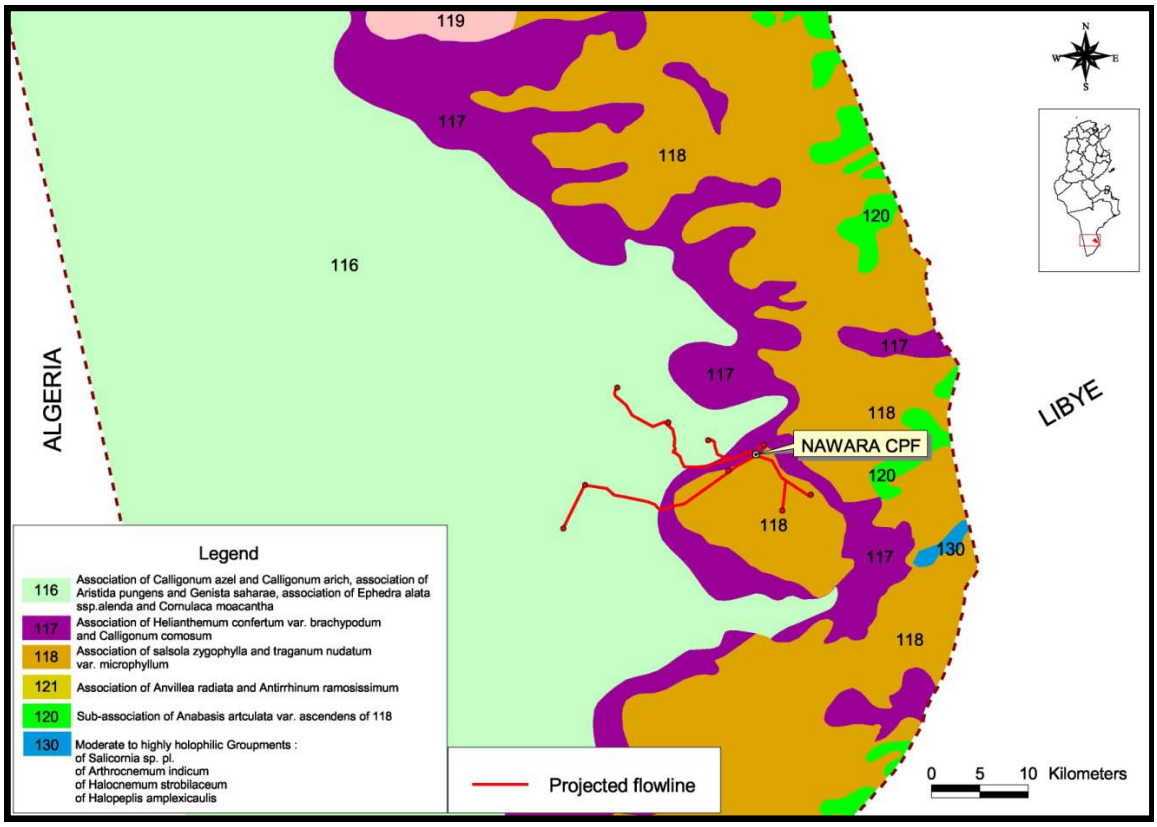


Figure 6.7 Phytoecological Map of the Study Area

Dahar is generally marked by a steppe cover with predominance to the West (along the eastern Grand Erg) of psammophilous species (*Helianthemum confertum, Oudneya africana, Calligonum comosum*…) and to the East (along Matmta Mountains) of xerophilous species (*Gymnocarpos decander*, *Helianthemum kahiricum, Artemisia herba-alba*). Depressions are marked by predominance of psammophytes such as *Retama raetam, Aristida pungens, Calligonum comosum, etc*.

Salt depressions are very rare in this region. Sandy or powdery limestone or gypsum Regs are covered with sparse vegetation where *Traganum nudatum* and *Cornulaca monacantha* are dominant.

Thanks to a relatively congenial milieu, Wadis and spraying areas house a rich and varied vegetation, mostly *Tamarix sp., Retama raetam, Pennisetum elatum, Aristida pungens, Calligonum comosum,* etc.

6.2.1.2 Plant Ecology Inventory

(i) Methodological Approach

The assessment of grazing resources in the study area was based on site surveys which led to the collection of sufficiently precise and up-to-date information on the natural tree cover and the plant ecology mapping of middle and southern Tunisia which was carried out by Houérou (1969) at 1/500.000.

The site survey was conducted during April 2009. It should be noted that 2009 was a relatively dry year, not favouring the growth of annual vegetations.

The method adopted consists in an in situ appraisal of:

- ✓ The floristic composition of vegetation: In view of the special nature of the Sahara region, marked by a short period of vegetation, we excluded annual species (very often short-lived) from the unit characteristics.
- ✓ Dominant species: each unit being thus characterized by the perennial species found therein; the species included as dominant or co-dominant are in this specific case perennial species, whatever they are ligneous or herbaceous.
- ✓ Vegetation Cover: As regards the various units identified, the tree cover was estimated at the closest value to one of the following cover classes: < 5%; 5-10%; 10-15%; 15-20%; 20-25%.

(ii) Description of Identified Units

Plant community of *Traganum nudatum* and *Arthrophytum schmittianum*

Location: It is the predominant unit in the study area. This unit is situated along the track linking Nawara to SP3 Pumping Station – Bir Zar.

Characteristics: It is the most productive and most balanced unit. It is the unit most used by herds. During the rainy seasons the unit becomes a good autumn or winter range. During the rest of the year it is a mediocre range for dromedaries.

***Floristic composition*:** The main taxons characterising this unit are:

- *Traganum nudatum*
- *Arthrophytum schmittianum*
- *Helianthemum kahiricum*
- *Fagonia cretica*
- *Sueada fruticosa*
- *Atractylis serratuloides*
- *Gymnocarpos decander*
- *Salsola villosa*
- *Anabasis articulata*
- *Stipagrostis plumosa*

***Vegetation Cover*:** the total cover is 15 to 20% with:

- *Traganum nudatum 5* to 8%;
- *Arthrophytum schmittianum* 3 to 5%;
- *H. Kahiricum* 5% ;
- *H.sessiliflorum* 3%
- Others 3 to 5 %.

Plant community of *Retama raetam, Aristida pungens* and *Cornulaca monacanta*

***Location* :** This association characterizes the less bright sand accumulations found on the site hills. This unit differs from the other units by the presence of *Cornulaca monacanta* species.

Characteristics : the vegetation of this unit is linked to the quicksand. All species, exclusively psammophilous, adapt to this Aeolian dynamics and grow upward. This applies for *Retama raetam, Aristida pungens* and *Helianthemum confertum*, etc. This unit is highly sensitive to desertification.

***Floristic Composition*:** This plant community regroups the following psammophilous species:

- *Retama raetam*
- *Aristida pungens*
- *Helianthemum confertum*
- *Cornulaca monacanta*
- *Traganum nudatum*
- *Oudneya africana*

Vegetation Cover: The cover is 5 to 10% with :

- *Aristida pungens* 2 to 3%;
- *Retama raetam* 3 to 5%
- *Cornulaca monacanta 2* to *3 %*
- *Helianthemum confertum* 1 to 2%;
- Others 2%.

Plant community of *Retama raetam, Ephedra alata-alenda* and *Helianthemum confertum*

***Location* :** This association characterizes the western hillside.

Characteristics : the vegetation of this unit is too linked to the quicksand. The soil is often subject to alternate periods of sand filling and deflation due the mobility of micro-nebkas. This unit seems to be more dynamic than the previous association.

***Floristc composition*:** This unit is especially characterised by the presence of two species *Ephedra alta-alenda* and *Calligonum comosum*. This plant community regroups the following psammophilous species :

- *Retama raetam*
- *Aristida pungens*
- *Helianthemum confertum*
- *Ephedra alata-alenda*
- *Traganum nudatum*
- *Stipagrostis obtusa*

Vegetation Cover: The cover rate is estimated at almost 10 to 15% with :

- *Ephedra alata-alenda* 3 to 4%
- *Retama raetam* 2 to 3%
- *Helianthemum confertum* 1 to 2%
- *Calligonum comosum* 1%
- *Rantherium suaveolens* 1%
- *Others* 3%

Riparian Unit

***Location*:** This plant community is found in the various small wadis and the spraying areas.

Characteristics: This vegetation benefits from an occasional water intake and a relatively rich soil which allows it to maintain a fairly balanced condition. This dynamic vegetation can evolve both in terms of floristic variety and soil cover.

The relatively small difference in the unit productivity between the dry season and the

rainy season may be the result of the fact that the unit benefits from the surface runoffs from autumn rainfalls.

***Floristic composition*:** the plant composition varies increasingly from one secondary range to another according to the degree of sand dunes. The main species represented in this unit are:

- *Retama raetam* : It is the species most representative of the physiognomy of the riparian vegetation.
- *Aristida pungens* : It occupies the Aeolian mantles.
- *Tamarix gallica* : It generally occupies nebkas of wadis beds and it displays an arborescent aspect.

In addition to *Euphobia guyoniana, Oudneya Africana, Helianthemum confertum,* and *Calligonum comosum.*

***Vegetation Cover*:** The total cover varies from 20 to 25% with :

- *Retama raetam 10* to *15%;*
- *Aristida pungens 8* to *12%*;
- *Euphorbia guyoniana* 2 to 3%
- Others 3%.

6.2.1.3 Description of the Main Existing Species

The main existing species within the Nawara development field are listed in table 6.6.

Table 6.6 Main Existing Species within the Nawara Development Field

NO.	Species Name	NO.	Species Name
1	*Anthyllis sericea ssp. henoniana*	18	*Gymnocarpos decander*
2	*Aristida obtusa*	19	*Helianthemum confertum*
3	*Aristida plumosa*	20	*Helianthemum kahiricum*
4	*Aristida pungens*	21	*Helianthemum sessiliflorum*
5	*Arthrophytum schmittianum*	22	*Launaea resedifolia*
6	*Arthrophytum scoparium*	23	*Linaria aegyptiaca*
7	*Asphodelus tenuifolius*	24	*Oudneya africana*
8	*Atractylis flava*	25	*Plantago albicans*
9	*Atractylis serratuloides*	26	*Retama raetam*
10	*Calligonum comosum*	27	*Rhanterium suaveolens*
11	*Cornulaca monacantha*	28	*Sueada Fructicosa*
12	*Euphorbia guyoniana*	29	*Salsola brevifolia*
13	*Echiochilon fruticosum*	30	*Salsola vermiculata*
14	*Echium pycnanthum*	31	*Savignya parviflora*
15	*Erodium hirtum*	32	*Traganum nudatum*
16	*Fagonia glutinosa*	33	*Tamarix gallica*
17	*Fagonia microphylla*		

Traganum nudatum subsp microphyllum

The species belongs to the Chenopodiacean family. It is a branchy Chamaephyte which rarely reaches one meter in height. It blossoms in the period from mid-autumn to late winter. The fruits are enclosed in thick hairs. The micro-phyllum variety is abundant mostly in the desert steppes over limestone-gypsum soils. It is found in the lower arid zone but is mostly heavily present in the Saharan zones. From an edaphic point of view, Traganum nudatum steppes occupy limestone and gypsum crusts and Regs, with low depth, capped with a sandy-slimy skeletal soil or an aeolian mantle.

This species is very much appreciated, particularly by dromedaries and goats.

Arthrophytum schmittianum

It is a sea-green easily spottable ligneous shrub with succulent articulated branches. The leaves are opposite, small in size, well-welded at the branch articulations. The plant growth and reproduction take place in autumn and winter. This species is considered Saharan-Mediterranean. It is found in stony and slimy semi-desert pastures. It extends southward to the Western and Central Sahara.

The species has a low grazing value and is mostly appreciated by camels

Retama raetam

It is a bright highly branched shrub which can reach up to 2 m in height. The leaves are small. The blooms are white, with stem. *Retama raetam* grows in autumn after the first rainfalls but most often in spring. It generally blossoms in February. In March the seedpods begin to appear and the seeds ripen in June.

The species is spread as from the humid bioclimatic stage to the Saharan stage. It colonizes the sand dunes and sand accumulations. In the study area, it is found in the wadi beds and on the bright sandy accumulations.

This moderately palatable species is known mostly for its highly important role in soil fixing. In a good year, the species consumption peak concurs with the flowering stage. It is appreciated mostly by goats. They eat the flower stems and sometimes even the seedpods. In summer, the young stems and seedpods fall under the shrubs and are eaten by goats and ovine.

Ephedra alata subsp. Alenda (Stapf.) Trabut

This species belongs to the Ephedracean family. Its vernacular name is Alenda, but it is known in English as Ephedra. It is a dieocious shrub which can reach up to 5 metres in height. It has a habit similar to R'tem's. The stems can reach such an advanced stage in their growth that they are used as common charcoal. The opposite leaves are scale-like. Flowering extends over the period from January to May.

This species used to be found in the entire sandy and dune area in the South. Due to excessive human pressure, the species has become rare and is no longer abundant in the Grand Erg oriental.

The species is useless in terms of grazing value. However, thanks to its high heating qualities, it is used as charcoal. Its buds and fruits are used in traditional medicine.

Stipagrostis pungens

The plant's vernacular name is Sbot. It has a hardy stem and can reach a height of up to one metre, forming substantial tufts. The leaves are rigid, with prickly tips. The vegetal growth mostly takes place in spring and the reproduction stage extends from late spring to June.

It is spread from Hammamet to the southernmost region and grows on dunes and sandy wadis. Although considered psammophyte, the species tolerates the presence of gypsum in quicksand-covered

substrate. In the study area, the species is found in wadi beds, on sandy mantled soils and on living sandy accumulations.

This quicksand-dune-fixing species is very much appreciated by dromedaries and to a lesser degree by small ruminants.

Cornulaca monacantha Del.

The species belongs to the Chenopodiacean family. Its vernacular name is Hadd. It is branchy, prostrated and often padded due to the great pressure from animals. The leaves are thick, small in size and marked by their spiny tips. The blooms (1 to 3) are small in size and generally appear clustered in autumn.

It is a purely Saharan species. It is found mostly on sandy steppes in the continental regions. In Tunisia, dense clusters of the species have been spotted in Djerid (Tozeur, Nefta) and close to Rjim Maatoug. It is also found in the easternmost part of the country (Borj El Khadhra).

Although it is relatively spiny, this species is highly appreciated by domestic and wild animals. In case of overgrazing, it takes various shapes, mostly a pad-like form, a sign of self-defence. In traditional medicine, it appears that it has purgative effects for men and animals. It is even thought to be used for the treatment of liver diseases in the western sub-Saharan region.

Gymnocarpos decander

Almost 30 cm high, this sub-shrub has russet or purplish small glomerule-like blooms and blossoms in spring.

It is widespread in the Middle and South under bioclimatic tiers ranging from the higher arid to the lower Saharan zones which are marked by moderate to hot winters. It grows in gypsum or slimy crusted skeletal soils in these zones. It is found in the entire study area.

This grazing species is known for its capacity to colonize extremely poor skeletal soils. The species palatability results from its phenology. It is least appreciated during the flowering stage.

Calligonum polygoides subsp.comosum

This species belongs to the Polygonacean family. Its vernacular name is Arta and is known in English as haired Calligone. It is the most typical phanerophyte in the Saharan region. It can reach up to 2 metres in height. The bark is whitish, especially during the time when leaves begin to fall. The leaves are small in size and scale-like.

Its biological cycle is marked by a very short-lived vegetal growth stage (February-May). The reproduction stage ends in June. The fruits, achene-form, bear several series of hairs.

The species is commonly found in the entire Saharan region, with the exception of the Grand Erg Oriental. It occupies the runoff deep and sandy alluviums in the South and the sand dunes. Its presence has been recorded in Mechhed Salah, Remada, Borj Bourguiba and in all Dahar.

It is an excellent grazing species, especially in spring. It also plays an important role in the quicksand fixing. Its wood is very much appreciated.

Helianthemum confertum

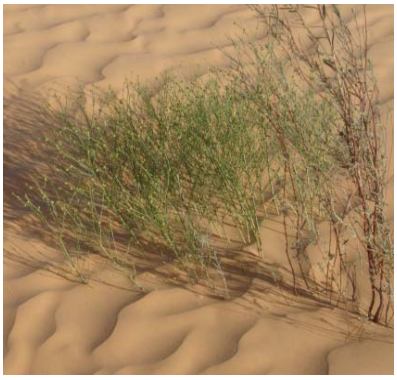
This is a plant with ligneous upright stems which can reach up to one meter in height. The leaves are elliptic with rolled margins and white ear-ended blooms. The species full vegetal growth takes place in spring and the flowering in April.

It is widespread in Bir Soltane, Kamour, K'sar Ghilane, Bir Aouine, Jneien, Mechiguig where it grows on the dune systems close to the Grand Erg Oriental.

H. Confertum is a grazing plant which is quite appreciated by cattle.

Euphorbia guyoniana

This species belongs to the Euphorbiacean family. Its vernacular name is Lebbina. It is a



dark green hemicryptophyte with highly branchy slender herbaceous habit. The stems contain latex and can reach up to one meter in height in conditions favourable to the species growth. The leaves are small in size, linear in shape, obtuse and dry up fast. Flowering is spaced out over the winter and spring seasons. The blooms have small bright yellow petals. The fruit is a 4-5 mm capsule which contains winged seeds. Once the upper parts dry up, growth is resumed during the following season from the buds buried in the soil or at the soil level.

This species is found almost exclusively in the Saharan region, especially in the sandy areas, down to the southernmost region (Borj El Khadra).

In the Saharan areas, it is used to treat insect and scorpion bites. Like all the other Euphorbes, it is useless as a grazing plant.

Plantago albicans

This plant has 10-20 cm high rosette-like leaves. They are whitish, vellous and silky with a floral stalk which can reach up to 40 cm in height. The flowering takes place in early spring and fructification ends around early summer. *Plantago albican*s grows mainly in spring and to a lesser extent in autumn, in rainy season. It is one of the species which grow quite early after the first autumn rainfalls.

This plant is abundant particularly in the Middle and Southern regions (down to Remada and Dhiba) beneath arid and sub-Saharan bioclimatic stages. It is widespread and grows particularly in deep sandy soils. In the study area, *P. albicans* is found almost everywhere.

This species, highly appreciated, is used as animal feed, especially in autumn.

Rhanterium suaveolen

It is a sub-shrub which forms 30-60 cm high tufts. It has numerous whitish green branches with linear small leaves and yellow blooms. The species vegetal growth generally begins in April and can last until August. The growth duration and intensity vary according to the quantity of water available in the soil. Flowering begins in April and reaches a peak in May.

The species is commonly found in the bioclimatic stage ranging between the higher arid and lower Saharan. It is widespread in the sandy steppes from Sousse to the Libyan border. It marks the physiognomy of the vegetal formations in Jeffara (to the southeast of the country). In the study area, R. suaveolens is mostly found between Jneien, Bir Aouine, Borj Bourguiba, etc.

The plant, of average grazing value, is known to be a nectar plant. It is also known in the south of Tunisia to cause abortion in goats in case of extensive grazing.

Salsola vermiculata

This perennial species belongs to the ligneous Chenopodiacean family but it does not exceed 60-70 cm in height. The vegetal growth begins as early as August but the flowering takes place only in autumn. The blooms are whitish and small in size.

It is a common species in the mid-south and in the Saharan zone. It is found in an area stretching down to Mechiguig in the southernmost part of the country.

It is a grazing species, very much appreciated by animals, especially ovine and goats. It also has therapeutic usages and is used for the treatment of some skin diseases.

Suaeda vera, Suaeda fruticosa

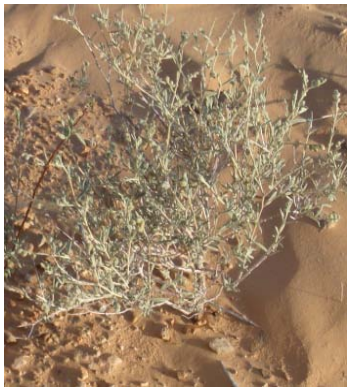
This sub-shrub belongs to the Chenopodiacean family. It has a whitish bark and upright or rolled out branches. The leaves are thick, sessile, linear, about 1 cm long, dark green but turn dark when they dry up. The blooms (1 to 3) are fixed at the leave axils.

It is a little halophilic species which generally grows on moderately salty soils throughout Tunisia.

The plant is used in Djerid to dye wool black. The seeds have cardio-active, anti-infective and healing effects.

Helianthemum lippii

It is a 10-40 cm high sub-shrub with reedy branches and greyish green linear leaves with rolled margins. It has a dense straight hair pubescence and yellow unilaterally eared blooms. The species vegetal growth begins after the first autumn rainfalls and reaches a peak in spring.



The species is widespread in the area from Cap-Bon to the northeast down to the Saharan bioclimatic stage in the South, where it grows on light or gypsum soils. In the sandy continental steppes, it grows on fairly stabilized and fairly gross sand alluviums. In the study area, it is commonly found in the sand mantled areas.

The species is very much appreciated by small ruminant and, particularly, goats. It is said to be toxic for dromedaries.

Oudneya africana

It is a shrub which can reach one meter in height. It has yearly whitish branches. The thick leaves are dark green with purplish blooms. The species phenology is marked by a vegetation activity which is fairly spaced out over a prolonged period of time. It begins after the first autumn rainfalls and lasts until summer. The species flowering takes place in the period between March and April.

The plant grows beneath sandy soils and desert torrent beds. It is found mainly in Jerid

and Nefzaoua. In the study area, this species is found on the borders of Erg (Ksar Ghilane, Kamour) and on the beds of some wadis.

This grazing plant is quite appreciated by dromedaries and is said to be edible.

6.2.2 Fauna

According to the literature, the study area is characterized by a more or less diversified Saharan fauna which is dependent on the ecological conditions of the site. It includes various species which are adapted to the variable weather conditions characteristic of this region. Among the species of this zone, we report the mountain gazelle (Gazella dorcas) and that of the dunes (Gazella leptoceros), having a colour which corresponds to that of sand (adaptation). These species are rather characteristic of dune sites, but they have a tendency to migrate to the zone looking for water. The predators, in particular the wolf, the jackal and the fox, are relatively abundant because of the pasture vocation and the presence of cow and sheep herds. The rabbit and rodents are well adapted to this environment.

The abundance of these species is highly related to the presence of shelter made of bushes of certain vegetation species constituting an adequate shelter environment.

Among the reptiles, we encounter the sand viper and the desert varan (*Varanus griseux*). These species are extremely dangerous.

One other species constituting a characteristic of the Oriental Great Erg is the sand boa (*Eryx jaculus*) which is extremely dangerous, as the case of the Naja (*Naja haje*). Other non or little dangerous reptiles exist, such as the lizards.

Insects also constitute a fauna characteristic of the zone, and their abundance indicates the high density of arachnids (scorpions and spiders). Finally, in terms of avifauna, many species of sedentary birds are adapted to the weather conditions of the region and many migrating species settle in this zone. In particular, we report the presence of a very rare bird in the whole Saharan zone of Tunisia. It is the Outarde houbara, a protected species which is rare and can exist in the regosolic point of the southerner Dahars. However, it is totally absent in dune-based environment.

Due to severe weather conditions in particular during daytime, we report that most of the animal species mentioned above have the tendency of remaining in their shelters. As such and during all our on-site observations, we have only noticed very few species.

Among the rare animals, encountered in the whole study area, we mention: a gazelle, a rabbit, a couple of Isabella (Saharan bird), a couple of ravens, few common birds in

Tunisia, lizards and few insects. However, the observed foot prints on the sand during the morning, indicate an intense activity of animal species during the night. A thorough fauna survey within the zone can only then be performed during the night.

6.2.3 Protected Species

According to Article 7 of the order of the Minister of Agriculture and Environment dated September 11th, 2012, relating to the organization of hunting activities during the season 2012-2013, hunting, destruction, capture, selling, buying, hawking and detention of the following species are prohibited by the law at all times :

- ✓ ***Mammals:*** stag, gazelles, buffalo, serval, mouflon with cuffs, lynx, cheetah, hyena, fennec, porcupine, bats, white hedgehog, Thomas's gundi, wildcat, otter, seal, saw, young wild boar and all young wild mammals.
- ✓ ***Birds***: African Bustard *Chlamydotis undulata*, Greater Flamingo, stork, Slender-billed Curlew, Marbled Teal, White-eyed Pochard, Purple Gallinule, Corn Grex, Shag Cormorant, Audouin's Gull, Eurasian spoonbill, night and diurnal bird of prey, eggs, nests and clutches for all wild birds.
- ✓ ***Reptiles and amphibians***: land, sea and freshwater Tortoises, desert lizard, tail whip, chameleon and frogs.

The export, the import and the transit of all the wild fauna species including any of their parts (mammals, birds, reptiles, amphibians, molluscs, insects, arachnids and annelids) are prohibited except upon a special authorization of the General Director of Forests.

The naturalization of the wild fauna species is submitted to the specifications approved by the decree of minister of the agriculture dated 28 March 2001.

6.3 Human Framework

6.3.1 Population

6.3.1.1 Demography

The study area is located in the sector of Borj El Khadra, delegation of Remada within the Governorate of Tatouine. This delegation covers 27 830 km^2 which is 70.4% of the governorate of Tataouine. The Remada delegation has 9 977 inhabitants (INS., 2005) with a population density of approximately 0.25 inhabitant/km^2.

According to the results of a census conducted by the National Statistics Institute in 2004, the population of the Borj El Khadra sector was 83 inhabitants grouped in 2261 houses and 1773 households (INS, 2005). It mainly consists of the military personnel at the frontier post of Borj El Khadra. The low population is largely due to the location of this sector within the Tunisian Sahara and the associated harsh desert conditions. The photo of houses in the region of Borj El Khadra is given below.

The area is also occupied by shepherds who are generally found in the area on a seasonal basis. They are generally not included in the census noted above and the exact size of this population is unknown.

6.3.1.2 Active Population

The distribution of the active population by branch of activity in the delegation of Remada, and the governorate of Tataouine is given in table 6.7.

Table 6.7 Distribution of the Active Population by Branch of Activity

		Governorate of Tataouine	Delegation of Remada	% of the delegation of Remada
Economic Activity	**Number of active population 15 years and more**	50 228	2779	-
	Activity rate %	47,7	42,4	-
Distribution of active population aged 15 years and more by branch of activity	**Agriculture and Fishing**	15198	595	25,1
	Manufacturing	1974	174	7,3
	Mining and Energy	833	87	3,7
	Building and public work	4944	280	11,8
	Trade	9065	322	13,6
	Transport and Communication	9574	871	36,8
	Education and Health	294	38	1,6
	Other services	41882	2367	100
	Undeclared	50 228	2779	-
	Total	47,7	42,4	-

Source: ODS., 2010

The number of active people aged 15 and more is 2779 and the activity rate is 42.4% in the delegation of Remada.

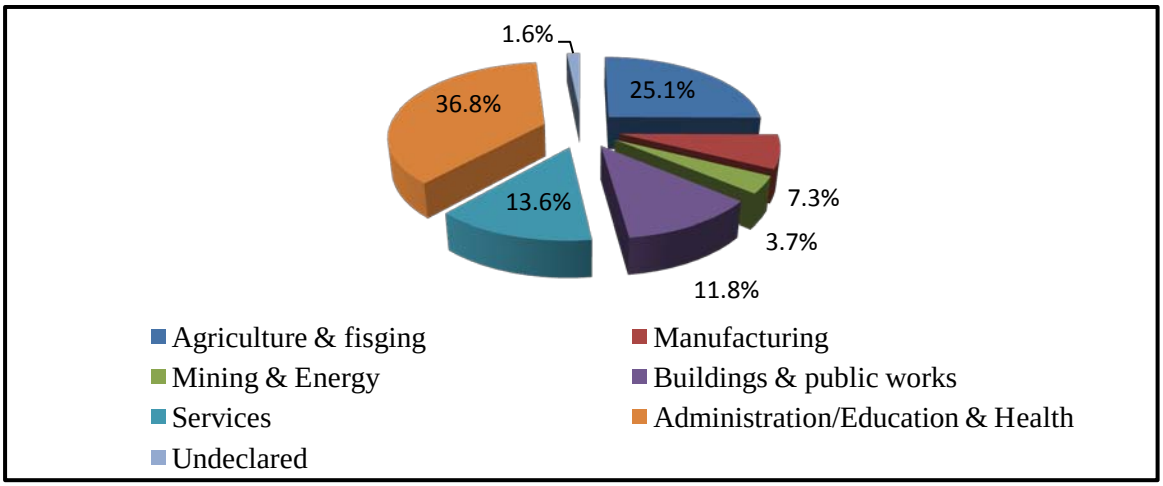


Figure 6.8 Distribution of Active Population by Branch of Activity within the delegation of Remada

According to this figure, mainly three sectors absorb the active population within the delegation of the study area (Remada) which are the administration/education and health branch (36.8%), followed by the agriculture sector (25.1%) and finally the services branch (13.6%).

According to the field survey, the working population in the hamlet of houses within Borj El Khadra region is 20 persons, among them 4 are unemployed.

6.3.1.3 Unemployment

The table 6.8 presents statistics of the unemployed persons aged 15 years and more and the rate of unemployment in the delegation of Remada, the governorate of Tataouine and in Tunisia.

Table 6.8 Unemployment Rate

Region	Number of unemployed 15 years and more	Unemployment Rate
Delegation of Remada	412	14.8%
Borj El Khadra sector*	4	-
Governorate of Tataouine	8,347	16.6%
Tunisia (2011 statistics)	704,900	18.3%

Source: ODS., 2010

**: According to a field survey carried out in February 2012*

6.3.2 Economic Activity

6.3.2.1 Agriculture

The agricultural area in the governorate of Tataouine is 1,706,991ha and the main crops are cereals, gardening, legume and arboriculture. The land use in Borj El Khadra region is based mainly on vegetables and fodder crops.

Land use in the study area is presented in figure 6.9 (see Figure 6.9 Land Use in the Study Area).

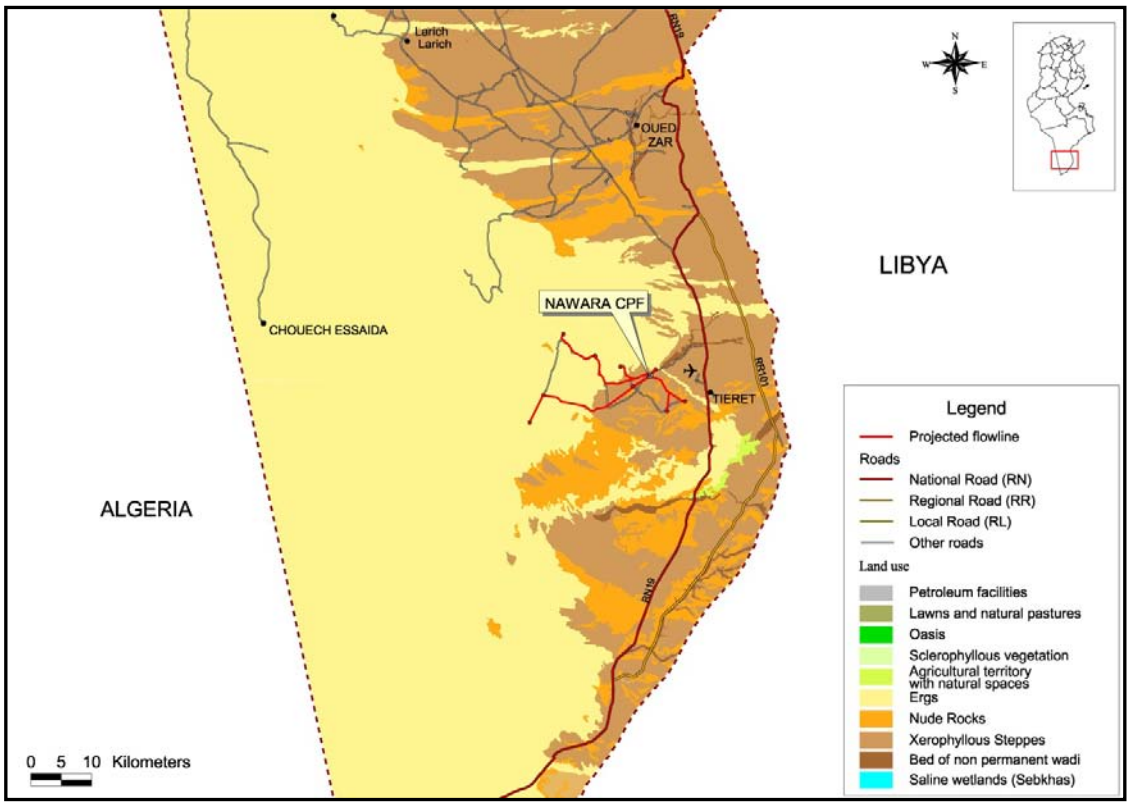


Figure 6.9 Land Use of the Study Area

Tables 6.9, 6.10, 6.11 and 6.12 give the distribution of agricultural lands with their use as well as the distribution of dry and irrigated crops.

Table 6.9 Distribution of Land Use (ha)

Region	Agricultural Area	Pastures	Forests	Non Agricultural Area	Total
Remada	30.000	780.000	398	810.398	2,105.609
Governorate of Tataouine	200.000	1,500.000	7,747	1,707.747	2,181.445

Source : ODS., 2010

Table 6.10 Distribution of Arable Land (ha)

Region	Cereals	Gardening	Legume	Arboriculture	Total
Remada	6	232	-	3,860	4,098
Total Governorate of Tataouine	2,192	766	27	51,600	54,584

Source : ODS., 2010

Table 6.11 Distribution of Irrigated and Dry Annual Crops (ha)

Type of crop	Region		Cereal	Legume	Vegetables	Fodders
Dry	Delegation of Remada	Area (ha)	200	-	-	-
		Production (T)	70	-	-	-
	Governorate of Tataouine	Area (ha)	870	27	14	-
		Production (T)	322	62	62	-
Irrigated	Delegation of Remada	Area (ha)	12	-	232	950
		Production (T)	63	-	4,513	285,000
	Governorate of Tataouine	Area (ha)	188	-	765	365
		Production (T)	1,930	-	14,735	7,330

Source: ODS., 2010

Table 6.12 Distribution of Irrigated and Dry Arboriculture

Type of crop	Region		Olive trees	Dates	Almond trees	Pomegrenate trees	Fig trees	Other
Irrigated	Delegation of Remada	Area (ha)	2,065	-	186	-	207	-
		Production (T)	420	-	15	-	-	-
	Governorate of Tataouine	Area (ha)	44,355	145	1,584	-	1,710	-
		Production (T)	557	-	100	-	60	-
Dry	Delegation of Remada	Area (ha)	614	103	140	64	64	241
		Production (T)	506	15	40	35	170	580
	Governorate of Tataouine	Area (ha)	1,607	230	261	304	199	732
		Production (T)	1,029	30	100	410	310	1,330

Source : ODS., 2010

6.3.2.2 Livestock Farming

Dahar is known to be a grazing area. It is used by herds of dromedaries and small ruminants (ovine and goats) from neighbouring regions.

(i) Breeding of dromedaries

The dromedary is a species adaptable to the harshest living conditions. It contributes to the valorisation and preservation of desert expanses marked by a thin vegetal cover and an extremely fragile ecosystem. In good years, at least 50% of the national camel herd head toward the Sahara and Dahar during the springtime.

The breeding of camels remains a traditional activity, but it helps meet the needs of the local population in terms of meat in the middle and south of Tunisia and valorising arid and desert areas abandoned by the other animal species or inaccessible to some of them.

The dromedary was used in the past to transport people and goods and to carry out farm works, but it has been discarded. It is now used as a mere source of meat due to the sedentation of the nomad populations, higher shepherding costs, underrating of camel scouting and the implementation of 1942 law regarding the slaughtering of dromedaries (under this law, the slaughtering of animals under 15 years was banned), the introduction of machines on farms and the development of means of transport (vans, tractors).

As a result, the number of camels has plummeted sharply over the last decades.
Since 1990, after the launch of the camel project in the South and transborder commercial exchanges with Libya, the number has increased considerably.

Table 6.13 Evolution of the number of camels in the Governorate of Tataouine (1890 - 2007)

Year	**1890**	**1930**	**1990**	**1998**	**2007**
Number	3,100	9,860	16,000	20,000	25,000

Due to the mobility of animals between the study area and the breeding “residence rounds”, it is difficult to identify a specific round (grazing duration, sanitary prophylaxis) and assess Dahar own production.
The strategy of transhumance toward the Saharan rounds and Dahar seems to be a key component in the way camel breeding is conducted in the south of Tunisia.

The number of camels which head towards the region each year depends on the earliness and quantities of rain falling in the residence rounds.

Watering locations determine the destination of transhumance.

The beginning and the end of transhumance are further determined by the behaviour of animals; they prefer to go grazing in depressions looking for tender vegetation. Camel raisers shun certain rounds and choose milder and less windy destinations.

(ii) Breeding of small ruminants

The study of the various zoo-technical aspects of the breeding of small ruminants was conducted based on the result of a survey of shepherds and data collection from the CRDA of Tataouine and the regional development departments.

Transhumance is a very old practice in Dahar round. It extends over a period of six months each year. It begins after the first autumn rainfalls and lasts to late spring. Watering locations determine the destination of transhumance.

Due to the lack of infrastructure in the area and the way breeding is conducted, it is difficult to determine the exact number of the herds of small ruminants which use the area rounds. The numbers listed in the table below are tentative figures computed on the basis of data provided by the CRDA of Tataouine.

Table 6.14 Estimation of the Number of Ovines and Caprines (× 1000 heads) using the Dahar

Gouvernorate	Ovines	Caprines	Total
Tataouine	298	232	530
Others	162	139	301
Total	**460**	**371**	**831**

The entire herds in Tataouine Governorate are considered as using Dahar. The herds of small ruminants are made up of goats and ovine. An average herd is composed of 54% of goats and 46% ovine.

Within the Borj El Khadra sector, there are only 300 heads of livestock (200 cows and 100 sheep).

6.3.3 Underground Resources

The largest underground resource is oil, especially in the regions of El Borma, Makhrouga, El Arich, Chouech Es Saida, Oued Zar, Hammouda, Adam and Cherouq, which provide the major part of the Tunisian oil production.

6.3.4 Infrastructure

Infrastructure within the study area is very limited. There is a 24 inch oil pipeline which is located eastern to the Jenein Sud permit boundary. The pipeline originates at the Ain Amenas hydrocarbon field in Algeria's Illizi Basin and travels approximately 760 km

northwards to Skhira export terminal situated along Gulf of Gabès shoreline.

The National road RN-19 and the regional road RR-101, as well as a number of smaller roads joining them from the West, pass eastern to the Jenein Sud permit boundary (see Figure 6.10 Infrastructure within the Study Area).

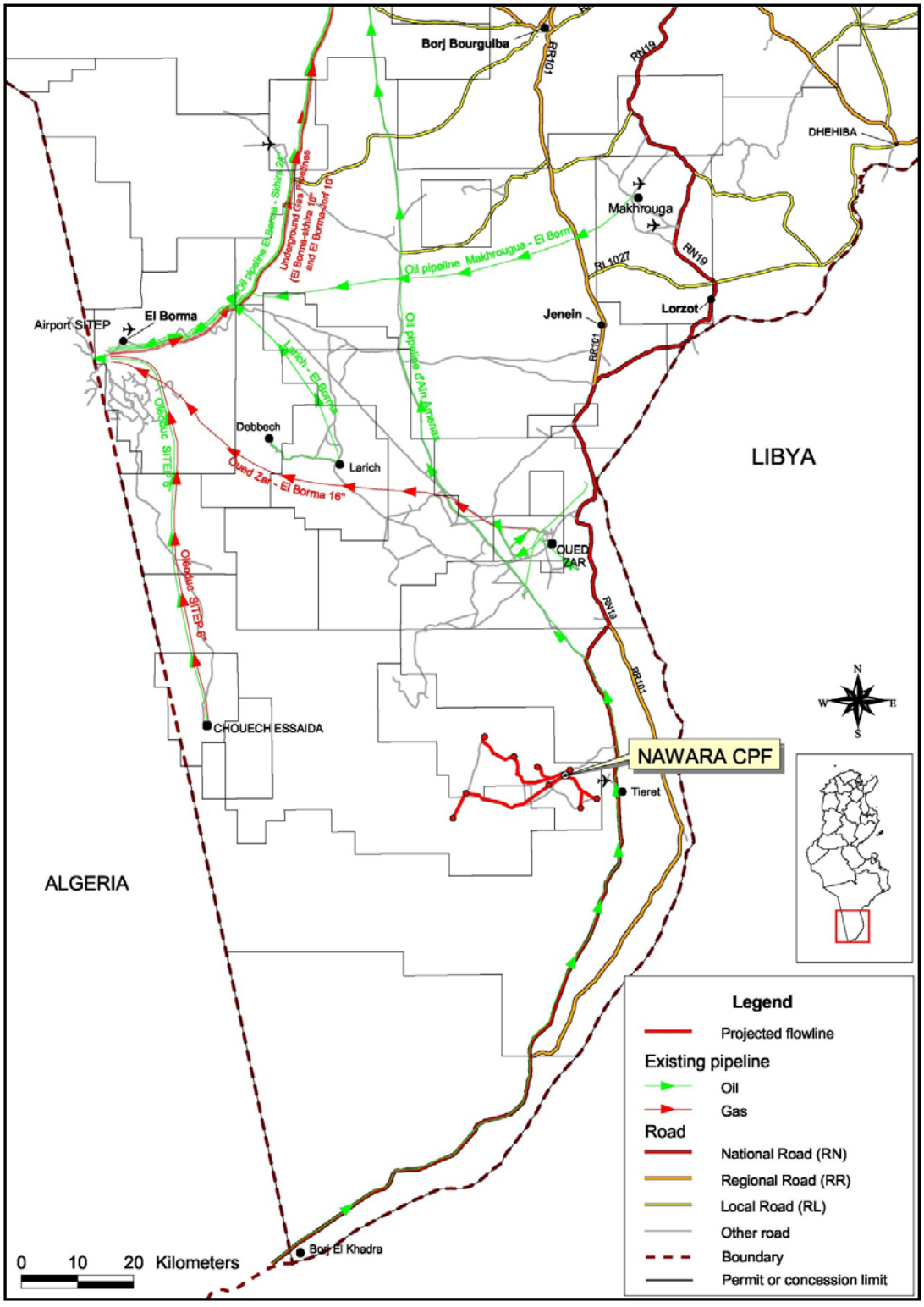


Figure 6.10 Infrastructure within the Study Area

6.3.5 Cultural and Archaeological Patrimony

Within the extreme south of the Tunisian Sahara, pre-historical documentation is almost absent and existing information provided by anthropologists and palaeontologists tends to be general in nature and dates from the beginning of the twentieth century.

A baseline survey was carried out by EAM during the period between 22 and 25 April 2009. Table 6.15 and Figure 6.11 represent a summary of the findings.

Table 6.15 Summary table of Archaeological Findings

Site	Type of Finding	Culture /Age	Coordinates	
			X	Y
1	No findings at Nawara well site	-	60 22 70	34 31 086
2	Flint debris, shaped earthen ware, ostrich egg fragments	Palaeolithic – Neolithic	60 11 96	34 31 024
3	Siliceous limestone points, blades, chipping chisels and scrapers; flint scrapers, rasps and points	Middle Palaeolithic	60 16 40	34 31 862
4	Flint points and blades	Middle Palaeolithic / Upper Palaeolithic	60 21 22	34 28 079

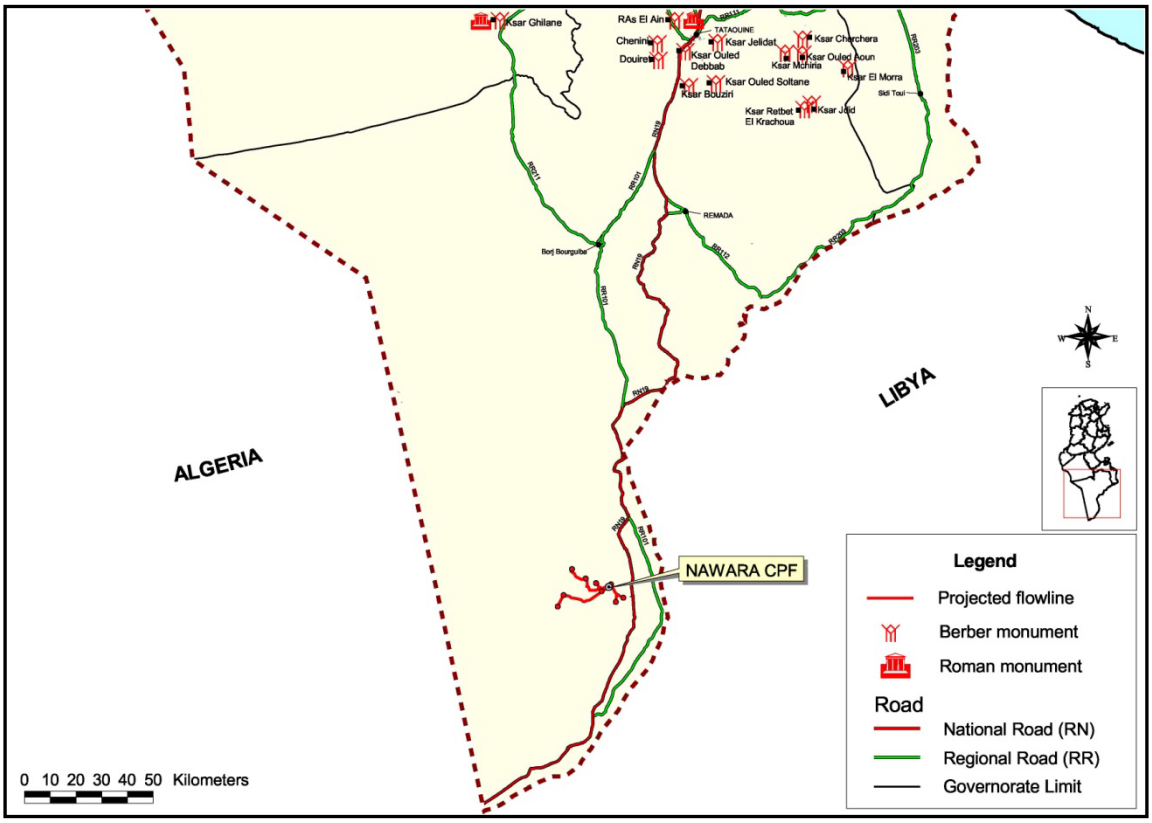


Figure 6.11 Archaeological Sites within the Study Area

6.3.5.1 Identification and Evaluation of Archaeological Artefacts

Nawara oilfield site is situated in an area of flat land which must have been used as a west-east landmark valley. The area lies between two hills, one to the South and the other to the North. Intensive exploration has been conducted in the study area in stages depending on the various topographical units.

Exploration of the oilfield's immediate surroundings did not reveal any traces of ancient culture (Photo no. 1a).

One kilometer to the west of the well, below the hill, rare evidences of existing Lithic material (especially flint lamellas) without any particular concentration were detected (Photo no. 1b). Two fragments of shaped ceramics and remains of ostrich eggs were also found but without any particular traces of usage (Photos no. 2 and no. 3). This material is typical of Neolithic cultures.

On the hill to the northeast of the Nawara field area, a deposit of siliceous limestone Lithic material cutting up is marked by the presence of relatively varied tools, such as points, blades, chipping chisels and scrapers, which belong to the Middle Palaeolithic Age (Photos no. 4 and no. 5).

On the same hill, in the outcrop of a flint intercalary layer traces of Lithic precrushing are made of flint debris and sporadic presence of relatively varied tools (Photo no. 6), mostly scrapers and rasps, as well as grossly chiselled points and cushion-edged blades belonging to the Mousterian culture.

Two to three kilometres to the south of the Nawara field at the bottom of the hill (Photo no. 7), scattered Lithic material is made of flint debris, including debris of Mousterian tools (single face points), and particularly more recent Capsian facies with cushion-edged, jogged and slanted truncation blades and microlites evolved into more complete geometrical forms (Photos no.8 and no.9).

Illustrations of the archaeological artefacts are given in photos 1 a-b, 2, 3, 4, 5, 6 7, 8 and 9.

1a

1b

2

3

4

5

6

7

8

9

6.3.5.2 Evaluation of the Archaeological Findings

Lithic tools found during the survey are marked by the Middle Palaeolithic Age, mostly Mousterian, which, in Africa, concurs with the Aterian (from Bir-el-Ater in Algeria) and is 40,000 to 20,000 years old. Among the flint or crystalline limestone tools traced back to this culture, points and rasps are most common. But the scrapers and chipping chisels as well as the two-faced retouch foliated pieces are found in great numbers and provide evidence of the evolution of Aterian into an Upper Palaeolithic Age.

On the hills scattered across the road linking SP3 Pumping Station to Nawara field, and on the hill to the northwest of Nawara field area, the lithic tool concentration is such that it constitutes pre-crushing sites, as proved by the commonly found debris and particularly simple and bipolar working edge nucleus. The site surface area is, however, very limited.

6.3.5.3 Conclusion

Based on the characteristics of the archaeological data obtained, it may be concluded that the Lithic artefacts scattered on the surface are of low significance. In fact, these tools are well-known in the Sahara and North Africa and, as such, they could be said to be commonplace.

By contrast, sites with a lithic material concentration, namely precrushing sites, all situated on hills, are of some importance, in view of their precise situation and the possibility of mapping certain operating chains of the Lithic industry but also the possibility of conducting an intersection operation and thus pinpointing the various stages in the palaeoenvironmental evolution, identifying the various forms of adaptation.

However, a request dated November 4th, 2013 was presented by OMV to the National Institute of Heritage to obtain an authorization for the realization of the project in the area (cf. Appendix VI Request for the authorization of National Institute of Heritage).

6.3.6 Protected Areas

No natural protected areas or National Parks exist within the study area.

6.3.7 Landscape

It is a desert landscape characterized by the presence of outcrops of Dahar and regs.

7.0 IMPACT ASSESSMENT METHODOLOGY

The adopted methodology in the evaluation of the impacts of the Nawara Concession Development CPF Project is based on the appreciation of a synthesis indicator which constitutes the impact significance. This indicator gives a judgment on the importance of gains and losses for the natural and human components of the environment related to the proposed project. The established judgment represents the integrated result of three components, including the intensity, the extent and the duration of the impact.

Figure 7.1 graphically presents the main process allowing the impact evaluation.

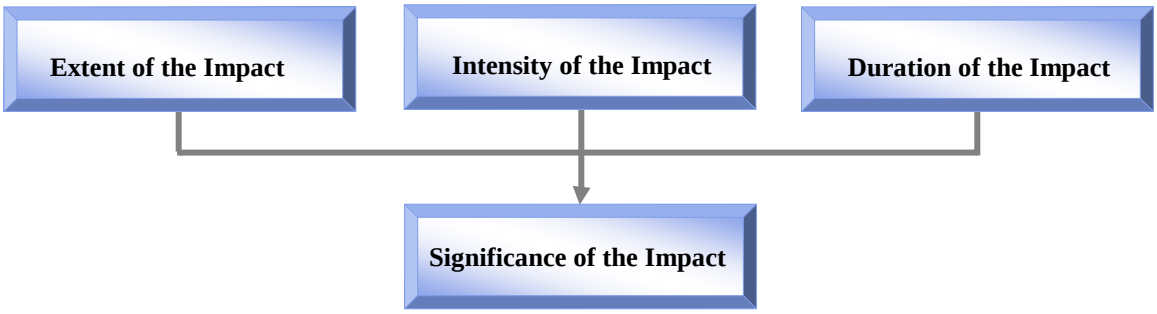
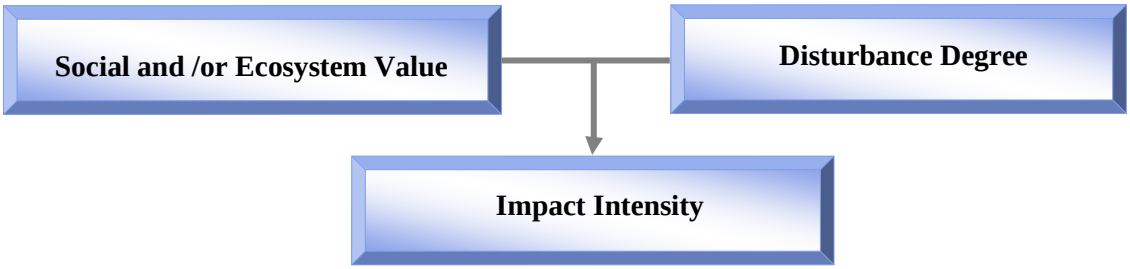


Figure 7.1 Procedure of Impact Evaluation

7.1 Intensity

The impact intensity shows the relative significance of the consequences attributable to the observed alteration of a component. It compiles the social and the ecosystem value of the component along with the anticipated disturbance degree of this component.



The combination of the disturbance degree and the value assigned to the component allows obtaining three levels of impact intensity: high, moderate and low.

- ✓ ***High***, when the impact highly modifies the quality or significantly limits the usage of a component presenting a main interest and exceptional qualities, whose conservation or protection are subject to a formal legislation or a general consensus ;
- ✓ ***Moderate***, when the impact reduces the quality or the usage of the component having a certain social value and/or recognizable qualities without necessarily compromising

its integrity ;

- ✓ ***Low***, when the impact modifies only in a little manner the quality, the usage or the integrity of an environmental component whose interest and quality do not constitute any growing concern.

7.2 Extent

The impact extent stands for the range or the spatial coverage of the effects generated by the intervention on the site. This concept refers either a distance or a surface over which the observed modifications felt by a component or else by the proportion of population being touched by these modifications.

The three levels, being considered in quantifying the impact extent are:

- ✓ ***Regional extent,*** when the impact affects a wide space or many components, being located within an important distance of the project or being felt by the whole population or by a large proportion of the population of the study area ;
- ✓ ***Local extent,*** when the impact affects a relatively limited space or a certain number of components located inside, nearby or at a certain distance from the project site ;
- ✓ ***Pinpoint extent,*** when the impact affects only a very limited space or a component being located inside or nearby the project site, or it is felt only by a limited number of individuals of the study area.

7.3 Duration

The impact duration indicates its time extent, defined as being the period of time during which the imposed modifications will be felt by a component.

The used method distinguishes the following impacts:

- ✓ ***Permanent,*** whose effects are felt in a continuous manner during the service life of the equipment or even beyond ;
- ✓ ***Temporary,*** whose effects are felt during a limited time period, generally corresponding to the construction period.

7.4 Significance

The interaction between the intensity, the extent and the duration allows to define the significance level of the impact affecting a component touched by the project. Table 7.1 presents the grid for determining the impact significance. This presents five significance levels varying from very high to very low, considering the three determining factors of

the impact: the intensity, the extent and the duration.

Table 7.1 Grid for Determination of Impact Significance

Intensity	Extent	Duration	Significance
High	Regional	Permanent	Very high
		Temporary	High
	Local	Permanent	High
		Temporary	Moderate
	Pinpoint	Permanent	High
		Temporary	Moderate
Moderate	Regional	Permanent	High
		Temporary	Moderate
	Local	Permanent	Moderate
		Temporary	Low
	Pinpoint	Permanent	Moderate
		Temporary	Low
Low	Regional	Permanent	Moderate
		Temporary	Low
	Local	Permanent	Low
		Temporary	Very Low
	Pinpoint	Permanent	Low
		Temporary	Very Low

In case the significance of the impact is considered moderate, high or very high, the operator is inclined to consider, in the conception phase, measures of control or / and mitigation to reduce or eliminate the negative repercussions of the project on the biophysical and human environment.

8.0 IDENTIFICATION AND ASSESSMENT OF ENVIRONMENTAL IMPACTS

This section of the report consists in presenting potential impacts of the project in relation with the biophysical environment and socioeconomic conditions. The discussion of potential impacts of the project aims to assess these impacts qualitatively to establish the necessary measures required for their mitigation.

The description, analysis and evaluation of potential impacts are provided for the following steps:

- ✓ Construction phase;
- ✓ Operation phase, and;
- ✓ Decommissioning.

8.1 Impact of the Construction Phase

It is known that atmospheric emissions, noise and a variety of liquid and solid waste will be generated in association with the construction activities. The following section provides a description and an assessment of the relevant biophysical impacts expected to occur during the construction phase of the proposed project.

8.1.1 Impact on Air Quality

During the construction phase, atmospheric emissions will result from fixed and mobile equipments (trucks, cranes, forklift trucks, generators, air compressors and other machinery). Atmospheric emissions will also be generated by vehicles used to transport personnel to the site. Emissions will be constituted of NO_x, SO_2, CO and TSP.

In addition, due to civil works including excavation, demolition, and construction, dust will be generated and may be made worse due to strong winds.

OMV will ensure that equipment is fit to purpose, in good condition and well maintained to minimise atmospheric emissions. In addition, the combined effects of the wind and the high temperature of exhaust gases will facilitate a rapid dispersion of atmospheric pollutants.

Taking into account the relatively limited scale of the project, impact on air quality would be considered low. With regard to the temporary and localised nature of the construction activities, the impact significance on air quality is considered ***very low***.

8.1.2 Impact linked to GHG Emissions

Construction activities generate greenhouse gases (GHGs) due to combustion of fuel. CO_2 emissions are especially related to movements of heavy vehicles used to truck

material and heavy equipment. However, these emissions are insignificant in comparison to the total emissions of greenhouse gases (GHGs) generated at the local and national scales. Also, the amounts of Volatile Organic Compounds are considered insignificant.

Therefore, the relatively small quantities of GHG emissions ensure that the impact intensity is low and due to the limited duration of the construction operations, the significance of this impact is judged to be ***low***.

8.1.3 Impact linked to Noise

During the construction period, the use of various fixed or mobile equipment naturally generates noise. However, the noise levels are unlikely to increase the current noise levels in the area.

The diversity of the construction activities makes it difficult to predict and to control noise pollution. Nevertheless, and in order to comply with the procedures and the rules in force, contractors should comply with the recommendations of the EU related to acoustic levels:

- ✓ 108 to 114 dB for hammers, manual cement compactor ;
- ✓ 106 to 108 dB for cable hydraulic lifting, loading machines, etc.

Taking into account the above, and considering the character of the site which is isolated and remote enough from the urban agglomerations, noise surrounding impact is considered with low intensity. Having a limited duration and a local extent, the significance of the impact is considered ***very low***.

8.1.4 Impacts linked to Vibrations

Most vibrations originating from construction activities are due to foundations preparation (excavations, etc.) and some other works including road construction and soil compaction. Traffic on a poorly surfaced road can also generate some nuisance. These vibrations may raise the following issues:

- ✓ Malfunction of sensitive equipment (electronic equipment for control). These sensitive facilities are rarely met on-site but have very low admissible vibrations.
- ✓ People discomfort is noted at levels of vibrations more than 0.1 mm/s. Vibrations are felt bothersome very quickly. The discomfort is felt depending on the vibration amplitude and frequency (Hz).

Taking into account that the vibrations are intermittent and with short duration, the intensity of the impact would be considered as low. With regard to the temporary and

local character of the construction activities, the impact significance of vibrations is considered ***very low***.

8.1.5 Impacts on Soil Quality

The movement of all-terrain vehicles and the base camp installation will cause localized and limited soil erosion. However, the sedimentary dynamics, controlled by the wind effects, will re-establish in the short term the dunes profile.

Moreover, the flowlines construction activities such as clearing, grading, trench excavation, backfilling, and the movement of construction equipment along the ROW may impact soil resources such as:

- ✓ Clearing removes protective vegetative cover and exposes the soil to the effects of wind, rain, and runoff, which increases the potential for soil erosion ;
- ✓ Grading and spoil storage can compact soil, reducing porosity and percolation rates and increasing runoff potential. Soil compaction destroys soil structure, reduces pore space and the moisture holding capacity of the soil, and then increases runoff potential.

Uncontrolled releases or spills of oil, lubricants and other pollutants would alter the soil. Pollutants resulting from spills and releases can stay for long time in soils. This can lead to soil physical-chemical properties alteration.

Locations where spills are likely to occur are localized areas of the project site. They are to be equipped with the appropriate containment facilities. In addition, OMV will put systems in place to prevent soil contamination and will provide spill cleanup equipment and material. Any contaminated soil will be collected and sent to a specialized company authorized by ME.

The residual impact related to accidental oil or chemical spills on soil quality is with low intensity. The impact will be localised and of short duration. Therefore, impact significance is considered ***very low***.

8.1.6 Impact on Aquifers

The CPF and flowlines construction activities are not likely to affect the groundwater resources which are at a depth exceeding considerably the magnitude of potential impacts. In addition, the existence of thick layers of rocky materials, gypsum, anhydrite and limestone interbedded with clays plays the role of waterproof screen between the soil

surface and the deep aquifer of Continental Intercalaire. The impact significance is therefore ***very low*** even ***negligible***.

8.1.7 Impact on the Biological Environment

8.1.7.1 Impact on Flora

In order to evaluate the impacts according to the methodology described below, the identified plant groups are listed according to their environmental value.

The environmental value of a component is the sum of the ecosystem-based value and its social value. The first (ecosystem-based value) is assessed on the basis of the role played by the plant group in its natural environment (protection against sand deposition and/or water erosion, protection of endangered wildlife and local flora, etc), while the second (social value) ensues from the importance of a plant community or some of its species in terms of uses by the local population (handicraft, fuel wood, etc) and animals (pastures, shelter, etc).

The ecosystem-based and the social values are established as follows:

- ✓ Low : valueless or almost valueless plant group;
- ✓ Medium: a plant group which can have some ecosystem-based and/or social value;
- ✓ High: a plant group with considerable importance for the ecosystem and/or society.

At Nawara field, four plant groups have been identified. Two of them have a high environmental value in view of several existing pastoral species, which are much sought-after by cattle, and the role which these species can play in combating wind erosion in a highly vulnerable area. Disturbance risk (caused by the development project) could be high. Disturbance risk is deemed high where more than 35% of the total surface area of a plant group in the area covered is affected. It is medium where such percentage ranges between 10 to 35%. It is low when the percentage is lower than 10%. Disturbance risk evaluation is further influenced by the rarity of the plant group.

Table 8.1 Environmental Value of the Existing Plant Groups

Plant Group	Ecosystem-based Value	Social Value	Environmental Value
Traganum nudatum and *Arthrophytum schmittianum*	Medium	High	High
Retama raetam, Aristida pungens and Cornulaca monacanta	Medium	Medium	Medium
Ephedra alata-alenda and Helianthemum confertum	Medium	Medium	Medium
Riparian units	Medium	High	High

Characteristics and uses of each of the existing species at the site were given in paragraph 6.2.1.3 in the previous section. Based on this information, the environmental value of each plant group has been established.

Given that less than 10% of the total surface area of the identified plant communities in the area covered is affected, the disturbance risk is low (see paragraph above).

Taking into account the short duration of construction activities and the local extent of the impact, the significance of the impact is evaluated as very low.

8.1.7.2 Impact on Fauna

The operations inherent to clearance and to camp establishment cause a reduction of the vegetation cover and a destruction of a certain number of animal burrows. Nawara development project will temporarily disturb the nearby fauna. Birds, as well as mammals (fennec, fox, wolf, etc.) capable of travelling long distances could find refuge in other similar sites. Only local populations represented by a few species of insects, reptiles and rodents will be affected.

Given that the Nawara field area constitutes a small section of a vast uniform area in terms of fauna and flora, the low animal density within the affected sites, and considering the absence of sensitive species in the study area that could potentially be damaged by the development project and the fact that the loss or the temporary decrease in population density does not modify the ecological balance, the impact intensity is considered as low.

Because of the local extent and the limited duration of the development project, the impact significance is judged very low.

8.1.8 Sewage Discharges

During construction, the influx of temporary workers can affect the environment through sewage disposal. However, the disposal of sewage will be according to the country's practices consistent with current legislation. Of local extent and temporary duration, the impact significance is, therefore, considered to be very low, even negligible.

8.1.9 Solid Waste Impact

Types of wastes potentially generated by the project during its construction phase are listed below:

- ✓ Domestic waste or trash;
- ✓ Construction debris, e.g., wood, metal, glass, insulation, etc.;
- ✓ Oily debris, e.g., oil filters, oily rags from vehicle and equipment maintenance;
- ✓ Contaminated soil as a result of accidental, small-volume releases, spills or leaks;
- ✓ Empty barrels, drums, and containers;
- ✓ Batteries (lead acid and other types).

These products will be collected by the contractor of the works and stored separately on the project site prior to being entrusted to authorized companies for recycling, or transported to an authorized landfill for disposal.

In addition to its temporary duration and local extent, the impact of solid waste generation is of low intensity. Therefore, its significance is considered very low.

8.1.10 Impact of Discharge of Hydrotest Fluids

The hydrotest of the flowlines is an important measure for avoiding and minimising risk associated with potential accidental releases of hydrocarbons. It is in itself a required preventive and mitigation measure.

This water will have the same physico-chemical characteristics as the drinking water. Assumed to be contaminated with welding debris and possibly grease, this water will be removed in evaporation pits.

Considering the short duration of discharge, the local extent and the quality of the hydrotest fluid, the impact significance will be very low.

8.1.11 Impact on Infrastructures

Except some saharian tracks, gathering flowlines will not encounter obstacles along their ways. Pipelaying during the crossing of these infrastructures will be performed in order to not compromise their uses. They will be crossed underneath using tunneling technique.

The impact will have a short duration (some hours) and local extent within the right of way of the pipeline, its significance is therefore very low.

8.1.12 Impact on Health and Safety

In saharan environment, construction activities could generate some risks for staff's health and safety, such as stings and bites of venomous animals, sunburn, illnesses or misplacement in the desert.

Considering these risks, OMV has taken the appropriate measures to deal with the different emergency situations, in particular:

- ✓ The establishment of safety and health instructions within the project area;
- ✓ The establishment of an emergency plan predicting the actions to be taken in case of accidental situations;
- ✓ The provision of an on-site medical service (first-aid worker, health kit, medicines, etc.), communication and transportation means;
- ✓ The organization of training and awareness sessions, at the beginning of the works, relating to personnel safety;
- ✓ The use of visible beacons with instructions to mark out the project area.

Moreover, the safeguarding of the personnel hygiene and safety is a subject of permanent concern to the contractor, of awareness and a firm application of safety rules established by the contractor. Consequently, the impact intensity is considered as low.

The significance of the impact is qualified as ***very low***. It mainly accounts for the limited duration of the project and the conditions under which the planned activities will be achieved.

8.1.13 Accidental Impacts

High standards for health and safety are maintained at all times. However, in rare occasions, an unplanned event can have the potential to compromise the safety of the crew and cause environmental damage. Potential non-routine events that may occur include spills during refueling operations.

In addition, the transportation and storage of diesel present risks such as fire incidents, explosion and soil contamination.

The prevention and response to such accidents is an integral part of OMV operational procedures. All spills are subject to a fast intervention procedure including an immediate containment and recovery of contaminated soil and its transportation for treatment and disposal in accordance with the regulation in force.

In order to limit these risks, OMV has taken the following precautions:

- ✓ Ensuring proper distances between the diesel storage installations and the ignition sources;
- ✓ Establishing procedures for diesel tank filling and emptying;
- ✓ Providing on-site fire and gas detection system, and fire fighting equipment to allow quick and efficient response against any ignition or fire incident;

- ✓ Providing an Integrated Control and Safety System to monitor, control and safeguard the flowlines, the CPF and oil and gas export pipelines.

A low magnitude of impacts is assigned to accidental events because of the unlikely occurrence of these events and because of the precautions and the response capabilities available to OMV. The extent of the impact is local or even pinpoint and the duration of the construction is temporary. Therefore, the significance of this impact is considered ***very low***.

8.1.14 Socioeconomic Impacts of the Construction Phase

The proposed project will directly employ an average of 300 people during the construction phase. Besides, most of the socio-economic impacts of the project are significantly positive especially on specific service sectors and in term of work supply. However, economic profits are modest with regards to the limited number of jobs and the short duration of the construction phase.

Consequently, the positive socio-economic impact intensity will be moderate, with local extent and short duration. The significance of this positive impact will, therefore, be ***low***.

8.2 Impacts of the Production Phase

8.2.1 Impact on Air Quality

During its operational phase, the CPF will inevitably generate air emissions such as nitrogen, sulfur and carbon oxides, as well as dust and volatile organic compounds.

Nitrogen oxides (NO_x) generally include NO and NO_2. They are the combination of oxygen and nitrogen from the air under the effect of high temperatures that characterize the process of combustion. During emission, these pollutants are generally in the form of nitric oxide (NO), which oxidizes in air to nitrogen dioxide (NO_2). This oxidation process can be accelerated in the presence of some oil or fine dust. NO_2 can also be transformed into NO under the effect of ultraviolet rays.

Sulfur dioxide (SO_2) results from the combustion of fossil fuels containing sulfur. The latter combines with oxygen during the combustion to form SO_2. When air is in excess, SO_2 combines with free oxygen to form SO_3.

Carbon monoxide (CO) and VOCs (volatile organic compounds) result from incomplete combustion of fuels. Their presence is a consequence of air deficiency and inadequate oxidation speed.

Fugitive emissions of volatile or semi-volatile organic compounds (VOCs, SVOCs) may

come from the storage, handling or accidental spills of hydrocarbons. Furthermore, the liquid hydrocarbons produced, handled or stored during operation of the project facilities may contain volatile organic compounds. Organic molecules of low molecular mass can easily evaporate under ambient conditions of temperature and pressure and will be dispersed in the atmosphere. These organic compounds have a significant Global Warming Potential (GWP), such as methane which has a GWP 21 times that of CO_2. Thus, hydrocarbons, oils and solvents storage tanks along with accidental spills are additional sources of fugitive emissions.

CO_2 equivalent is a measure for describing how much Global Warming Potential (GWP) a given type and amount of greenhouse gas may cause, using the functionally equivalent amount or concentration of CO_2 as the reference. CO_2 equivalent of CH_4 and N_2O have been considered as 21 and 310 respectively based on 100 years Global Warming Potential (GWP).

An inventory of air emissions was carried out by OMV. The estimated percentages (by weight) of yearly pollutant emissions during normal plant operations are shown in Figure 8.1. CO_2 is the major pollutant followed by CH_4 and NO_X.

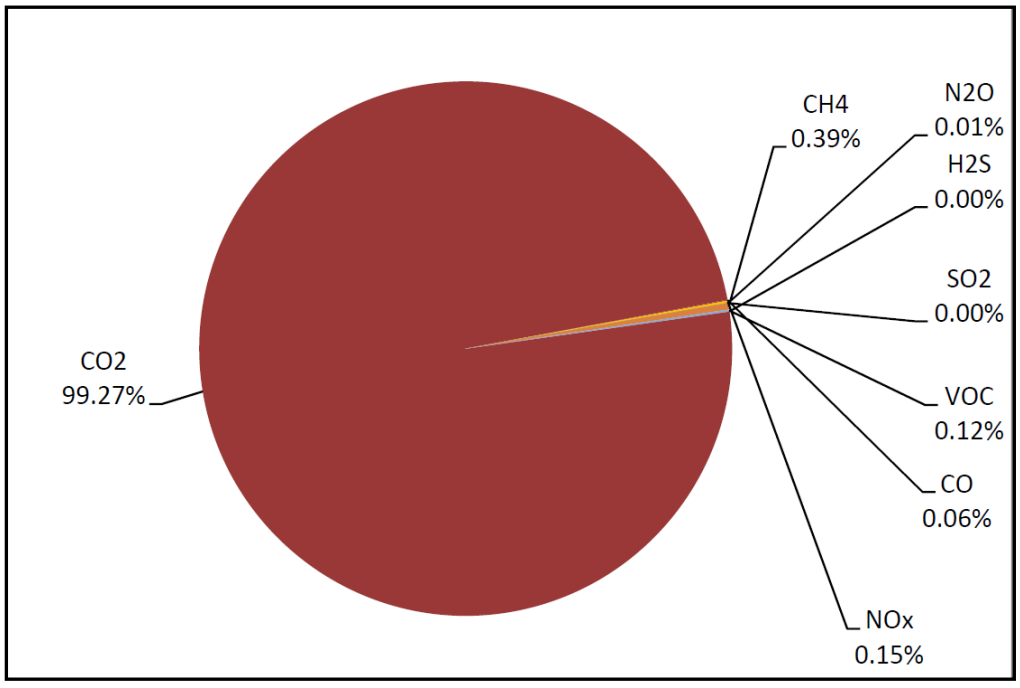


Figure 8.1 Percentage Yearly Air Pollutant Emissions During Normal Operations

Total GHG emissions from the Nawara Facilities during normal operation are estimated to be 55,133 T/Yr CO_2 equivalents. CO_2 is the main GHG pollutant which contributes over 91% of the GHG. Figure 8.2 highlights the main sources which contribute towards

GHG pollution.

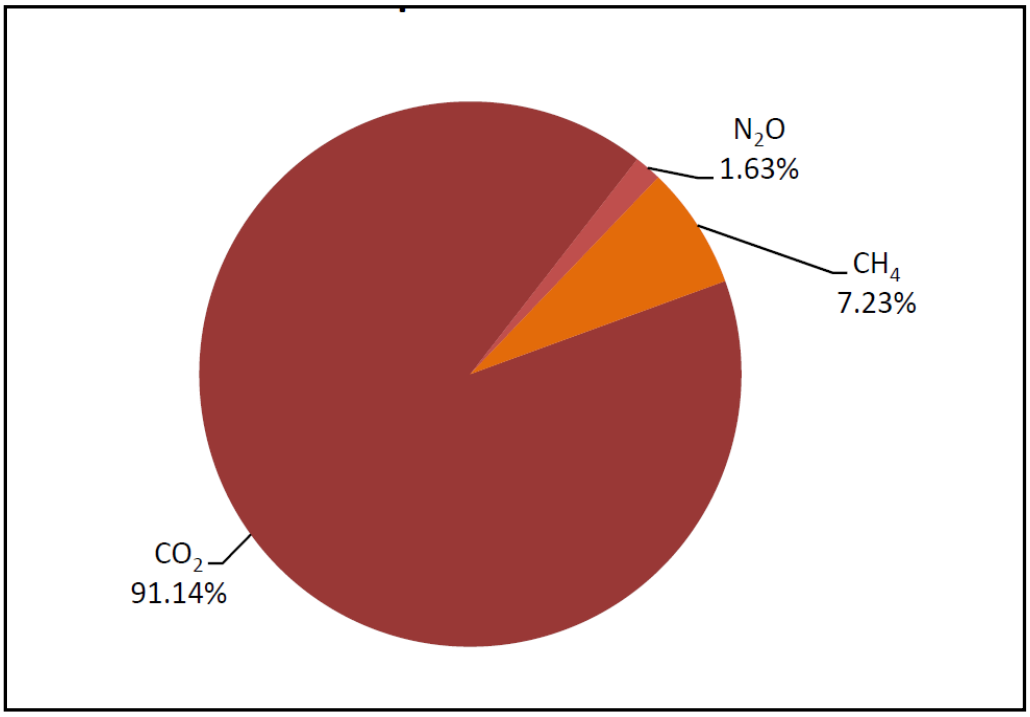


Figure 8.2 GHG Contribution during Normal Operations

It is important to mention that the CPF emissions are in accordance with the thresholds required by the Decree no. 2010-2519 dated 28 September 2010 fixing the maximum concentration of air pollutants from stationary sources.

Fine particles with diameters less than 10 microns are produced by the combustion of fossil fuels in industrial and mobile sources (diesel buses and trucks). They can remain in suspension for a long time and can be transported over long distances.

Emissions from the CPF are low in terms of dust and oxides of nitrogen. For the operation of production units at the facility, OMV will use natural gas as fuel. Therefore, there will be no SO_2 emissions. In addition, the combined effects of wind and high temperature of these discharges facilitate their dispersion. Therefore, these emissions will not cause any deterioration to the ambient air quality.

The intensity of this impact is considered low, given the small amount of emissions released. Of local extent and permanent duration, the impact significance is therefore considered ***low.***

8.2.2 Noise Impact

Some of the CPF components are sources of noise which can affect the noise level in the area. The main sources of noise are:

- ✓ Gas compressors;
- ✓ Export pumps;
- ✓ Emergency Power generators.

Production activities inevitably generate noise and hence increase noise levels in the vicinity of the CPF site. The first people to be affected by noise generated by such activities are workers. However, noise can also affect the neighborhood.

A high level desk top Noise Study was required for the Nawara Development Front End Engineering and Design (FEED) project to identify the noise impacts from the equipment at the proposed CPF and help develop potential solutions that will minimize noise impacts. The scope of the Noise Study includes:

- ✓ Develop a noise model for the CPF;
- ✓ Preparing noise maps for the CPF;
- ✓ Identifying and performing a high level assessment of potential noise issues;
- ✓ Proposing potential sound attenuation measures; and
- ✓ Preparing a Noise Study Report.

As such the equipment involved comprises equipment used for power generation modules, gas compression, transfer pumps and chemical treatment etc.
In accordance with the project brief a series of noise maps were prepared for the CPF.
Figure 8.3 shows the noise map reflecting the normal operational phase at a notional receptor height of 1.5 m. The figure assumes every item of equipment meets 85 db at 1m specification. The contour plots are displayed as colour coded areas in 5 dB increments over a range from 35 dB(A) to 85 dB(A). Internal building levels are not shown on the contour plots.

In addition, operators exposed to noise are equipped with adequate means of protection. Thus, in view of the desert character of the project site and the absence of residences, the intensity of noise impact is considered low. Taking into account the permanent duration of the facility's operational phase and its local extent, the impact significance is therefore ***low***.

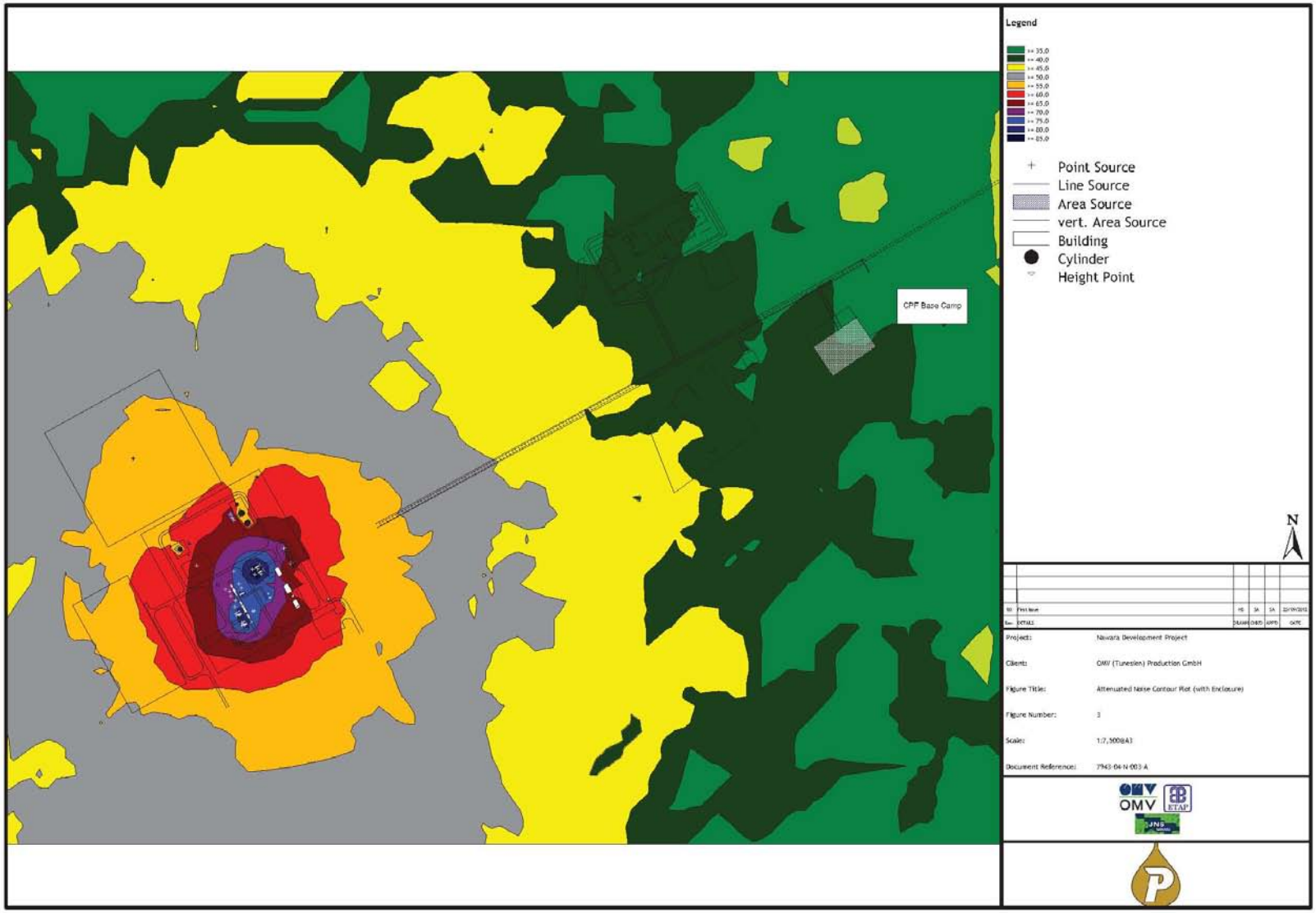


Figure 8.3 Noise Map - Attenuated Noise Contour Plot (with enclosures)

8.2.3 Sewage discharges

During operations, the main issues associated with sewage discharges relate to:

- ✓ The discharge of process wastewater and runoff water from the production facilities;
- ✓ The disposal of sewage effluent, wastewater and other liquid wastes from the permanent operating camp.

Volumes of such discharges will be low during the operation phase owing to the nature of activities and the limited workforce. They are to be handled and treated in accordance with applicable requirements. The impact of such discharges is of low intensity, local extent and permanent duration. Thus, impact significance is judged ***low***.

8.2.4 Impacts on Soil

The drainage of contaminated water along with any spills of oil and lubricants present a risk of soil contamination through infiltration. Pollutants migrate under the influence of gravity to the zone of saturation and diffuse in the water flow direction. Depending on the volume and the physico-chemical characteristics of contaminants and the soil type, such contamination can have a significant extent.

However, this risk is unlikely because all measures are taken to avoid contamination.
Produced water is collected from different sources (inlet separators, scrubbers, etc.) and fed to the closed water treatment system. Treated water will be routed to evaporation pit. In addition, any spillage will be subject to a response procedure including the immediate recovery of contaminated soil and its treatment and disposal in accordance with regulations in force. Lubricants and chemicals are stored in a concrete and fenced area.
The impact intensity is low given the low probability of leaks or spills of contaminants. Similarly, volumes released during such events are very low. Taking into account the local extent of the impact and its permanent duration, the impact significance is, therefore, considered ***low***.

8.2.5 Flowlines Maintenance

The flowlines maintenance activities generate large quantities of waxy residues and hydrocarbons at pig receiver. These residues classified as hazardous wastes can contaminate the land at receiving facilities. However, OMV has planned adequate facilities to collect these residues. This waste will be transported toward a specialized and authorized center for treatment and disposal in conformity with the legislation in force.

Given the short duration of the impact of its local extent and the absence of sensitive

receptors within the residues reception area, the significance of the impact will be ***very low***.

8.2.6 Socioeconomic Impact of the Operational Phase

During the production phase, it is anticipated to add permanent staff to handle the CPF operations, with additional support provided by contractors as needed. Although the plant is not a labour intensive facility, during operations, the proposed plant would provide employment opportunities (skilled workers) and revenue to regional supporting businesses and industries within the south of Tunisia. The national revenue will increase by way of direct and indirect taxes, duties, etc. The Tunisian oil and gas infrastructure development will get an impetus with this growth and will provide a significant boost to the energy sector.

Further, the construction of the new CPF would result in millions of dollars being injected in the regional and national economy. Additionally, it would help increase the potential of exploitation of energy resources and the dynamism within the area.

The high impact intensity is supported by the generated gains arising from the oil and gas production. The significance of the impact is considered ***very high***, reflecting the long-term positive effects of the project on the national economy.

8.3 Growth-Inducing Impacts

It is recognized that the availability of a new means of hydrocarbons transportation and processing may be a contributing factor in stimulating economic growth and could result in the construction of additional oil/gas and power infrastructures. The proposed project could help meet existing energy needs.

If the project is constructed, additional processing capacity would be available, which could potentially accommodate future projected growth in the southern regions.

8.4 Decommissioning Impacts

Decommissioning will be carried out at the end of the facilities life, in accordance with prevailing legislation and industry best practicable technology that is available at the time. The overall approach applied to achieve an efficient decommissioning has been to give priority to designing the facilities and planning work activities in such a manner to avoid generation of hazards or environmental impacts. The aim will be to decommission production facilities and leave the site as near as possible to its original aspect.

All activities will be conducted in a manner to cause a minimum disturbance, especially

to the environment. Therefore, necessary precautions and measures would be taken by OMV during decommissioning operations, such as:

- ✓ Information and meetings with relevant regional and national authorities;
- ✓ Using high-performance and fit for purpose machines and managing the works in order to reduce work duration, noise and atmospheric emissions;
- ✓ Selection of the adequate period of works;
- ✓ Elaboration of procedural guidelines and providing equipment to clean up and treat any pollution discovered during decommissioning.

The timing and activities undertaken during decommissioning will not be finalised until the end of the facilities life. A detailed decommissioning plan will be prepared and submitted to the relevant authorities at least 12 months prior to the commencement of activities (Hydrocarbons Code). The decommissioning phase duration is likely to extend over 6 to 12 months and will be subject to an independent Environmental Impact Assessment (EIA).

The impact intensity of decommissioning activities will be low. Of local extent and temporary duration, the impact is, therefore, of ***very low*** significance.

8.5 Conclusion

Impacts associated with the construction phase are more important than those likely to occur during operations of the development project's associated facilities. During construction phase, foundations establishment and equipments installation, more people and machinery will be involved in construction works. Larger areas will be affected and a more important number of animals will be disturbed. These effects, however, would cease after construction once sites restoration is completed. For the production phase, possible impacts will only be felt in a small area limited to the CPF site and its immediate surroundings. The nature of the milieu will also account for the attenuation of such impacts.

9.0 MITIGATING MEASURES

Project impacts have been identified and discussed in the previous chapter. The negative effects of the project are on the whole insignificant compared to the generated positive economic impact. However, OMV has taken required control and mitigating measures to overcome negative environmental effects. These measures regard the headings below.

9.1 Mitigation Measures for the Construction Phase

The main safeguards and mitigation measures planned for the proposed project will be related to:

- ✓ Reduction of atmospheric emissions and dust;
- ✓ Reduction of noise;
- ✓ Control of contractors' policy;
- ✓ Work organization;
- ✓ Protection of soil;
- ✓ Erosion prevention;
- ✓ Waste management;
- ✓ Safety of personnel.

9.1.1 Mitigation Measures of Impacts on Air

The following measures will be implemented to minimize the air emissions impact:

- ✓ All vehicles, mobile and fixed facilities shall be properly maintained to maximize combustion efficiency and minimize air emissions;
- ✓ Vehicles and engines will not be left running unnecessarily.
- ✓ The use of machinery and equipment of recent design, compatible with all standards in terms of emission of gaseous pollutants;
- ✓ Establishing a system to control emissions from equipment;
- ✓ Watering dry and loose materials to avoid dust raising;
- ✓ Avoiding dust emissions from materials storage and transportation of construction materials by the use of protective tarpaulins;
- ✓ Regular watering of tracks used by trucks and construction equipment.

9.1.2 Noise Mitigation Measures

Construction equipment and machinery will increase noise levels. OMV will make sure that all the equipments are well maintained and fitted with manufacturer’s noise and emission abatement equipment. Also, in that respect vehicle speed will be restricted. In addition, the contractor will be instructed to use low noise engines and machines where

practicable, to comply with the international standards.

9.1.3 Control of Contractors' Policy

This policy should be prepared in support of the environmental management plan to ensure that contractors adopt safe working practices and environmental measures in compliance with relevant statutory requirements and OMV's Management Standards and Guidelines. Its covers all construction work carried out by principal contractors and sub-contractors employed on OMV contracts.

Contractor compliance will be assessed through a combination of site inspections and formal audits. Site inspections in the form of a walkthrough will be employed by OMV HSE personnel to assess management procedures adopted. Non compliance with the Code of Practice (or the policy) and other relevant statutory guidelines may result in immediate termination of the contract.

An audit programme developed as part of the EMP will monitor and evaluate implementation and compliance with the control of contractors' policy. The audit will include auditing of the site procedures as well as reporting and documentation. All observed non-compliances will be reported to the Project Manager, and corrective actions including solutions and preventive actions will be taken.

The inspection and auditing results will be documented and used to indicate areas of non-compliance to allow for corrective measures to be implemented using an Action Tracking System.

OMV shall ensure that this policy and appropriate records are monitored and reviewed on a regular basis.

9.1.4 Work Organization

The following measures aiming to mitigate environmental impacts are included in the organization of the different field activities:

- ✓ Using, as far as possible, the existing tracks to reduce ground disturbances and the vegetative cover destruction;
- ✓ Use spaces not covered by vegetation to avoid uprooting plants
- ✓ Driving as slowly as possible to avoid the erosion of tracks and to drive in the best safety conditions;
- ✓ Establishment of an emergency plan predicting the actions to be taken in case of accidental situations;

- ✓ Setting-up an on-site medical device (first-aid, medicines, etc.), communication and transportation means;
- ✓ Instructing the personnel in terms of safety and environment;
- ✓ Consulting and informing the local authorities on the duration and the extent of the planned activities, taking into account their recommendations;
- ✓ Respecting OMV Health, Environment and Safety directives.

9.1.5 Mitigation Measures of Impacts on Soil

Field works must take into account the potential effect on land caused by continuous use of equipment and vehicles. The work will take place in a desert environment with sparse or no vegetation. However, because of the slow growth of plants, when damaged, they may take several seasons to regenerate.

The following measures will be implemented to control the damage during the planned activities:

- ✓ Avoid driving over vegetation whenever possible and leave isolated vegetation stands undisturbed;
- ✓ Use existing tracks as much as practical and minimise activities outside the construction area;
- ✓ Storage tanks should be bunded to contain any fuel spillage. The bund should have capacity for more than the total volume in the storage tanks;
- ✓ Refueling areas should be sealed with concrete. On-site refuelling operations should always be subject to strict control ;
- ✓ Contaminated soils by eventual oil spills will be treated on-site by a specialized company authorized by the ME for treatment and disposal.

9.1.6 Erosion Prevention

All activities associated with construction will be carried out within the restricted project area. OMV will ensure that surface disturbance is reduced to an absolute minimum. The same procedure will be applied in the settlement of temporary access tracks and storage areas designed for pack sand and materials used in the project.

9.1.7 Waste Management

A waste management plan, based on the best examples and practices, will be established on-site. OMV will ensure collection of waste and its storage in separate appropriate containers. To this end, waste will be stored separately in a central storage area until it will be reused or transferred off-site. Contractors will use appropriate containers for

collecting and transporting waste to the public landfill of Tataouine.

OMV will develop a plan detailing the location, nature and number of camps for the smooth running of the project. It will also ensure compliance with hygiene and safety measures including:

- ✓ Reducing the use of land and access roads (OMV will propose a traffic plan);
- ✓ Avoiding storage and handling of hazardous materials;
- ✓ Collecting and managing solid household and other waste according to the waste management plan proposed as part of this study (see Chapter 10);
- ✓ Restoration and rehabilitation of the affected areas used for camps, developing an abandonment and site remediation plan and removal of all waste and equipment installed.

9.1.8 Water Management Plan

Being executed in a desert area known for its limited and scarce water resources, the project raises a number of issues related to water. It is therefore recommended that a *Water (Use, Treatment and Disposal) Management Plan* is prepared. Key elements of the plan should include the following:

- ✓ Minimization of water use;
- ✓ Disposal; and
- ✓ Inspection, auditing and reporting.

All personnel will be educated to reduce water usage and prevent its waste. No additional waste (non-sanitary) will be discharged to the wastewater system. Oily waste and other liquid hazardous wastes will be collected separately whenever possible for recycling or disposal in an appropriate licensed facility.

9.1.9 Safety

The temporary increase of heavy vehicles traffic within the construction zone raises safety risks for workers. A specific plan for traffic management will be established by the different on-site stakeholders.

Routes should be selected to avoid, or at least limit, any increase in traffic in the project areas with high risk, as well as around the CPF site.

A number of measures will be taken around and within the site:

- ✓ Speed limitation required;
- ✓ Separation between traffic lanes and pedestrian ways;

- ✓ Installation of light signs, and provision of special areas for parking and waiting when required;
- ✓ Reversing without assistance will not be permitted.

In case of particularly intense traffic, an employee will be responsible for regulating traffic at crossings and in all hazardous areas. Gates equipped with work placards will mark off a security zone around the site and access of unauthorized persons to the site will not be allowed.

9.2 Mitigation Measures for the Operational Phase

9.2.1 Mitigation Measures of Air Emissions Impacts

Usual mitigation measures focus on reducing air emissions of power generators, boilers, etc. These measures include the reduction of emissions of NO_X, SO_2, CO, CO_2 and airborne particles.

Mitigation measures at the source are planned and classified according to the emission sources as follows:

- ✓ Power generation using overhead processed gas as fuel;
- ✓ The preferential use of combined heat and power cogeneration systems and heat exchangers;
- ✓ Adequate regulation and control of combustion process and parameters (excess air, residence/stay time, gas recirculation, etc…) in order to maximize energy efficiency and save fuel consumption and hence reduce emissions;
- ✓ Development and implementation of maintenance procedures for equipment, accessories and filters used for emissions reduction;
- ✓ Establishing a system for monitoring air quality to measure and evaluate that emissions are within acceptable levels and that air quality in neighboring areas is not damaged;
- ✓ Reduction of fugitive emissions from hydrocarbons storage tanks and accidental spills through the development and implementation of a rapid response procedure to limit the spreading of spilled products and recover them in order to be integrated into the process of energy production or burned, if necessary;
- ✓ Regular maintenance of equipment to avoid excessive fuel consumption and minimize volatilization of unburnt components;
- ✓ Promotion of renewable energy (solar, wind, etc.).

9.2.2 Mitigation Measures for Operational Noise

During the operation of the plant, compressors, fans, pumps, boilers and turbines can cause noise. In this regard, the CPF is built in compliance with noise standards. Facilities conform to international standards for safety and environment.

It remains for potential suppliers to identify the measures they believe appropriate to achieve the specification for their particular product, but outline mitigation measures are liable to include:

- ✓ Enclosure of the main Compressor Package drivers and gearbox;
- ✓ Provision of acoustic enclosures for the Gas Turbines Power Units, with suitable silencers on inlet and exhaust and lagging to any exposed ductwork (assumed this is already specified);
- ✓ Provide enclosures to all the Export Gas Compressors and Discharge Coolers;
- ✓ Application of acoustic lagging to all noisy valves;
- ✓ Utilisation of low-noise multi stage valve trims to limit valve noise.

In addition, OMV conducts regular monitoring of noise at the site limits and at the edge of the CPF site. Establishing a system to monitor noise levels would ensure that the equipment meets the specified requirements regarding noise, and that noise levels do not exceed acceptable levels at the site and surrounding areas.

However, if the noise thresholds are exceeded, the use of silencers and other acoustic barriers is recommended.

9.2.3 Mitigation Measures of Impacts on Soil

Soil may be contaminated by operational leaks or accidental spills of chemicals stored or handled on-site, such as hydrocarbons, oils, lubricants, solvents, additives, and various used reagents. To avoid such situations, OMV has established a prevention plan and installed protection and containment equipment as follows:

- ✓ Construction of diked storage areas for the storage of oil and hazardous substances:
  - These areas' dikes will be designed to contain 110 % of the storage tank capacity;
  - The drainage system of these areas will be fitted with isolation valves;
  - Oil and chemicals storage tanks are equipped with alarms to avoid the risk of overflowing;
- ✓ Storage of chemical products in containers or on palettes equipped with a plastic dust cover against severe weather.

In addition, soil could be contaminated following disposal or uncontrolled discharge of solid waste. Therefore, a waste management plan is developed and implemented by virtue of Law no.96-41 of 10 June 1996 relating to waste and the control of its management and disposal. This plan is presented later in Chapter 10.

9.2.4 Pollution Prevention and Response

9.2.4.1 Pollution Prevention

All sites where hazardous substances are used or stored shall have a written Spill Prevention and Control (SPC) Procedure. The purpose of the SPC procedure is to prevent pollution by identifying potential spill scenarios and developing procedures to prevent and control them.

The transportation of hazardous substances (including waste) has to be done in accordance with Tunisian regulations.

9.2.4.2 Pollution Response

Cleanup and remediation activities of spills and accidental releases of hazardous substances shall be carried out in accordance with Tunisian regulations.

As a general rule, risk based corrective action shall be applied in all cleanup and remediation activities.

10.0 ENVIRONMENTAL MANAGEMENT PLAN

10.1 Introduction

The Environmental Management Plan (EMP) aims to describe the measures, actions and means that will be implemented to eliminate or reduce to acceptable levels the significant impacts of the project on the biophysical and socio-economic components as identified in the EIA. More specifically, the EMP should ensure:

- ✓ Protection of personnel's health and safety and prevention of environmental hazards;
- ✓ Compliance with the standards, regulations, know-how and best practices along with the use of appropriate technologies;
- ✓ Carrying out works according to principles of sound management and use of appropriate equipment and good practices;
- ✓ Inclusion of environmental risks monitoring and control measures, and the establishment of prevention and mitigation means in case of events that may pose hazards to the health and environment.

The Environmental Management Plan of the project is divided into nine sections:

1. Impacts register;
2. Waste management plan;
3. Risk management plan;
4. Environmental monitoring program;
5. Capacity-building & Staff training plan;
6. Local recruitment plan;
7. Documentation & Environmental communication;
8. Environmental audit;
9. Cost of the EMP.

10.2 Impacts Register

Based on the findings of the EIA, national and international standards and best practices, the Impacts Register summarizes:

- ✓ Potential adverse impacts of the project on the environment;
- ✓ Mitigations for identified impacts;
- ✓ Responsibility for implementation and monitoring of adopted mitigation measures.

Table 10.1 Environmental Impacts Register

Project Phase	Potential Negative Impacts	Mitigation Measures	Responsibility	Cost ($)
Construction Phase	Air pollution: dust and engine exhaust fumes Noise nuisance Traffic accidents: increased risk	✓ Impose speed limits. ✓ Use covers for dusty loads. ✓ Use water sprays to prevent airborne dust (maximizing recycling opportunities). ✓ Use wheel washers to prevent transfer of mud to public roads. ✓ Prevent "black smokes": ensure all vehicles engines are well maintained. ✓ Limit the work area to flowlines ROW. ✓ Use a safety barrier to separate pedestrians and vehicles in high-risk areas. ✓ Switch off engines when not in use. ✓ Schedule road traffic movements to avoid noise sensitive periods, periods of high pedestrian risk and maximum background traffic movement. ✓ Install temporary road signage and lighting.	EPC Contractor	Included in the project cost
	Public security hazards	✓ Do not store pipes outside designated lay down areas. ✓ Erect perimeter security fence and appropriate warning notices. ✓ Forbid access to unauthorized people.	EPC Contractor	Included in the project cost
	Impact on Health, Safety & environment	✓ Elaboration of Health and safety procedures for project site ✓ Elaboration of an "Emergency Response Plan" ✓ Provision of medical (first aid, medical equipment, medecins, etc.), and communication and transportation means ✓ Provision of firefighting equipment ✓ Provision of Oil spill response equipment ✓ Staff training in the Health, Safety & Environment aspects ✓ Display of instructions and markup of the project area	OMV	100 000
	Permanent damage to natural landscape Ecological disturbance Interference with other land users	✓ Where appropriate, plough to break-up and loosen all compacted soil when the construction work is finished. ✓ Use existing tracks and follow the defined flowlines ROW as closely as possible. ✓ Abandon the flowlines ROW in order to discourage their use after the proposed activities. ✓ Take all reasonable measures to reinstate disturbed areas to the original condition. ✓ Where required, install drainage system with the aim of reducing soil erosion by rain water runoff.	EPC Contractor	Included in the project cost

	Unsuitable storage of wastes causing diseases Risks to health and safety and the environment as a result of poor control of hazardous waste Odour nuisance	✓ Post-installation, clear surrounds of all rubbish, debris, and surplus/defective construction materials. ✓ Make appropriate provisions for the collection of wastes from the construction site, with the fundamental objective of keeping hazardous, inert industrial and domestic wastes separate. ✓ After use, the radioactive source will be returned in the same conditions of storage and transport than those for imports to the country of origin. ✓ Establish a general policy of "waste minimisation" in the following order of priority: - Reduce production at source; - Reuse in the same process; - Recycle for use elsewhere. ✓ Only use disposal as the final option, and by incineration with energy recovery if feasible. ✓ Establish a "consignment notes" system to ensure wastes transferred to subcontractors are properly transported and disposed of off-site in the manner intended by company. ✓ Provide suitable waste containers (with lids) at all major points of waste production. ✓ Forbid disposal of wastes by any other method than this on-site service. ✓ Provide suitable sanitary facilities for workers during construction phase.	OMV	125 000
Operational Phase	Operational Noise	✓ Facilities are equipped with acoustic enclosures and silencers. ✓ Establishing a system to monitor noise levels at the site and surrounding areas. ✓ OMV plans to carry out a noise monitoring within Nawara CPF by a specialized company	OMV	30,000
	Soil Contamination	✓ Storage of chemical products in containers or on pallets equipped with plastic dust cover against severe weather. ✓ Construction of diked storage areas for the storage of oil and hazardous substances. ✓ Storage of used oil and oil filters in metal drums to be delivered to SOTULUB. ✓ Recovery and transport of flowlines scraping products in order to be treated by a specialist company authorized by the Ministry of Environment ✓ Managing waste in conformity with Law no. 96-41 of 10 June 1996 relating to waste and the control of its management and disposal.	OMV	20,000

	Impact on Air Quality	✓ Adequate regulation and control of combustion process and parameters (excess air, residence/stay time, gas recirculation, etc.) in order to maximize energy efficiency and save fuel consumption and hence reduce emissions. ✓ Development and implementation of maintenance procedures for equipment, accessories and filters used for emissions reduction. ✓ Establishing a system for monitoring gas emissions in the CPF. ✓ Regular maintenance of equipment to avoid excessive fuel-gas consumption and minimize volatilization of unburnt components. ✓ Promotion of renewable energy (solar, wind, etc.). ✓ Gas will be flared in a Low Pressure flare assuring a perfect combustion of gases.	OMV	50,000
	Impact on Groundwater	✓ Disposal of the produced water in watertight evaporation pits ✓ Monitoring program of groundwater quality	OMV	Included in the initial project cost
	Impact on Health and Safety	✓ The establishment of safety and health instructions within the project area. ✓ The establishment of a specific emergency response plan predicting the actions to be taken in case of accidental situations. ✓ Existence of a medical service on site (rescuers, equipment care, medicines, etc.), Means of communication and transport. ✓ The organization of training and awareness sessions, at the beginning of the works, relating to personnel safety. ✓ The use of visible signs with instructions to mark out the CPF area.	OMV	50,000
Decommissioning	Soil and Groundwater Contamination	✓ Removal of installations according to the best practices so as to prevent air and soil pollution. ✓ Following procedural guidelines while cleaning up and treating any pollution discovered during decommissioning. ✓ Site restoration as near as possible to its original aspect. ✓ Information and meetings with relevant regional and national authorities.	OMV	100,000

10.3 Waste Management Plan

OMV advocates using the principle of the **5R**s subject to local environmental regulation and availability of resources to handle waste. These "5Rs" are described as follows:

- ✓ **Reduce** : generating less waste in their original form.
- ✓ **Reuse** : reusing materials in their original form.
- ✓ **Recycle** : converting waste back into a usable material.
- ✓ **Recover** : extracting materials or energy from a waste for other uses.
- ✓ **Residue** : an unavoidable waste residue which requires a waste disposal method e.g. licensed landfill, incineration, etc.

The above methods are usually used in combination; reduction and reprocessing or recovery and reuse. Selection of disposal methods is based on the following factors:

- ✓ Waste category;
- ✓ Waste property;
- ✓ Environmental impacts;
- ✓ Logistics;
- ✓ Availability of acceptable disposal methods.

10.3.1 Liquid Waste

(i) Runoff

These waters of a small quantity will be collected in a basin through ditchs. The runoff will then pass through a separator to recover the floating phase. Uncontaminated waters (compliance with the Tunisian standard NT106.02 relating to the effluent discharge into the public domain) will then be discharged into the receiving environment.

It is to mention that the ditchs should be regularly scraped out.

(ii) Sanitary Waters

Sanitary waters are made of black waters from toilets and grey waters from showers, sinks, washers, laundry and kitchens.

During the production phase and following the development project, there will be about 10 people working on-site. The sanitary waters would represent about 3 m^3/day. They will be evacuated to a lined and sealed sanitary water pit of approximately 24 m^3 and which is located near the base camp.

These effluents, which meet the public discharge requirements of the Tunisian standard NT 106.02 will be removed by a vacuum truck on a regular basis and transported towards the ONAS wastewater treatment plant in Tataouine.

(iii) Used Lubricants

The process oil, the engine oils, the hydraulic oils and gears lubricants, which result from the systematic maintenance of the equipement and engines are stored in metallic containers and delivered to the SOTULUB for reprocessing. A register is maintained by OMV in order to facilitate the traceability of these waste products in conformity with the Decree no. 693-2002 of April 1st, 2002.

(iv) Produced Water

The production of water is not expected for the first two years. The maximum produced water rate is estimated at 168 m^3/day. These waters will be eliminated in two watertight evaporation pits with a capacity of 9600 m^3 each and a permeability no greater than 1 x 10^{-7} cm/sec. These pits will be designed as described in Chapter 5.

(v) Hydrotest Water

Before commissioning, the pipeline will be subject to a hydrotest in accordance with the technical specifications required to check the integrity and rigidity of the pipeline.

This water will have the same physico-chemical characteristics as the drinking water. It will be mixed with a corrosion inhibitor and an oxygen scavenger.

The test of each section will be made by temporary scrapers. These scrapers can clean the pipeline and control the water quantity introduced into the pipeline. Assumed to be contaminated with welding debris and possibly grease, this water will be removed in watertight evaporation pits.

10.3.2 Solid Waste

Several types of solid waste are generated during the production phase. Nevertheless, these wastes can be classified in three main categories according to the terminology of the Law no. 96-41 which stipulates that: "*Waste is classified according to its origin as domestic and industrial waste and according to its inherent hazards as hazardous, non-hazardous, and inert waste*". This classification matches with the European directives.

(i) Inert Waste

The Law no. 96-41 defines inert waste as any "*waste composed of soil or natural rocks extracted from quarries or resulting from activities of demolition, construction or renovation, that is mainly of mining nature and that is not contaminated by hazardous substances or other elements which are potential generators of nuisances*".

In this category, we include the wastes from the demolition or construction works, which will mainly have a mineral nature and which will not be contaminated by dangerous

substances. These wastes will be removed and disposed off in areas reserved for such purpose.

(ii) Non Hazardous Wastes

The main waste stream generated during the production phase is domestic waste. This waste is segregated into:

- ✓ organic waste which is collected and transported to the municipal landfill of Tataouine;
- ✓ plastic bottles and metallic cans are collected by a specialized company and delivered to the nearest ECO-Lef center;
- ✓ package of milk and juice as well as yoghurt cups are transported to the municipal landfill of Tataouine.

It is important to mention that OMV maintains a waste segregation system (plastic, metal and glass).

Other waste consists of industrial waste:

- ✓ plastic films used for packaging are delivered to ECO-Lef center of Tataouine;
- ✓ wood pallets as well as scrap metal are sorted and delivered to companies authorized by the ministry of environment for waste collection and recycling.

(iii) Hazardous Waste

Hazardous wastes are managed in different ways depending on their type. We distinguish:

- ✓ Valorization: OMV carries out a regeneration of catalysts for reuse.
- ✓ Recycling: Metallic drums, used batteries and filters are entrusted to a specialized company for treatment and recycling;
- ✓ Treatment such as neutralization, biological and chemical treatments, etc. Thus, sludge as well as oily wastes such as oily rags are entrusted to a specialized company. Medical wastes are disposed by a specialized company and shall in no case left on the site. These companies are required to submit to OMV a final disposal certificate proving the final destination of such wastes in the appropriate disposal sites.

OMV records all hazardous wastes including their quantities and disposal methods.

10.3.3 Gas Emissions

OMV makes an investment on integrated environmental protection concerning the air emissions domain. This domain covers the prevention or reduction of emissions of gaseous, liquid and particulate pollutants to the atmosphere and the monitoring of air emissions. For this reason equipment and plant (end-of-pipe and integrated prevention) destinated to control and/or avoid air emissions as well as to monitoring of air emissions were purchased by OMV.

Emissions to air consist of exhaust gases containing Carbon Dioxide (CO_2), Carbon Monoxide (CO), Nitrous Oxide (N_2O), Oxides of Nitrogen (NOX), Methane (CH4), volatile organic compounds (VOC), Sulphur Dioxide (SO_2) and Hydrogen Sulphide (H_2S) from various types of combustion equipment, vents and flares. The main sources of emissions identified for this project are:

- ✓ Emissions from gas combustion equipment: Gas Turbine Generators (GTG) and fired heater;
- ✓ Emissions from CO_2 venting;
- ✓ Emissions from flaring;
- ✓ Emissions from diesel combustion equipment: Emergency Diesel Generator, fire water pumps.

Estimated air emissions are summarized in table 10.2.

10.3.4 Noise and Vibration

OMV will take measures in a way to avoid a noise source, which could affect the health or the safety of the workers. An appropriate ear protection will be worn in areas where the noise level continuously exceeds 85 dBA.

Table 10.2 Estimated Air Emissions Summary – Operations

Pollutant	Yearly Estimated Emissions - Normal Operations (T/yr)						Yearly Estimated Emissions - Non-routine Operations (Flare Worst Case Scenario) (T/yr)
	Turbines	Heater	Diesel Combustion	Flare Pilot	CO_2 Venting	Total Emissions	
CO_2	24674	10771	209	38.6	14426	50119	243.3
CO	24.2	3.1	1.2	0.13	0.0	28.7	0.8
NOx	60.1	12.1	4.6	0.022	0.0	76.9	0.1
N_2O	1.97	0.86	0.014	0.0012	0.0	2.85	0.008
SO_2	0.00	0.00	0.007	0.0002	0.0	0.007	0.001
CH_4	3.77	0.27	0.009	0.52	192	197	3.3
VOC	0.46	2.43	0.124	0.22	58	62	1.4
H_2S	0.00	0.00	0.00	0.00	0.0	0	
GHG - CO_2 Equivalent	25365	11044	214	50	18461	55133	18461

10.4 Emergency Response Plan

The Emergency Response Plan (ERP) aims to ensure the employees' safety and the cleanliness of the areas immediately surrounding the project site in case of emergencies. This manual ensures that interventions are carried out smoothly from the alert stage to the emergency intervention stage allowing operations personnel to prepare for the imminent emergency situation and to take control of it.

Pursuant to Article 59.3 of the Hydrocarbons Code, and in order to ensure emergency interventions, OMV is required to:

- ✓ Have, in place, sufficient quantities of pollution and fire fighting products and equipment as well as first care medicines and safety means to be used for accident victims;
- ✓ Work out safety and emergency plans covering exceptional situations that may arise on the working site or the legal dependencies.

A copy of the said plans shall be provided to the Granting Authority and the Competent Authorities.

OMV is also required to contract insurance policies covering his civil responsibility in case of damages caused to third parties estates because of his activity including notably the risks of damaging the environment.

10.5 Environmental Monitoring Program

Environmental monitoring is necessary to gauge the impact of operations on the site. By implementing appropriate plans with sufficient detail, it is possible to minimize and control waste generation, limit physical disturbances, and operate in a responsible manner. The environmental monitoring program will be implemented by the field crew consistent with the requirements of the Environmental Management Plan and include:

- ✓ The decennial check of the tight ness of oil tanks in conformity with the regulation in force ;
- ✓ Monitoring of waste management generated by the project and holding of a waste tracking register;
- ✓ Bi-annual monitoring of groundwater quality in a water well located in the vicinity of the project area (Nawara water well) during the exploitation phase.

The geographic and UTM co-ordinates of the water wells are as follows:

Water well	Geographic co-ordinates Spheroid WGS 84	UTM co-ordinates, zone 32 (Cent Merid 9°E), Carthage datum
Nawara	Longitude : 9° 43’ 49,82’’ E Latitude : 31° 25’ 8,07’’ N	X = 539819 m Y = 3475276 m
Proposed water well	Longitude : 10° 04’ 10.76’’ E Latitude : 31° 00’ 47.24’’ N	X = 602270 m Y = 3431090 m

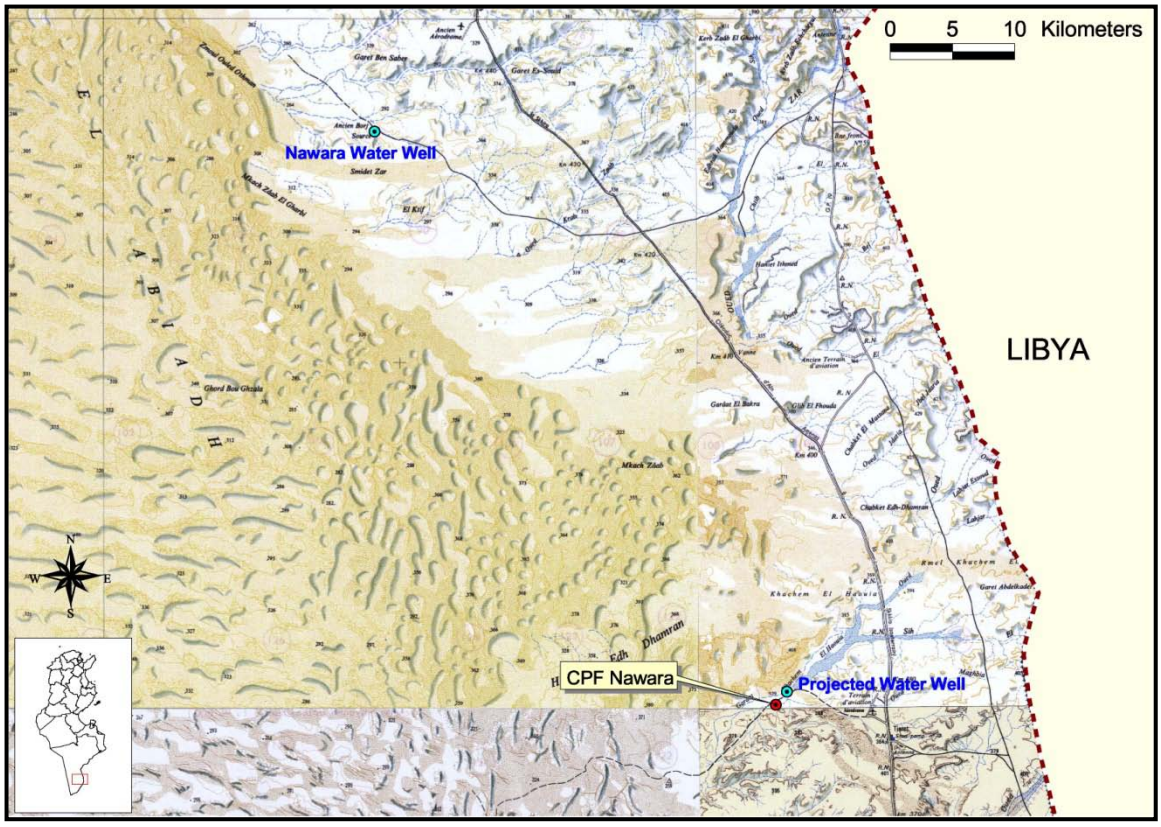


Figure 10.1 Water Wells Map

Laboratory analyses of the water sample were carried out and covered the pH, salinity, total petroleum hydrocarbons (TPH) and minerals. The analysis showed that TPH is low, the salinity is 0.7 ‰ and pH is slightly alkaline (Appendix VII). These values will be considered as reference for the projected monitoring program.

- ✓ Hazardous waste treatment by companies authorized by the ministry of environment;
- ✓ Commitment to submit, during the production phase, a periodic report on the management of hazardous waste.

10.6 Competence Building & Staff Training Plan

Although people who are hired by OMV for the CPF operations are skilled professionals, it is necessary to provide them with training sessions designed to increase their operational efficiency. Training is divided into technical, theoretical and practical and

supervised by the HSE manager.

10.7 Local Recruitment Plan

The local recruitment plan will aim to identify and maximize the profile of positions that can be filled by local population, define the system and places of recruitment and develop a staff monitoring system.

10.8 Documentation & Environmental Communication

The environmental management process must be accompanied by monitoring tools designed to document and communicate the results of the implemented plans between the staff and the various responsibility levels involved in the project. Among these tools, reports, minutes and periodic official communications produced by the various involved parties which allow to document the undertaken actions, the non-compliance cases and measures taken to adjust them.

The following table outlines the different stakeholders' responsibilities in the preparation of documents and communications.

Table 10.3 Guidelines for Communication

Author	Addressee	Frequency	Situations' Description
EPC Contractor	OMV	Start of work	Presentation of training and HSE programs for review and approval
EPC Contractor	OMV	Weekly	Waste Management Report
OMV	ANPE	Quarterly (During the production phase)	Environmental Report
OMV	ANPE	Bi-annual	Underwater quality monitoring report
OMV	ANPE	Before decommissioning	Environmental Impact Assessment for Nawara production facilities Abandonment
OMV	ANPE	After decommissioning	Reclamation Report for Nawara Production Facility

10.9 Environmental Audit

Environmental audits shall be carried out in accordance with ISO 19011 – Guidelines for Quality and Environmental Management Systems Auditing.

Environmental internal audits are undertaken by persons independent of the work being audited. Environmental audits are carried out against Company Standards (policies, guidelines, procedures etc.) and Tunisian Environmental Regulations to assess environmental management performance in the area of air, water and noise emissions, waste, etc.

A schedule of environmental audits will be developed and will ensure that at least the following elements of the Environmental standard are audited:

- ✓ Making use of mitigation measures;
- ✓ Waste management plan;
- ✓ Risk management plan;
- ✓ Environmental monitoring program;
- ✓ Competence building & Staff training plan;
- ✓ Equipment & Vehicule circlation plan;
- ✓ Local recruitment plan;
- ✓ Documentation & Environmental communication.

10.10 Cost of the EMP

The cost of the Nawara production facility development project in Nawara concession is estimated at 330 MM$. The cost related to the Environmental Management Plan is estimated at 330,000 dollars. The cost breakdown is as follows:

✓ Staff and HSE consultants fees	100 000 $
✓ Waste Management (solid & liquid)	100 000 $
✓ Air and Noise monitoring	80 000 $
✓ Miscellaneous	50 000 $

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APPENDICES

Appendix I Order of the Minister of Industry and Technology establishing the Nawara Concession

4.2.2. Les risques liés aux moyens et aux procédures de travail :

- matériels, équipements et réseaux.
- processus et modes de travail.
- infrastructures et œuvres spéciales.
- les erreurs humaines.
- autres dangers.

4.2.3. Les risques liés aux éléments extérieurs :

- les réseaux de communication, d'électricité et les autres réseaux publics.
- les établissements avoisinants.
- les atteintes diverses.

4.2.4. Les risques liés aux éléments naturels :

- inondations.
- foudres.
- séismes.
- autres éléments naturels (glissement de terrain, humidité, chaleur, grand froid).

4.3. Récapitulation des résultats, identification des accidents les plus probables et estimation des impacts :

4.3.1. Identification des dangers et estimation de leurs impacts.

4.3.2. Combinaisons probables entre les risques.

4.3.3. Identifications des accidents les plus probables.

4.3.4. Synthèse des résultats.

4.4. Identification et analyse quantitative détaillées des scénarios des accidents les plus importants :

4.4.1. Justification du choix des scénarios d'accidents importants.

4.4.2. Description détaillée de chaque accident.

4.4.3. Estimation des conséquences de chaque accident et de ses effets possibles.

4.4.4. Analyses des résultats.

5. Les mesures à prendre pour limiter les éventuelles conséquences :

Les mesures à prendre concernant les points suivants sont déterminées et justifiées sur la base des données et résultats prévus aux paragraphes précédents:

5.1. Nature des constructions et les conditions de leur exécution.

5.2. Compartimentage interne de l'établissement et isolements de ses différentes sections, unités et réseaux.

5.3. Volume de stockage des produits utilisés.

5.4. Conditions et règles d'exploitation.

5.5. Procédures de travail et de production et améliorations adoptées.

5.6. Les barrières de prévention et de sécurité.

5.7. Système de détection automatique des fuites de gaz, d'incendie et des matières dangereuses.

5.8. Les équipements et les moyens d'intervention.

5.9. Prévention des foudres.

5.10. Prévention des séismes.

5.11. Programmes d'entretiens et de contrôles.

5.12. Exercices périodiques et essais.

5.13. Périodes d'interruption temporaire.

5.14. Organisation interne et gestion.

5.15. Qualification et formation du personnel.

5.16. Procédures de contrôle et de surveillance.

5.17. Procédures de contrôle requises suite aux accidents.

6. Répercutions sur l'environnement :

Répercutions de l'établissement sur l'environnement : récapitulatif de l'étude d'impact sur l'environnement.

7. Procédures et moyens d'intervention face aux accidents :

7.1. Les moyens matériels :

7.1.1. Les moyens et matériels (spécifications techniques, dimensionnement ou nombre, disponibilité, distance, ...).

7.1.2. Les moyens spéciaux (eau d'extinction, produit émulseur, produit de neutralisation, ...).

7.2. Les moyens humains :

7.2.1. Qualifications.

7.2.2. Compétences.

7.3. Les moyens de secours extérieurs :

7.3.1. Les moyens des organismes publics (type, disponibilité, distance, ..).

7.3.2. Compétences.

7.4. L'alerte :

7.4.1. Les moyens et les procédés.

7.4.2. Démarches et procédures.

7.5. Les éléments nécessaires pour l'élaboration du plan d'opération interne.

7.6. Alerte et information du voisinage.

8. Les éléments importants pour la sécurité.

9. Références bibliographiques.

10. Annexes (plans, cartes, caractéristiques techniques ....)

Arrêté du ministre de l'industrie et de la technologie du 20 février 2010, portant institution d'une concession d'exploitation d'hydrocarbures dite concession « Nawara ».

Le ministre de l'industrie et de la technologie,

Vu le code des hydrocarbures promulgué par la loi n° 99-93 du 17 août 1999, tel que modifié et complété par la loi n° 2002-23 du 14 février 2002, la loi n° 2004-61 du 27 juillet 2004 et la loi n° 2008-15 du 18 février 2008,

Vu le décret n° 2000-713 du 5 avril 2000, portant composition et fonctionnement du comité consultatif des hydrocarbures,

Vu le décret n° 2000-946 du 2 mai 2000, fixant les coordonnées géographiques et les numéros des repères des sommets des périmètres élémentaires constituant les titres des hydrocarbures,

Vu le décret n° 2004-1105 du 13 mai 2004, portant approbation de la convention et ses annexes relatives au permis de recherche « Jenein Sud » et signées à Tunis le 10 novembre 2003, entre l'Etat Tunisien d'une part, l'Entreprise Tunisienne d'Activités Pétrolières et la société OMV AG d'autre part,

Vu le décret n° 2005-1838 du 27 juin 2005, portant ratification de l'avenant n° 1 à la convention et ses annexes régissant le permis de recherche « Jenein Sud »,

Vu l'arrêté du ministre de l'industrie du 15 février 2001, fixant les modalités de dépôt et d'instruction des demandes de titres d'hydrocarbures,

Vu l'arrêté du ministre de l'industrie et de l'énergie du 8 avril 2004, portant institution d'un permis de recherche d'hydrocarbures dit permis « Jenein Sud » au profit de la société « OMV AG » et de l'Entreprise Tunisienne d'Activités Pétrolières,

Vu l'arrêté du ministre de l'industrie, de l'énergie et des petites et moyennes entreprises du 5 juillet 2007, portant extension d'une année de la durée de validité de la période initiale du permis « Jenein Sud »,

Vu l'arrêté du ministre de l'industrie, de l'énergie et des petites et moyennes entreprises du 19 avril 2008, portant extension d'une année de la durée de validité de la période initiale du permis « Jenein Sud »,

Vu la lettre du 6 avril 2004 par laquelle la société « OMV AG » a notifié la cession de la totalité de ses intérêts dans le permis de recherche « Jenein Sud » au profit de sa filiale « OMV (Tunesien) Exploration GmbH »,

Vu la demande et la demande complémentaire déposées à la direction générale de l'énergie respectivement le 19 juin et le 19 septembre 2009, par lesquelles la société « OMV (Tunesien) Exploration GmbH » et l'Entreprise Tunisienne d'Activités Pétrolières ont sollicité l'attribution d'une concession d'exploitation d'hydrocarbures dite concession « Nawara »,

Vu l'avis favorable émis par le comité consultatif des hydrocarbures lors de sa réunion du 2 octobre 2009,

Vu le rapport du directeur général de l'énergie.

Arrête :

Article premier - Est instituée, une concession d'exploitation d'hydrocarbure dite concession « Nawara » au profit de la société « OMV (Tunesien) Exploration GmbH » et de l'Entreprise Tunisienne d'Activités Pétrolières selon des taux de participation respectifs de 50% chacune.

Art. 2 - La concession « Nawara » couvre une superficie de 528 kilomètres carrés soit 132 périmètres élémentaires, et est délimitée conformément au décret susvisé n° 2000-946 du 2 mai 2000 par les sommets et les numéros de repères figurant dans le tableau ci-après :

Sommets	N° des repères
1	300 166
2	304 166
3	304 164
4	310 164
5	310 158
6	330 158
7	330 148
8	338 148
9	338 136
10	330 136
11	330 140
12	326 140
13	326 144
14	318 144
15	318 142
16	312 142
17	312 146
18	310 146
19	310 152
20	300 152
21/1	300 166

Art. 3 - La concession d'exploitation « Nawara » est accordée pour une durée de trente ans à compter de la date de publication du présent arrêté au Journal Officiel de la République Tunisienne.

Tunis, le 20 février 2010.

Le ministre de l'industrie
et de la technologie
Afif Chelbi

Vu
Le Premier ministre
Mohamed Ghannouchi

MINISTERE DE LA CULTURE ET DE LA SAUVEGARDE DU PATRIMOINE

Arrêté du ministre de la culture et de la sauvegarde du patrimoine du 20 février 2010, relatif à la protection des éléments et des collections archéologiques dont la propriété revient à l'Etat.

Le ministre de la culture et de la sauvegarde du patrimoine,

Vu le code du patrimoine archéologique, historique et des arts traditionnels promulgué par la loi n° 94-35 du 24 février 1994, tel que modifié par la loi n° 2001-118 du 6 décembre 2001, et notamment ses articles 5 et 50,

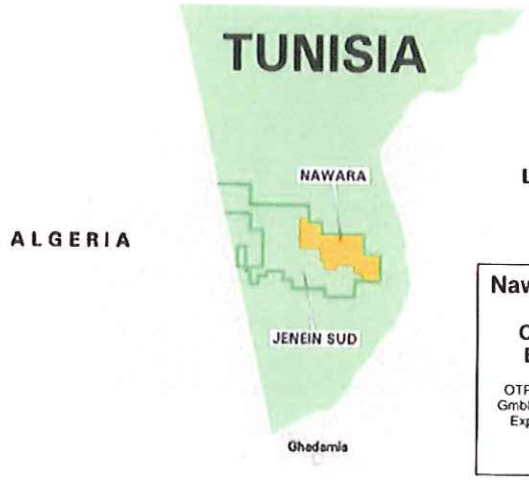
Appendix II Plan of Development

OMV

ETAP

Amendment #3 of
PLAN OF DEVELOPMENT

Nawara Concession



Nawara Concession

OTP (OP) 50%
ETAP 50%

OTP- OMV (Tunesien) Production GmbH is a 100% subsidiary of OMV Exploration & Production GmbH

Original filed November 2008

Rev No	Revision	Originator	Reviewed and Agreed	Approved	Approved
3	Issued for Submission	ADM Nawara C. Enzendorfer Date	Project Owner C. Cox Date 5/5/13	JV Representative OMV R. Oswald Date	JV Representative ETAP M. Akrout Date

Table of Content

1. Introduction

The original Plan of Development (POD) for the Nawara Concession was submitted to ETAP for approval on 20 February 2009 reflecting the status of the G&G evaluation as of December 2008. On this basis the Nawara production concession was granted in February 2010. ETAP decided to take their maximum share of 50% in the development JV. The aim of the original development scenario was to assure a gas delivery rate of 1.33 million m3/day through the South Tunisian Gas Project (STGP) gas transportation and treatment facilities for the domestic gas market.

In early 2011 OMV acquired all assets from Pioneer in South Tunisia. With this transaction OMV also gained additional capacity access to the STGP. Since the associated gas volumes to be recovered from the Pioneer oil assets were found to be not sufficient to fill the STGP capacity, it was decided to increase the Nawara plateau production rate to utilise the entire capacity share in the STGP. After extensive sub surface study work it has been concluded that an increase of the sales gas plateau rate to 2 million m3/day is sustainable with the discovered and prospected volumes in the Nawara concession.

Consequently, the design capacity of the Central Processing Facility (CPF) was increased to 2.7 million m3/day raw gas, which includes 10 % shrinkage for the LPG extraction and a 20% spare capacity to ensure the plant availability as per the envisaged sales gas contract.

An amendment to the POD ("Amendment #2"; attached as Appendix 4) describing these design changes was approved by ETAP and issued to DGE in mid-2012 together with the request to upgrade the market reservation to 2 million m3/day.

As of July 1 2012, OMV took over the coordination of the STGP consortium from eni (Steering Committee resolution dated 12 July 2012). The framework agreement governing the activities of the STGP consortium expired with end 2012 and eni opted not extending the agreement. This decision is documented in a final Steering Committee resolution from February 7, 2013 and a letter from eni dated 31 January 2012.

In the meantime the market reservation over 2 million m3/day has been granted to the Nawara Concession by DGE (letter dated 13 February 2013). Despite the fact that STGP had been given market access by STEG of 4 mn scm/d at Gabes (letter STEG dated 28 February 2008), no concessions other than Nawara have applied for a market reservation to utilize this STGP market access. This and the fact that eni had left the STGP Consortium led the Nawara JV decide to integrate the STGP facilities into the scope of the Nawara concession development to ensure the Nawara gas is developed efficiently for the benefit of all stakeholders.

2. Scope Changes to Original Development Concept

Following changes are applied to the original development concept to facilitate the integration of Nawara and STGP in a cost and schedule efficient way.

The field facilities within the NAWARA Concession required to pre-treat raw gas and condensate will remain widely unchanged to the original concept as described in the previous POD and its amendments. The installation of the water treatment unit and the Mercury removal filters have been deferred to the time when they become really required.

Export for the pre-treated rich gas was originally foreseen via a 24" gas pipeline from the Nawara Concession to the STGP inlet facilities in Hamouda ("Hamouda Receiving Station"). Since no other concessions than Nawara will provide gas into the pipeline for the foreseeable time, and the STGP Consortium is dissolved, the Hamouda Receiving Station will not be built but be replaced by a standard valve station.

The former Nawara export pipeline to Hamouda will be extended to a length of 370 km from the outlet of the Nawara CPF to Gabes. The discharge pressure at the CPF will be 47 bar and the arrival pressure in Gabes 35 bar. The pipeline routing will be along the previous STGP West route parallel to the existing Trapsa oil pipeline and STEG gas and liquid pipelines from El Borma to Gabes. The new pipeline will be able to transport up to 10 mn scm/d of gas without intermediate

compression, and thus will provide additional transportation capacity to cater for potential future gas discoveries or associated gas from oil discoveries in South Tunisia. This additional capacity will be made available to any upstream concession on a tariff basis and under the condition that they have to deliver gas at required inlet conditions as specified in the Basis of Design for Upstream Concessions document. The key specifications are: Water dew point -12 degC, HC dew point +10degC, CO2 content < 2%vol and a delivery pressure from the Nawara concession of 47 bar. The upstream concession(s) has to cover also any investments for additional compression requirements for the Nawara concession resulting from the higher pressure regime in the pipeline. Tie in points for third party gas delivery will be provided at any of the eleven valve stations along the pipeline route. The design pressure of the pipeline will be 111bar to accommodate the later capacity increase and associated compression.

In Gabes the rich gas will be treated further in a "fit for Nawara purpose" Gas Treatment Plant (GTP) of 2.7 million m3/day inlet capacity to produce commercial products: gas, propane and butane as per their respective specifications and stabilized light condensate. Commercial gas will be delivered to STEG gas grid at Gabes at 76 barg, the LPG products (propane and Butane) will be delivered to STIR via the SNDP storage facilities at Gabes.

In addition to Hydrocarbon processing, the GTP will also function as the control centre for the pipeline operations.

The Nawara CPF was initially planned as a standalone development. Following the acquisition of Pioneer assets in South Tunisia in early 2011, the project scope has been revised in order to maximise the synergies with the existing Cherouq facilities and the future oil developments by OMV in South Tunisia. A central operations, maintenance and infrastructure site will be built to provide services to OMV operated assets in South Tunisia and potentially also to Nawara. Details of this hub concept are described in chapter 6.

As mentioned already in Amendment #2, the project scope also includes the completion of three (3) wells which were drilled during the appraisal phase but were not completed yet. These are Ritma-1, Kholoud-1, Banefsej-1.

Furthermore, three (3) of the previously completed wells require re-completion since the completion was damaged by severe sand production during the well testing phase. The new completion design and workover concept has been presentd to ETAP and was already approved in late 2012. The concerned wells are Nawara-1, Ahlem-1 and Sourour-1.

Two (2) wells are ready for production already now without any further intervention. These are Fella-1 and Ahlem-2.

Further details about the facilities scope are given in chapter 6 of this amendment.

3. Operations and Maintenance Philosophy

All Operations and Maintenance (O&M) activities for the entire integrated system, Nawara CPF, Pipeline and GTP will be undertaken by one Production Operator who will be agreed and staffed by the Nawara JV partners.

The O&M philosophy for the Nawara CPF has been developed to support the design intent of optimized manning level based on a common and shared infrastructure and maintenance hub in Waha (warehouse, workshop, logistics, accommodation, etc.). It is envisaged that during commissioning and initial operations period the Nawara facilities will be manned until stable operating conditions are established. For this purpose a temporary camp will be provided in Nawara. Then the facility should be operated under the Optimally Manning concept, where the optimum number of people is employed in order to warrant safe operations and achievement of availability targets as required by the GSA.

As mentioned above, the GTP will also function as the control centre for the pipeline operations. This means that operations and maintenance of the 370km export pipeline will be managed and conducted from the GTP in Gabes.

4. Legal & Fiscal Frame of the Investment in NAWARA

The revised Nawara POD by integrating the former STGP facilities pipeline in this development plan, is considered to be under the legal and fiscal regime of the NAWARA Concession (each 50% share ETAP and OMV). This approach is consistent with existing laws and contracts and according current known legislation. It also allows the JV to go ahead with the development of the NAWARA Concession and bring the gas to the Tunisian customers as scheduled and without the necessity of further commercial negotiations.

Nawara will build the gas export pipeline to Gabes under article 75 of Hydrocarbons Code accommodating a capacity of up to 10 mn scm/d although Nawara would need only a capacity of 2.7 mn scm/d. This represents a significant pre-investment for the Nawara titleholders with an uncertain return since the availability of future gas discoveries in south Tunisia to fill the remaining capacity is highly uncertain at this point in time. Article 113.3 of the Hydrocarbons Code as modified by the law no. 2008-15 allows the titleholder to build and tax deduct an investment reserve up to 20% of it's taxable results on an annual basis in order to finance the setting up of pipelines. This tax incentive will allow OMV to commit in this amendment no. 3 of the PoD to the pre-investment in the oversized gas pipeline as well as to the oil export pipeline from the Nawara Concession to the Trapsa pipeline.

Any tariff charges to third party users of the pipeline from Nawara to Gabes (11 valve stations will be availbale along the pipeline for tie in) will be treated as income of the Nawara Concession. Same will be the case for thrird party use of any spare capacity in the GTP. The tariff will be determined in accordance with the terms of Article 82 of the Hydrocarbons Code and will be subject to DGE approval. Specifically, the tariff charge calculation will have to consider the development and operating costs of the facilities, a minimum economic lifetime of 15 years, the fiscal regime of the Nawara Concession and a rate of return for the investors of 10%.

Fiscal metering stations will be installed by the upstream concessions following the design specification as developed by the former STGP consortium. Their location shall be at the transfer point of wet rich gas streams into the pipeline (for the case of the Nawara concession, this will be at the outlet of the Nawara CPF).

Fiscal sales metering stations will be installed at the custody transfer points of sales products (i.e. at the GTP outlet for sales gas and LPG products).

5. Agreements required

In order to achieve the above described targets, the JV requested support from the Tunisian Government in obtaining right of way along the west route to Gabes and all other regulatory approvals required to build the pipeline.

The JV also asked the Government to protect the execution of the NAWARA/STGP development from adverse impacts resulting from strikes, sit-in's, and similar activities to the largest extend possible.

Notwithstanding that no formal confirmation for the above has been received by the government, it is the mutual understanding of both, the investors and the government, that such support and protection will be granted by the government when this Amendment # 3 of the Plan of Development will be approved and OMV & ETAP commit to the development of the facilities accordingly.

The following agreements need to be executed for the proposed concept:

1. Approval of NAWARA Amendment # 3 to POD (ETAP & DGE)
2. Gas Sales Contract NAWARA – STEG

3. Propane, Butane products Sales Agreements NAWARA – STIR
4. LPG Storage Agreement NAWARA - SNDP
5. Crude Transportation Agreement NAWARA – TRAPSA
6. Waha Infrastructure Hub Service Agreement – Cherouq Concession Holder

Furthermore, an agreement has to be reached about the operatorship of the facilities. Due to the nature of the Nawara – STEG Gas Sales Contract ("ship or pay"' "take or pay" regime), it is mandatory that the Nawara CPF, the pipeline and the GTP at Gabes will be operated by the same entity controlled by OMV & ETAP in order to avoid any conflict of interest.

Due dates for above agreements are as per the attached integrated schedule.

6. Facilities Development Details

6.1 Nawara CPF

Subsequent to the initial POD and its amendments # 1 and # 2, further engineering studies have been undertaken to define the basic concept for Nawara Development.

A brief summary of finalized selected concept is given below.

i. Gathering system from the 8 wells (Nawara-1, Ahlem-1, Ahlem-2, Sourour-1, Ritma-1, Fella-1, Khouloud-1, Benefsej-1)

ii. Central Processing Facilities located in Nawara for:

   a) Inlet manifold and test separator
   b) Condensate/Gas/Water Separation
   c) Gas Dehydration
   d) Gas Sweetening
   e) HC Dew pointing
   f) Condensate Stabilization
   g) Condensate Storage
   h) Produced water system
   i) Gas and Condensate Metering Units
   j) Utilities

iii. Condensate Export pipeline (6" approx. 10 km) to TRAPSA.

The CPF will be sized for the plateau production rate which corresponds to the current market reservation to be contracted with STEG (2.0 mn Sm3/d sales gas for Nawara Concession). The CPF plant design capacity will have a 10% margin for gas shrinkage due to processing in Nawara and Gabes and an additional 20% margin to cater for the take or pay clauses provided in the Gas Sales Agreement.

One single gas train is considered for rich and lean gas respectively. The design will consider all flexibility requirements for wide operational envelope for different lean and rich gas composition mixtures.

The Nawara CPF has been designed based on following production data.

		Operating Rate	Design Capacity
Gas Production	mn Sm3/d	2.2	2.7
Condensate Production	bpd	5,000	7,000
Peak liquid Production***	bpd	7,500	9,450
Sales Gas Rate (in Gabes)	mn Sm3/d	2.0	2.5
*** based on max. 25% water cut from all producing wells			

The battery limit of the CPF is on the upstream side the Flow vale of the well X-mas tree and on the down stream side the outlet flanges of fiscal metering stations for rich gas into the main pipeline and condensate into the TRAPSA pipeline. The gas export pressure at battery limit is 47 bar.

The CPF location has now been fixed at near Nawara-1 wellhead resulting from extensive studies carried out during pre-feasibility phase of the project.

6.2 Pipeline Nawara to Gabes

The pre-treated Gas in Nawara CPF will be routed via a 370 km buried gas pipeline to the Gas Treatement Plant in Gabes where it will undergo deep refrigeration in order to bring it to the sales gas specification.

The main Pipeline will include:

- 370 km of 24 ", 111 bar design pressure, Carbon steel pipeline; the pipeline is designed for a capacity of 10 MSCMD with an arrival pressure of 35 bars at Gabes GTP inlet.
- 370 km of single mode fiber optic cable, 48 core, including SDH network and telecom equipment allowing transport of process controls, safety, voice and video data;
- Pipeline SCADA system and leak detection equipment;
- 11 x Line Valve Stations 24" (LVS) – every 30 km, equipped with photovoltaic supplies, E&I equipment, CCTV, F&G, etc. ;
- ESDVs 24" down stream Nawara CPFand up-stream GTP Gabes;
- Impressed current cathodic protection (ICCP) stations along the pipeline (currently, every 60 km);
- 24" Pig Launcher up-stream the pipeline located in the boundary limit of Nawara CPF and Pig Receiver at GTP entrance (Gabes);

Tie-in of any potential future gas discoveries or associated gas from oil discoveries will be made to the closest line valve station where provisional tie-ins arrangements (both piping and fiber optic) are provided.

6.3 Gas Treatment Plant in Gabes

At the Gas Treatment Plant (GTP) the rich Nawara gas will be treated to produce 2.0 mn Sm3/d sales quality gas and associated LPG and condensate products to their respective required specifications.

In a first treatment step the gas will be cooled down with a mechanical gas refrigeration unit to establish the sales gas specifications as agreed in the Gas Sales Agreement. The gas will then be compressed and exported to STEG.

The liquid byproduct from the refrigeration unit (C3+) will be fractionated in dedicated columns to produce commercial Butane, Propane and a small amount of stabilized condensate.

The GTP plant will include:

a) Inlet Separation
b) Gas Refregeration
c) De-Ethanizer Unit
d) De-Propanizer Unit
e) De-Butanizer Unit
f) Sales gas Compression
g) Sales Gas Fiscal Metering Unit
h) LPG products Pumping units to SNDP
i) LPG products Fiscal Metering Units
j) Utilities (taking into consideration waste heat recovery)

The GTP will be designed based on:

		*Operating Rate**	*Design Capacity***
Sales Gas Production	mnSm3/d	***2.0***	***2.5***
Propane production	tons/d	***63***	***114***
Butane production	tons/d	***65***	***110***

Note:

* based on the average simulated volumes from the 100% Lean and 30% Lean/70% Rich mix

**based on simulated volumes from the 30% Lean/70% Rich gas mix

The upstream battery limit of the GTP is the inlet flange of the inlet slug catcher. Here the gas arrives at 35 bar. The down stream battery limits are the outlet flanges of fiscal sales gas and LPG product meters. Sales gas shall be exported at 76 barg.

6.4 Infrastructure Hub Waha

After the Pioneer acquisition it was proposed to develop a common Infrastructure and O&M Hub close to Waha in order to maximize synergies between all OMV operated assets in South Tunisia.

This infrastructure will be capable of providing a central control room, living and working spaces, and transportation support. The site will also be able to deliver operational support such as maintenance services, warehousing and common IT/communications systems.

Tiaret airport situated close to Nawara shall be upgraded to be capable to receive commercial aircrafts operating in country (such as the ATR 72 used by SITEP for El Borma) This will allow to maximize synergies, lower air transportation operating expenditure while still supporting both Waha and Nawara safe operations.

In light of the lower expectations in recovery and field life time from the STOD (South Tunesian Oil Development) project the concept was adjusted to be executed in 2 phases.

Phase 1 to be initiated already in 2013. Scope is to build a permanent camp and facilities in Waha (Cherouq Concession) to replace the current rented camp. In addition the airstrip in Tiaret (close to the TRAPS SP3) will be upgraded together with the road link between Tiarat and Waha. For start up and during the first year of production from Nawara, a temporary camp will be provided at Nawara location. The planning and execution of the Waha infrastructure upgrade is currently being supported by the project team but not part of the NAWARA project scope.

Phase 2 will be initiated after the first year of Nawara production. A decision will be made whether Nawara can be operated remotely from Waha or not. In the first case the Waha Infrastructure Hub will be expanded to accommodate the Nawara needs. In the latter case, the Nawara temporary camp will be replaced by a permanent one. The exact extend of the infrastructure required to support Nawara will be decided only after the first year of production during which the infrastructure will be provided by means of temporary, rented facilities. The expansion of infrastructure will form a new project all together and thus, the required funds for building a permanent camp in Nawara or upgrading the Waha infrastructure facilities are not part of the current Capex estimate. However, Opex for rental facilities (either from a contractor or from Waha) are included. All services Nawara will receive from the Waha Hub will be charged out through tariff payments. Refer to Agreement #6 in Chapter 5 of this amendment.

7. Community Relations and Social Responsibility

The development will be undertaken as per the structured approach of OMV community relations practices. OMV has conducted several social initiatives for the south of Tunisia in the past and is committed for the future (about one (1) million TDN for medical setup improvment at Tataouine hospital, cleaning equipment for Tataouine municipality, National Guard housing upgrade, Kembout water tank renewal, Automechanic shop, etc...).

OMV followed a clear and transparent process to derive community relation projects. The approach is as follows

1. Identification of stakeholders (project affected people, NGOs, governments, etc.)
2. Public consultation & disclosure of information
3. Assess & evaluate environmental & social impacts in all project phases
4. Necessary actions to manage the environmental & social impacts, e.g. health, safety & environment, action plan

The project has conducted a social baseline and needs assessment study on 2010 and is currently updating and extending its scope to cover Gabes and the STGP route areas. The environmental and social risk/opportunity is assessed as per the guideline of the IFC (International Finance Corporation member of the Wold Bank Group) and the African Development Bank (ADB) terms of references for community consultation, public disclosure, compensation and resettlement.

The goal of OMV and ETAP is to foster local content development and job creation. These requirements are already translated in the contracting strategy. EPCC tenderers shall demonstrate a commitment to maximise Tunisian content in, as a minimum, the form of Tunisian Contractors and Suppliers. Failure to demonstrate a genuine commitment to employing Tunisian companies will result in a disqualification. The JVP strive particular interest to the employment and capacity building in the South of Tunisia. A vocational training initiative in Tataouine to improve employability of local people in various industries has been lunched in 2012 with a budget totaling 6 million TDN. Further a wide consultation with local stakeholder and social society; training topics such as entrepreneurial skills, qualified welding, HSSE, and English language skills have been selected. The sponsorship project will last for 2 years and it is expected that the National Professional Training Agency will ensure sustainability in the future.

8. Capex, Opex and Economic Analysis

8.1 Input Assumptions

CAPEX : The total capital expenditure for the execution of the development scope starting May 2013 until first gas is USD 814 mn to be invested over the next three years (2013/2014/2015). After first gas, additional captal expenditures of USD 287 mn are required for drilling 23 additional wells and installation of Front End Compression at the CPF inlet. Underlying cost estimates are class 2 for CPF and pipeline and class 4 for GTP. Cost Details are listed in below table.

All Figures in USD million, 100%.

	2013	2014	2015	2016+	Total Field Life
CPF Nawara & upstream	36.1	144.9	144.9		325.9
24" Pipeline Nawara-Gabes	130.4	95.9	43.3		269.6
GTP and Compression Gabes	10.0	73.2	73.2		156.4
Work overs	0.0	14.3	17.3		31.6
Owner Cost	6.3	12.0	12.0		30.3
Future wells (23) and tie ins				255.6	255.6
Future FEC				31.0	31.0
Total	**183**	**340**	**291**	**287**	**1100**

Note: Nawara CPF includes a cost escalation for market increase of USD 39.2 mn.

OPEX: The estimated annual operating expenses during Plateau production are listed below. All Figures in USD million, 100%.

Opex – Nawara CPF	23.3
Opex - Pipeline and GTP	6.6
Escalation	3.8
Total annual Opex for the whole project	**33.7**

PAST COST: The past exploration cost spent on drilling and testing of 9 wells and engineering studies for the development projects is 194.7 USD.

PRODUCTS: The production profile for sales gas remained unchanged from the profile as provided in Amendment #2. Total estimated gas sales will be 510 bcf over a period of 25 years. Plateau length is estimated to be around 17 years.

The production volume for condensate has been increased slightly from 11 to 13.5 mn bbl to refelect the additional condensate recovery due to the deep cooling in the GTP.

The daily LPG production (and thus the total LPG recovery) has been reduced by 45% to reflect the lower recovery efficiency of a Mechanical Refrigeration versus the previously selected Turbo Expander technology and the leaner gas composition from the Nawara gas only versus the previous mix. Thus, the overall LPG recovery over 25 years dropped from 19 mn boe to 10.5 mn boe.

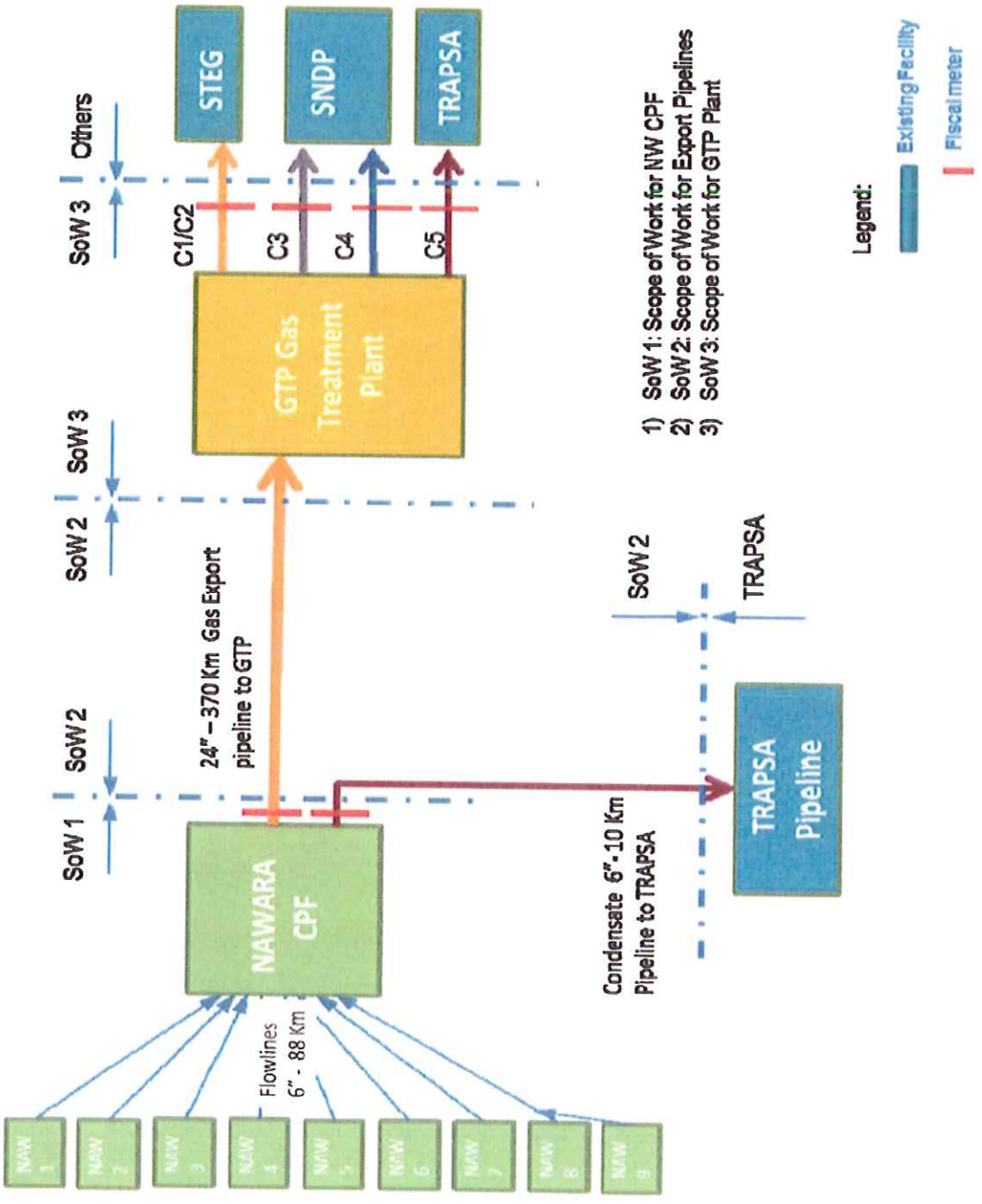
The above Capex estimate is based on a deterministic cost estimation methodology and includes contingencies for market price escalations and technical contingency (for scope which is not

100% defined yet). It does not include contingency to cover for probabilisticly determined project risks, as identified in the project risk register.

8.2 Economic Results

A summary of economic Key performance Indicators (KPI's) is provided in appendix 2.

Appendix 1: Sketch of Development Scope

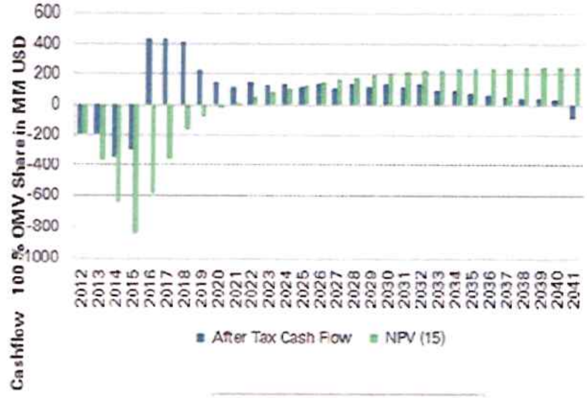


Appendix 2: Economic Analysis

Economics Summary — Nawara basecase - 100% w/o carry repayment (Full cycle) — Date: 13/03/13

OMV Cashflow

dis counted to 1/1/2013



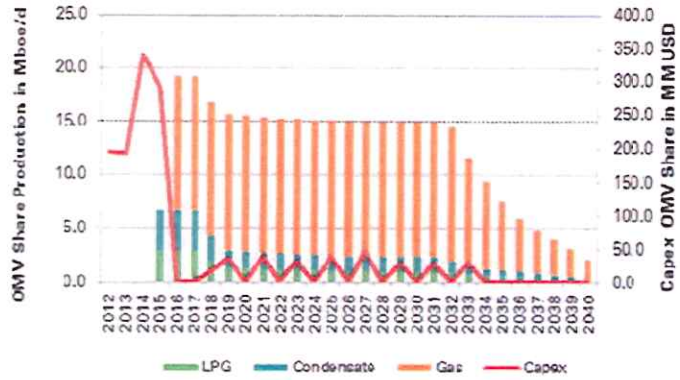
Prices

	LPG	Condensate	Gas
	USD/bbl	USD/bbl	USD/mscf
2013	65.99	101.00	11.67
2014	66.26	101.00	11.67
2015	69.73	101.00	11.67
2016	69.98	101.00	11.67
2017	69.98	101.00	11.67
2018ff	69.98	101.00	11.67

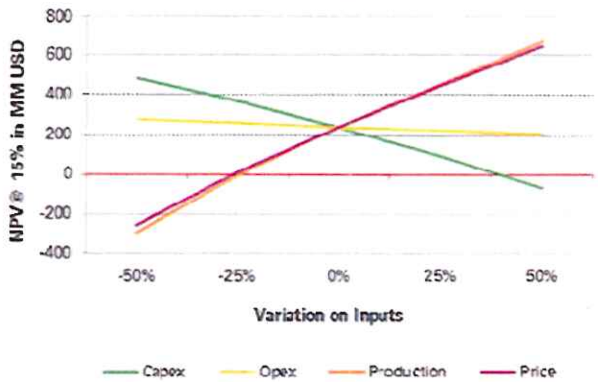
KPIs OMV Share 100%

NPV @ 10 %	MM USD	609.6
NPV @ 15 %	MM USD	241.0
Rate of Return	% p.a.	20%
DPI @ 10 %		0.6
Maximum Exposure	MM USD	1018.7
Capex	USD/boe	11.1
Opex	USD/boe	6.4
Payout @ 10%	years	7.5
Costs OMV Share		
Total CAPEX	MM USD	1305.3
Total OPEX	MM USD	749.4
Production OMV Share		
Total Liquids	MMSTB	24.0
Total Gas	BSCF	559.7
Total Equivalent	MMBOE	117.3

OMV Capex and Production



Sensitivities



Calculated by: Yosri Maknine

Reviewed by: Josef Donner

Appendix III Project Approval by General Directorate for Energy

République Tunisienne
Ministère de l'Industrie
Direction Générale de l'Energie
DI'PH/RB

Date 22 MAI 2013
Number A 09977

GM		HSSE	
EXP		HR	
PE		BDS	
OE		DEV	
FIN		STGP	
PROC		OA	
TPS/Ser		NOA	
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TRANSMISSION PAR TELEFAX

DESTINATAIRE : Mr Le Directeur Général
OMV

N° FAX : 70 168 201/202 71. 462. 555

Mr Le Président Directeur Général
de l'Entreprise Tunisienne d'Activités Pétrolières

N° FAX : 71 285 280

DATE : 21 Mai 2013

EXPEDITEUR : Direction Générale de l'Energie

N° FAX : 71 787 804

REFERENCE : DPPH

NOMBRE DE PAGE : 2
(Celle-ci incluse)

OBJET : Concession Nawara - Avenant n°3 au plan de développement.

REF. : Votre lettre en date du 8 Mai 2013

Par lettre en date du 8 mai 2013 déposée à la Direction Générale de l'Energie le 17 mai 2013 vous m'avez transmis pour approbation, deux exemplaires de l'Avenant n°3 au Plan de développement de la concession d'exploitation des hydrocarbures « Nawara ».

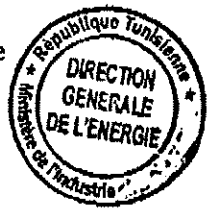
En réponse, j 'ai l'honneur de vous informer que la dit avenant n°3ne soulève pas d'objection de notre part tant qu'il n'est pas contraire ou incompatible avec les dispositions du Code des Hydrocarbures et des règlements pris pour son application.

Toute fois Nous vous rappelons qu'en ce qui concerne la constitution des réserves de réinvestissement prévue à l'article 113 du code des hydrocarbures pour le financement des dépenses des canalisations de transport du brut et du gaz de la concession Nawara, celle-ci doit faire l'objet d'une demande détaillée comportant les modalités de la constitution des dites réserves et la concession à partir de laquelle seront constitués ces réserves pour le présenter pour examen au Comité Consultatif des Hydrocarbures.

Meilleures salutations

Le Directeur Général de l'Energie

Rachid Ben Daly



Appendix IV Preliminary authorization of Tataouine CRDA for the Drilling of the Water Well

Move & More. OMV

Mr. Le Commissaire Régional au Développement Agricole de Tataouine
CRDA Tataouine
Tataouine
3263 Tunisia

Int. CC: GM, O&E, E&R, DEV, HSE, BDC, LEG

July 03, 2013
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OMV Exploration & Production

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Registration:

MF: 504991/A
RC: B156351997

www.omv.com

Objet: Demande d'autorisation ministérielle pour la réalisation d'un forage d'eau as la concession Nawara.

Pièces Jointes : Fax du CRDA du 4 Novembre 2010 ;
- Demande d'autorisation signée ;
- Engagement avec signature légalisée ;
- Copie de l'Etude d'Impact sur l'Environnement ;
- Carte de localisation du forage d'eau projeté.

Monsieur,

Dans le cadre de développement de la concession Nawara et en vue d'assurer les besoins en eaux pour les phases de construction et d'exploitation, nous vous prions de bien vouloir nous accorder l'autorisation en objet applicable pour la recherche et l'éventuelle utilisation des eaux souterraines à une profondeur supérieure à 50 mètres. Vous trouvez dans les pièces jointes toutes les données requises pour notre demande. Cependant, nous restons à votre disposition pour tout complément d'information.

Dans l'attente d'une suite favorable, nous vous prions, Monsieur, d'accepter nos plus hautes considérations.

NF

Pp

10/7/13.

Copie

الجمهورية التونسية
وزارة الفلاحة والموارد المائيّة
المندوبية الجهوية للتنمية الفلاحية
بـ...نابل.....

مطلب للحصول على رخصة للبحث و التنقيب عن المياه الجوفية و امتياز في استغلالها *

مجلة المياه الصادرة بالقانون عدد 16 لسنة 1975 مؤرخ في 31 مارس 1975
و خاصة الفصول 13 و 15 و 53 و 57 منها
الأمر عدد 56 لسنة 1985 مؤرخ في 2 جانفي 1985 يتعلق بتنظيم تصريف النفايات في المحيط

☐ شخص مادي ☒ شخص معنوي

--*-*-*-*-*-*-*-*

- اسم طالب الرخصة ولقبه (أو الاسم الاجتماعي) :...ODV (Tunesien) Production GmbH...
- الممثل القانوني للمؤسسة : .....Oswald Reinhard Josef.....
- عدد بطاقة التعريف الوطنية P 5 4 0 3 4 0 4 بتاريخ 07/03/2011 مسلمة بـ..... جوازسفر
- المهنة أو الغرض الاجتماعي..استكشاف واستغلال المحروقات.....
- العنوان أو المقر الاجتماعي..عمارة 2 على Waterside بحيرة تونس ضفاف البحيرة تونس
- نقطة المياه : ☐ عين ☐ بئر ☒ بئر أنبوبية ☐ وادي

11-05.12-02

عمادة...برج الحفناوي...معتمدية...برمادة...ولاية...نابل.....

- الحاجات المائية :

- الدفق الأقصى...2.5.9.2...م3/ في اليوم - حجمه السنوي...14.2.4.3.8...م3/في السنة
- أثناء المدة المتراوحة من شهر ..أفريل...2014...إلى شهر ..ديسمبر...2014.....
- لمدة .....8.....ساعات في اليوم ، من الساعة .....إلى الساعة.....

---

*- في صورة الحصول على نتائج إيجابية يمكن للطالب الحصول على امتياز في الاستغلال بصورة ضمنيّة.

*- في صورة الحصول على نتائج سلبية يتم الاستغناء عن مطلب الامتياز.

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- استعمـــال المـــاء :

• للـفـلاحـــــة : ☐ الري ☐ الرش

- مساحة الأرض.....
- الزراعات الموجودة حاليا (نوعا ومساحة).....
- الزراعات المنتظرة (نوع ومساحة).....

• للصـنـاعـــــة : (تقديم دراسة فنية حول تأثير المشروع أو النشاط الصناعي على المحيـــــط):

- نوع الصناعة..استكشاف ومعالجة البترول والغاز.....
- مآل المياه المستعملة..أحواض تبخر.....(Evaporation pit).....
- طريقة معالجة المياه..وحدات مصاغة داخل بناية عالية (معالجة من نوع CPI).....
- موقع تصريف النفايات..جمع ونقل من قبل شركات مرخص لها.....

• للأغـراض المنـزلـيـــــة :

- تجمع سكني بـ..مركز معالجة المحروقات..عدد السكان .....100.....
- مآل المياه المستعملة..نقل إلى أقرب محطة تطهير..طريقة معالجة المياه..حسب المادة العضوية...
- موقع تصريف النفايات..جمع ونقل من قبل شركات مرخص لها.....

رأي رئيس الدائرة
(مع ذكر التاريخ و التوقيع):
.....
.....
.....
.....
.....
.....

في ..عين صالح.. 30 جويلية 2013

إمضـــاء الطالـــب

Vu pour légalisation de la signature apposée
ci-contre
Le.....
Le.....
par le/la
identifié
Montant
suivant
du.....
Arrondissement

Reinhard Josef OSWALD
2330
3 1 JUIL 2013
Ben Cheikh la MONCEF

copie

إلتزام

اني الممضي اسفله السيد Oswald Reinhard Josef

صاحب جواز سفر عدد P5403404 بتاريخ 2011/03/07

العنوان: عمارة Waterside، نهج بحيرة توركانا، ضفاف البحيرة, تونس.

أصرح بانني المسؤول الوحيد عن النتائج التي ستسفر عنها أشغال التنقيب عن المياه الجوفية حسب المطلب الذي قدمته إلى الادارة العامة للموارد المائية بتاريخ: 31 جويلية 2013 و المسلمة إلى دائرة الموارد المائية بالمندوبية الجهوية للتنمية الفلاحية بتطاوين قصد الحصول على رخصة البحث عن المياه الجوفية على عمق يفوق 50 متراً.

بموجب هذا الالتزام لا يمكن باي حال من الأحوال أن اطالب باي تعويضٍ في صورة الحصول على نتائج سلبية لاشغال البحث و التنقيب عن المياه الجوفية.

حرر ب: تونس

في: 30 جويلية 2013

إمضاء معرف به

Reinhard Josef Oswald

JUIL 2013

Copie

Appendix V Request for Ministerial authorization for the Drilling of the Water Well

REPUBLIQUE TUNISIENNE
MINISTERE DE L'AGRICULTURE
DES RESSOURCES EN EAU ET DE LA PÊCHE
CRDA DE TATOUINE
A/RE

0 4 NOV 2010

N ° 1 0.

FAX

A MONSIEUR LE DIRECTEUR GENERAL DE LA SOCIETE OMV Exploration GmbH

Avenue Slimane Ben Slimane – BP 158–
2092 El Manar II – Tunis
FAX: 70168201

OBJET: Demande d'autorisation de création et d'exploitation d'un forage d'eau dans la région de Tiaret.
REFERENCE: Votre fax du 25/10/2010.
P.J.: Demande d'autorisatiion.
Un engagement

Suite à votre fax référencié ci-dessus, j'ai l'honneur de vous informer que la nappe d'eau dans la zone du projet se situe a une profondeur de l'ordre de 300 m, à cet effet nous vous appelons à consulter le CRDA (Arrondissement des Ressources en Eau) pour entamer les procedures de l'acquisition d'une autorisation ministerielle pour la réalisation d'un forage et la recherche des eaux souterraines à une profondeur supérieur à 50m.

Avec nos respects les plus profonds.

Le Directeur Général
Le Commissaire Régional au développement
Agricole de Tataouine
Bahri Khalili

Date	05 NOV 2010		
Number	3191		
GM	✓	FIN	
E&R		BDC	
O&E	✓	HSEQ	
DEV		HR	
TPS		Admin	
Serept		Legal	
f...To		c.....Cc	

Commissariat régional au développement agricole de Tataouine – Adresse: cité 7 Novembre 3263 Tataouine.
Tél.: 75870473 – 75870374 – 75870005 – fax: 75870085 - Email: crda.tataouine@agrinet.tn

Appendix VI Core Drills in the Study Area

Coring boreholes

According to the Norm NF P94 - 116

N° Job : AS 151 -2012

Project :	Geotechnical Survey for Nawara Gathering system and CPF (CPF site)			**coring boreholes N°**	CPF - SC1		
				Date :	08/2012		
Site :	Nawara-jnein south	**Spud Date :**	23/08/2012	**cheked by** :	W. HAMZA		
Client :	OMV	**Date :**	23/08/2012	**water level** :	Néant		
Investigation :	Coring borehole	**coring diameter :**	**Coordinates**	**X**	**Y**	**Z**	
Crew chief :	Nizar	101 mm		601352	3430195	329	

Depth	Thikness (m)	Lithologiy	Symbols	Samples	depthf m/TN	S.P.T. tests N1	S.P.T. tests N 2	S.P.T. tests N1+N2
					0			
		Fractured calcareous crust with witish gypsum .			1	28	R	R
2,00	2,00			EI11 (2,00 - 2,50)	2			
2,50	0,50	Beige to whitish clay tuff			3	33	R	R
		sandy tuff crust with gypsum		EI12 (4,00 - 4,50)	4			
4,50	2,50				5	R	R	R
				EI13 (6,00 - 6,50)	6			
					7	R	R	R
		yellow limestone.			8			
					9	R	R	R
				EI14 (9,50 - 10,00)	10			
					11	R	R	R
					12			
13,00	8,50				13	R	R	R
		yellow limestone altenated with fine intercalations of micro conglomeratic marl .			14			
15,00	2,00				15	34	41	75

Siège Social : Rue Ennasria, Immeuble Essafir - 4éme étage - **Appt. N°40** - 3027 Sfax-TUNISIE
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afric.soil@wanadoo.tn

Coring boreholes

According to the Norm NF P94 - 116

N° Job : AS 151 -2012

Project :	Geotechnical Survey for Nawara Gathering system and CPF (CPF site)				**coring boreholes N°**		CPF - SC2
					Date :		08/2012
Site :	Nawara-jnein south	**Spud Date :**	24/08/2012		**cheked by :**		W. HAMZA
Client :	OMV	**Date :**	24/08/2012		**water level :**		Néant
Investigation :	Coring borehole	**coring diameter :**		**Coordinates**	**X**	**Y**	**Z**
Crew chief :	Nizar	101 mm			601412	3430251	328

Depth	Ethikness (m)	Lithology	Symbole	samples	Depth m/TN	S.P.T.tests N1	N 2	N1+N2
					0			
					1	29	R	R
		Calcareous with tuff and gypsum crust with sandy intercalations beige to reddish.		EI21 (2,00 - 2,50)	2			
					3	R	R	R
				EI22 (3,50 - 4,00)	4			
5.00	5.00				5	25	R	R
5.30	0.30	Sandy crust						
5.70	0.40	Calcareous crust		EI23 (6,00 - 6,50)	6			
					7	R	R	R
					8			
					9	R	R	R
		yellow limestone altenated with fine intercalations of micro conglomeratic marl .		EI24 (9,50 - 10,00)	10			
					11	R	R	R
					12			
					13	R	R	R
					14			
15.00	9.30				15			

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afric.soil@wanadoo.tn

Coring boreholes

According to the Norm NF P94 - 116

N° Job : AS 151 -2012

Project :	Geotechnical Survey for Nawara Gathering system and CPF (CPF site)			**coring boreholes N°**	CPF - SC3		
				Date :	08/2012		
Site :	Nawara-jnein south	**Spud Date :**	26/08/2012	**cheked by :**	W. HAMZA		
Client :	OMV	**Date :**	26/08/2012	**water level :**	Néant		
Investigation :	Coring borehole	**coring diameter :**	**Coordinates**	**X**	**Y**	**Z**	
Crew chief :	Nizar	101 mm		601510	3430298	326	

Depth	thikness (m)	Lithology	Symbols	samples	depth m/TN	S.P.T. test N1	S.P.T. test N 2	S.P.T. test N1+N2
0					0			
				EI31 (1,00 - 1,50)	1			
					2	R	R	R
		sandy tuff with gypsum crust with some calcareous intercalations		EI32 (3,00 - 3,50)	3			
					4	25	R	R
				EI33 (5,00 - 5,50)	5			
6,00	6,00				6	R	R	R
		beige to yellowish sand with gypsum crust						
7,00	1,00			EI34 (7,00 - 7,50)	7			
		.beige to whitish sandy and calcareous crust			8	R	R	R
8,50	1,50				9			
		.Sandy crust with calay and gypsum beige to yellowish			10	R	R	R
11,00	1,50				11			
		Sandy crust with clay locally oxydated beige to greenish			12	R	R	R
13,00	2,00				13			
		yellow limestone altenated with fine intercalations of micro conglomeratic marl .			14	27	33	60
15,00	2,00				15			

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Coring boreholes

According to the Norm NF P94 - 116

N° Job : AS 151 -2012

Project :	Geotechnical Survey for Nawara Gathering system and CPF (CPF site)				**coring boreholes N°**		CPF - SC4
					Date :		08/2012
Site :	Nawara-jnein south	**Spud Date :**	27/08/2012		**cheked by** :		W. HAMZA
Client :	OMV	**Date :**	27/08/2012		**water level** :		Néant
Investigation :	Coring borehole	**coring diameter :**		**Coordinates**	**X**	**Y**	**Z**
Crew chief :	Nizar	101 mm			601351	3430298	326

Depth	thikness (m)	Lithology	Symbols	Samples	depth m/TN	S.P.T. tests N1	S.P.T. tests N 2	S.P.T. tests N1+N2
0					0			
		calcareous tuff with gypsum crust beige to whitish.						
2,00	2,00			EI41 (2,00 - 2,50)	2			
					3	19	22	41
		alternatinon of sandy tuff with gypsum and limestone crust		EI42 (4,00 - 4,50)	4			
					5	22	R	R
6,00	4,00			EI43 (6,00 - 6,50)	6			
					7	R	R	R
				EI44 (7,50 - 8,00)	8			
					9	R	R	R
		yellow limestone altenated with fine intercalations of micro conglomeratic marl .			10			
					11	R	R	R
					12			
					13	R	R	R
14,20	8,20				14			
		beige to greenish oxydated clay with locally marl				23	R	R
15,00	0,80				15			

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afric.soil@wanadoo.tn

Coring boreholes

According to the Norm NF P94 - 116

N° Job : AS 151 -2012

Project :	Geotechnical Survey for Nawara Gathering system and CPF (CPF site)				**coring boreholes N°**		CPF - SC5
					Date :		08/2012
Site :	Nawara-jnein south	**Spud Date :**	29/08/2012		**cheked by** :		W. HAMZA
Client :	OMV	**Date :**	29/08/2012		**water level** :		Néant
Investigation :	Coring borehole	**coring diameter :**		**Coordinates**	**X**	**Y**	**Z**
Crew chief :	Nizar	101 mm			601472	3430374	325

depth	thikness (m)	Lithology	Symbole	sampless	depth m/TN	S.P.T. tests N1	S.P.T. tests N 2	S.P.T. tests N1+N2
0,30	0,30	vegetal terrain						
						18	19	37
						23	R	R
						21	25	46
						24	R	R
						R	R	R
				EI51 (6,00 - 6,50)				
						R	R	R
				EI52 (8,00 - 8,50)				
		fine sand with tuff and gypsum locally calcareous with some alluvial intercalations beige to whitish				23	27	50
						21	23	44
				EI53 (12,00 - 12,50)				
				EI54 (13,50 - 14,00)				
15,00	14,70							

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afric.soil@wanadoo.tn

Coring boreholes

According to the Norm NF P94 - 116

N° Job : AS 151 -2012

Project :	Geotechnical Survey for Nawara Gathering system and CPF (CPF site)			**coring boreholes N°**	CPF - SC6		
				Date :	08/2012		
Site :	Nawara-jnein south	**Spud Date :**	31/08/2012	**cheked by :**	W. HAMZA		
Client :	OMV	**Date :**	31/08/2012	**water level :**	Néant		
Investigation :	Coring borehole	**coring diameter :**	**Coordinates**	**X**	**Y**	**Z**	
Crew chief :	Nizar	101 mm		611420	3430374	325	

Depth	Thikness (m)	Lithology	Symbole	samples	depth m/TN	S.P.T. tests N1	S.P.T. tests N 2	S.P.T. tests N1+N2
0,30	0,30	reddish dune and silicious sand						
						17	15	32
						15	25	40
						28	R	R
						R	R	R
						22	23	25
				EI61 (6,00 - 6,50)				
						24	26	40
				EI62 (8,00 - 8,50)				
		beige to whitish fine sand with tuff ,gravel and gypsum locally calcareous				R	R	R
						20	21	41
				EI63 (12,50 - 13,00)				
						R	R	R
				EI64 (14,50 - 15,00)				
15,00	14,70							

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afric.soil@wanadoo.tn

Coring boreholes

According to the Norm NF P94 - 116

N° Job : AS 151 -2012

Project :	Geotechnical Survey for Nawara Gathering system and CPF (CPF site)			**coring boreholes N°**	CPF - SC7		
				Date :	09/2012		
Site :	Nawara-jnein south	**Spud Date :**	08/09/2012	**cheked by :**	W. HAMZA		
Client :	OMV	**Date :**	08/09/2012	**water level :**	Néant		
Investigation :	Coring borehole	**coring diameter :**	**Coordinates**	**X**	**Y**	**Z**	
Crew chief :	Nizar	101 mm		601350	3430348	325	

Depth	Thikness (m)	Lithology	Symbols	samples	depth m/TN	S.P.T. tests N1	S.P.T. tests N 2	S.P.T. tests N1+N2
0					0			
		reddish dune sand silicious and locally rocky						
1					1	11	10	21
1,30	1,30							
2				EI71 (2,00 - 2,50)	2			
3		beige to whitish fracturated tuff with limestone locally gravel .			3	42	R	R
4					4			
5					5	R	R	R
5,50	4,20			EI72 (5,50 - 6,00)				
6					6			
7					7	R	R	R
8					8			
9		beige to whitish fracturated tuff with limestone crust locally alluvial.			9	R	R	R
10				EI73 (10,00 - 10,50)	10			
11					11	R	R	R
12				EI74 (12,00 - 12,50)	12			
13					13			
14					14	R	R	R
15					15			
15,00	9,50							

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afric.soil@wanadoo.tn

Coring boreholes

According to the Norm NF P94 - 116

N° Job : AS 151 -2012

Project :	Geotechnical Survey for Nawara Gathering system and CPF (CPF site)				**coring boreholes N°**		CPF - SC8
					Date :		09/2012
Site :	Nawara-jnein south	**Spud Date :**	09/09/2012		**cheked by :**		W. HAMZA
Client :	OMV	**Date :**	09/09/2012		**water level :**		Néant
Investigation :	Coring borehole	**coring diameter :**		**Coordinates**	**X**	**Y**	**Z**
Crew chief :	Nizar	101 mm			601235	3430425	326

Depth	Thikness (m)	Lithology	Symbols	Samples	depth m/TN	S.P.T. tests N1	N 2	N1+N2
0					0			
1		tuff lightly sandy beige to reddish			1			
2					2	23	25	48
3.00	3.00			EI81 (2,50 - 3,00)	3			
		beige to whitish tuff with sand locally alluvial.			4	35	R	R
5.00	2.00			EI82 (5,00 - 5,50)	5			
					6	R	R	R
					7			
					8	25	R	R
		beige to whitish tuff with sand locally calcareous with gypsum lightly gravel.			9			
				EI83 (9,50 - 10,00)	10	31	R	R
				EI84 (11,00 - 11,50)	11			
					12	R	R	R
					13			
					14	R	R	R
15.00	10.00				15			

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afric.soil@wanadoo.tn

Coring boreholes

According to the Norm NF P94 - 116

N° Job : AS 151 -2012

Project :	Geotechnical Survey for Nawara Gathering system and CPF (CPF site)			**coring boreholes N°**	CPF - SC9		
				Date :	09/2012		
Site :	Nawara-jnein south	**Spud Date :**	10/09/2012	**cheked by** :	W. HAMZA		
Client :	OMV	**Date :**	10/09/2012	**water level** :	Néant		
Investigation :	Coring borehole	**coring diameter :**	**Coordinates**	**X**	**Y**	**Z**	
Crew chief :	Nizar	101 mm		601383	3430513	327	

Depth	thikness (m)	Lithology	Symbols	Samples	depth m/TN	S.P.T. tests N1	S.P.T. tests N 2	S.P.T. tests N1+N2
0,30	0,30	. reddish dune siliceous sand.						
						18	22	40
						21	23	44
		. beige to whitish fine sand with tuff and gypsum locally alluvial.		EI91 (2,50 - 3,00)				
						28	R	R
4,80	4,50					R	R	R
		. beige to whitish fracturated calcareous with tuff with gypsum crust		EI92 (5,50 - 6,00)				
6,00	1,20					25	27	52
		beige to whitih fine sand with tuff and gypsum and gravel locally calcareous with some alluvial intercalations.		EI93 (8,50 - 9,00)				
						R	R	R
				EI94 (11,50 - 12,00)				
						R	R	R
						R	R	R
15,00	9,00							

Siège Social : Rue Ennasria, Immeuble Essafir - 4éme étage - **Appt. N°40** - 3027 Sfax-TUNISIE
Adresse Postale : B.P 35 - 3052 Sfax - TUNISIE / **Tél.** : + 216 74 403 139 - **Fax** : + 216 74 406 331
afric.soil@wanadoo.tn

Coring boreholes

According to the Norm NF P94 - 116

N° Job : AS 151 -2012

Project :	Geotechnical Survey for Nawara Gathering system and CPF (CPF site)				**coring boreholes N°**		CPF - SC10
					Date :		09/2012
Site :	Nawara-jnein south	**Spud Date :**	12/09/2012		**cheked by :**		W. HAMZA
Client :	OMV	**Date :**	12/09/2012		**water level :**		Néant
Investigation :	Coring borehole	**coring diameter :**		**Coordinates**	**X**	**Y**	**Z**
Crew chief :	Nizar	101 mm			601135	3430637	328

Depth	Thikness (m)	Lithology	Symbols	samples	depth m/TN	S.P.T. tests N1	S.P.T. tests N 2	S.P.T. tests N1+N2
0					0			
		reddish siliceous dune sand			1	15	17	32
2,00	2,00			EI101 (2,00 - 2,50)	2			
		. beige to whitish fine sand with tuff and gypsum locally alluvial.			3	18	22	40
3,50	1,50				4			
		beige to reddish tuff with clay and gravel			5	23	21	44
6,00	2,50			EI102 (5,50 - 6,00)	6			
					7	28	25	53
					8			
		beige to whitish fine sand with tuff and gypsum and gravel locally calcareous with some alluvial intercalations			9	25	R	R
				EI103 (10,00 - 10,50)	10			
					11			
					12	R	R	R
				EI104 (13,00 - 13,50)	13			
					14			
					15	R	R	R
15,00	9,00							

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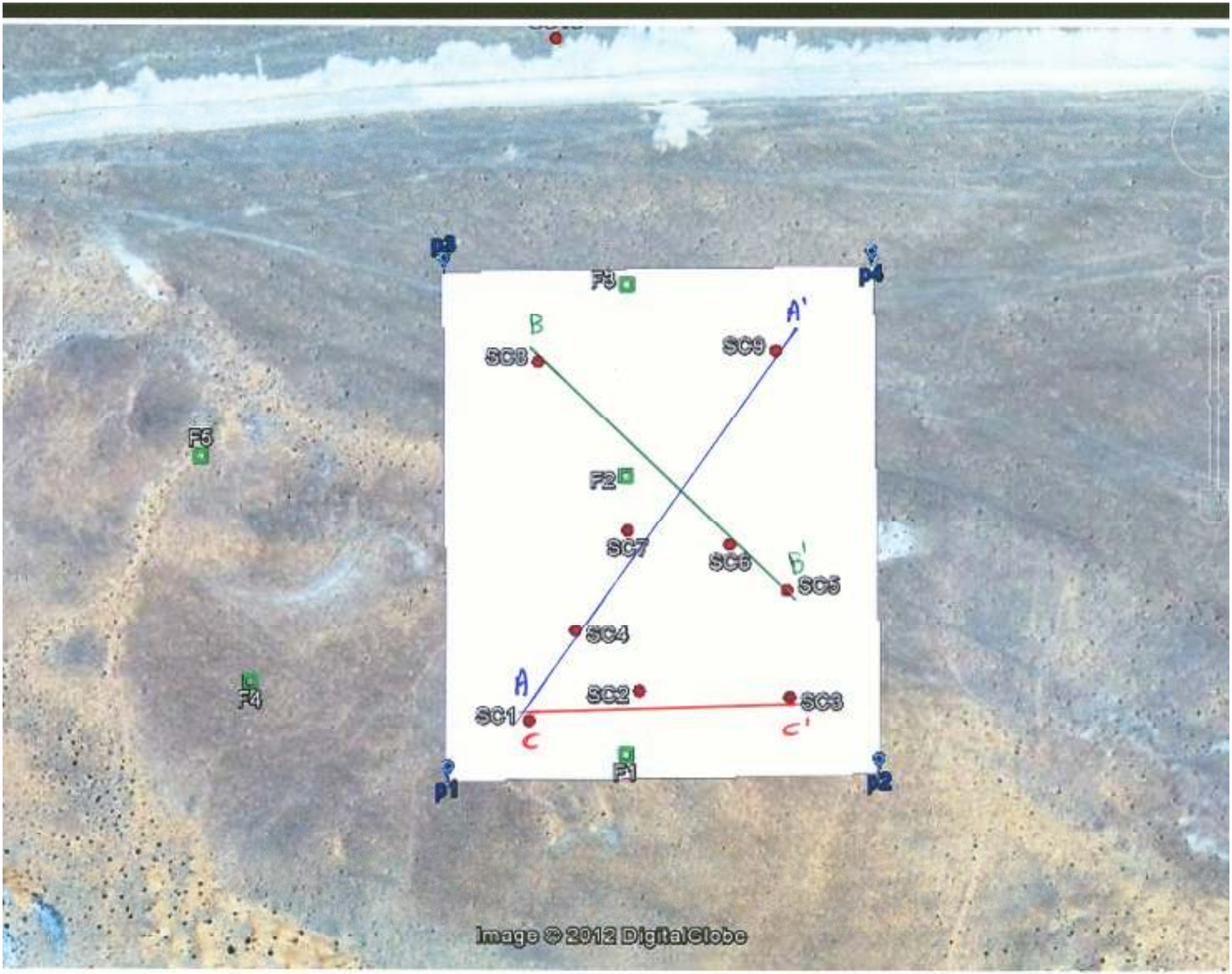
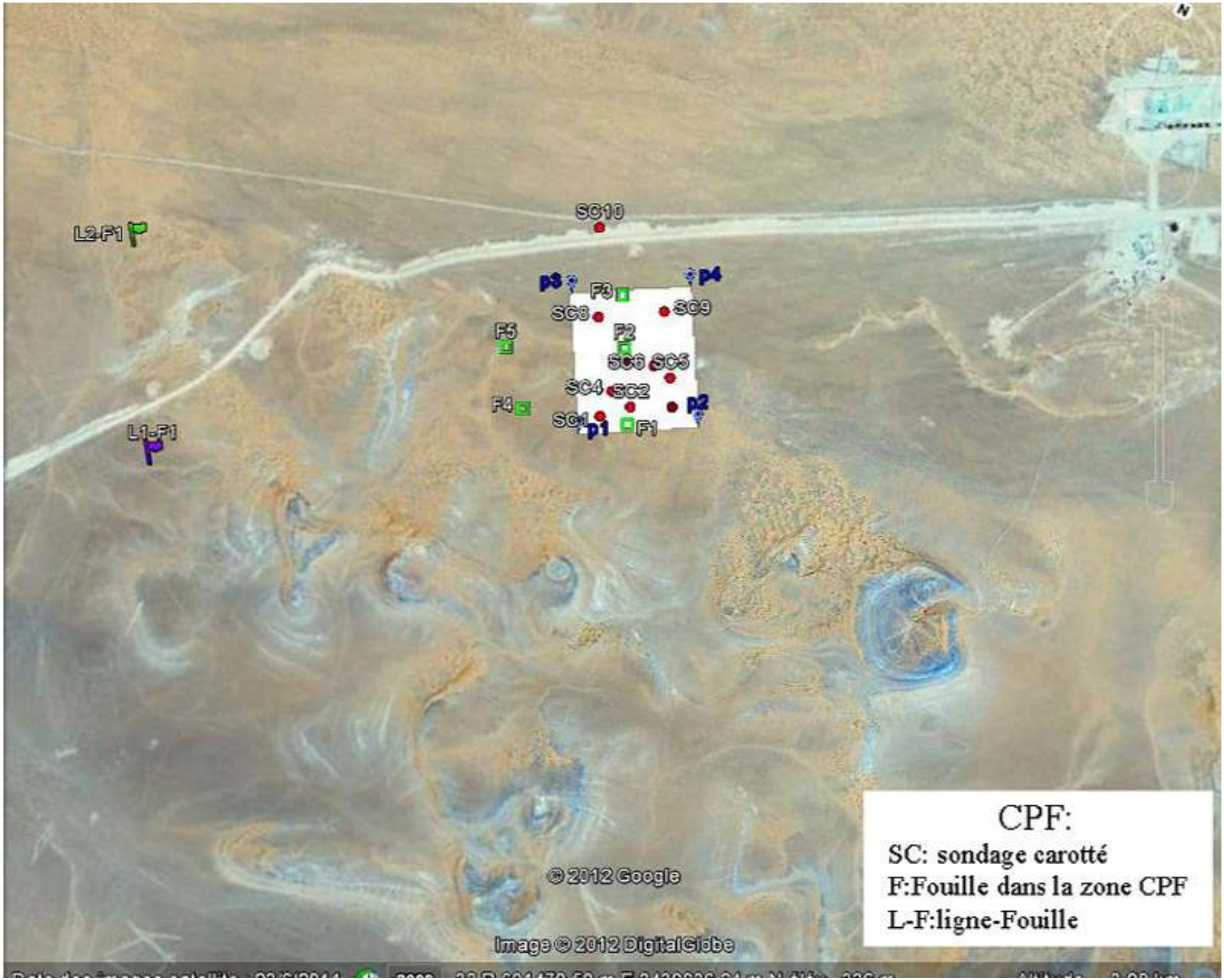
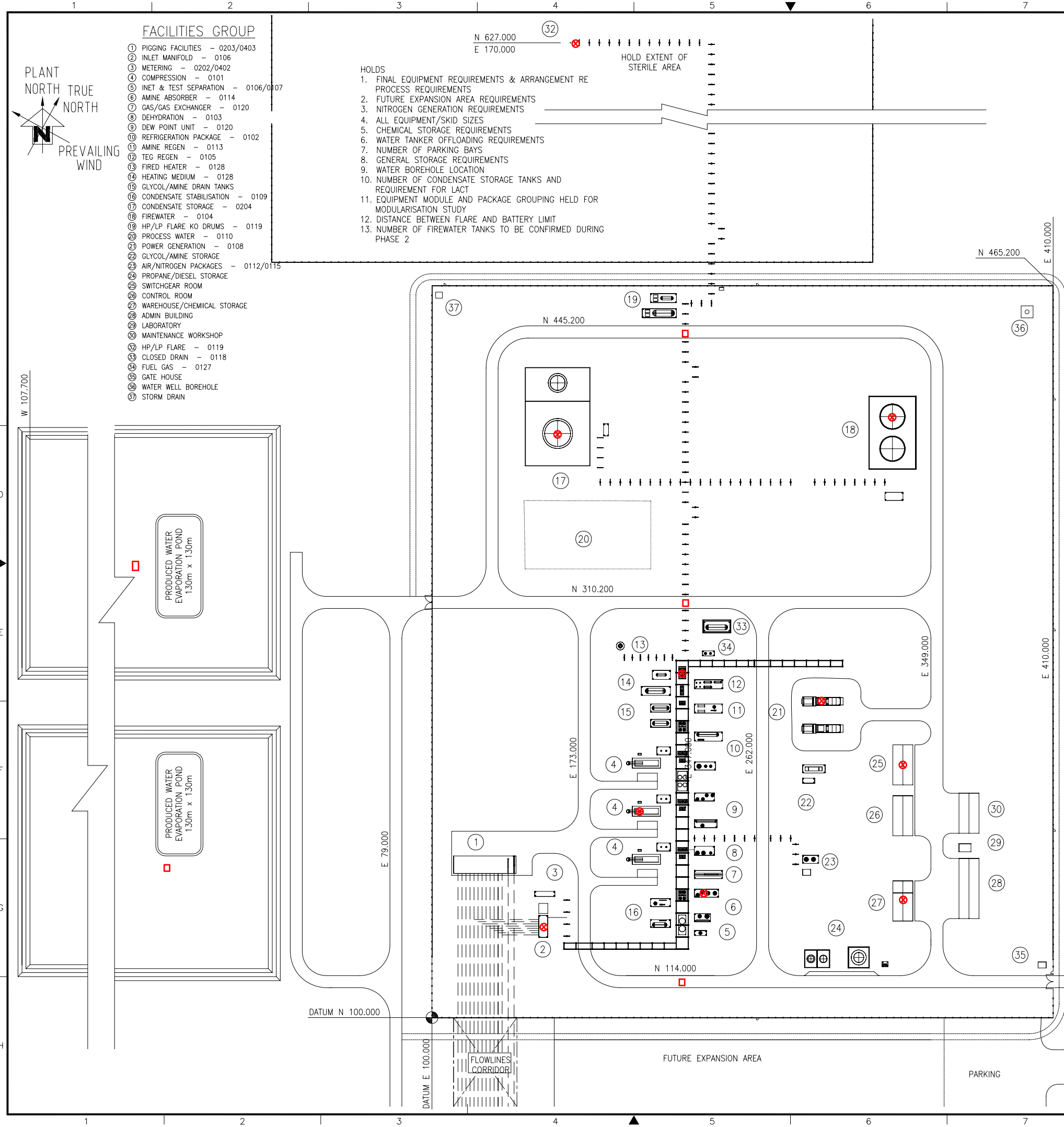

P3
P4
P5
P1
P2
F3
F5
F2
F4
F1
A'
B
SC8
SC9
SC7
SC6
B'
SC5
SC4
A
SC2
SC3
SC1
C
C'
Image © 2012 DigitalGlobe


L2-F1
SC10
P3
P4
F3
SC8
SC9
F5
F2
SC6
SC5
SC4
SC2
F4
P2
SC1
P1
F1
L1-F1
© 2012 Google
Image © 2012 DigitalGlobe
CPF:
SC: sondage carotté
F:Fouille dans la zone CPF
L-F:ligne-Fouille



LEGEND – (SEE DRG.No. NA-PEL-CPF-0000-ME-DRW-0001 FOR EQUIPMENT LOCATION)

INLET MANIFOLD UNIT – 0106		WATER TREATMENT UNIT – 0110	
0106-XX-0100	INLET MANIFOLD – HP & TEST HEADER	0110-V-2002	PRODUCED WATER FLASH DRUM
0106-XX-0376	INLET MANIFOLD MP & LP HEADER	0110-P-2003A/B	PRODUCED WATER FEED PUMPS
0106-V-1001	TEST SEPARATOR	0110-XX-057	EVAPORATION POND
INLET SEPARATOR UNIT – 0107		0110-X-2006	PRODUCED WATER TREATMENT PACKAGE
0107-V-1101	INLET SEPARATOR	CONDENSATE STABILISATION UNIT – 0109	
AMINE ABSORBER UNIT – 0114		0109-E-1201	PRE-HEATER
0114-V-1401	AMINE ABSORBER K.O. DRUM	0109-V-1202	WATER/CONDENSATE SEPARATOR
0114-C-1403	AMINE ABSORBER COLUMN	0109-C-1204	CONDENSATE STABILISATION COLUMN
0114-F-1402	MERCURY REMOVAL KIT	0109-E-1205	CONDENSATE REBOILER
0114-F-1408	AMINE ABSORBER FILTER COALESCER	0109-E-1206	CONDENSATE/CONDENSATE HEAT EXCH'R
0114-E-1409	SWEET GAS COOLER	0109-P-1213A/B	OFF-SPEC CONDENSATE RECYCLE PUMPS
AMINE REGENERATION UNIT – 0113		0109-E-1202	START-UP HEATER
0113-XX-013	AMINE REGEN FLASH DRUM	CONDENSATE STORAGE – 0204	
0113-XX-014	AMINE REGEN LEAN/RICH EXCHANGER	0204-T-1208/09	CONDENSATE STORAGE TANKS
0113-XX-015	AMINE REGEN STRIPPER COLUMN	0204-E-1207	CONDENSATE RUN DOWN COOLER
0113-XX-016	AMINE REGEN CONDENSER	EXPORT PUMPS – 0201	
0113-XX-017	AMINE REGEN CONDENSATE DRUM	0201-P-1211A/B	CONDENSATE EXPORT PUMPS
0113-XX-018A/B	AMINE REGEN REFLUX PUMPS	0201-P-1211C	CONDENSATE EXPORT PUMP (FUTURE)
0113-XX-020A/B	AMINE REGEN LEAN SOLUTION BOOSTER PUMPS	CONDENSATE METERING – 0202	
0113-XX-021	AMINE REGN LEAN SOLUTION COOLERS	0202-J-1212	CONDENSATE METERING PACKAGE
0113-XX-022A/B	MECHANICAL FILTERS	CONDENSATE PIPELINE – 0203	
0113-XX-023A/B	CARBON FILTERS	0203-SP-1701	EXPORT CONDENSATE PIG LAUNCHER
0113-XX-024A/B	MECHANICAL FILTERS	HP/LP FLARE UNIT – 0119	
0113-XX-026A/B	AMINE REGEN LEAN SOLUTION PUMPS	0119-XX-059	HP FLARE KO DRUM
0113-XX-027	ANTIFOAM TANK	0119-XX-060A/B	HP FLARE KO DRUM PUMP
0113-XX-028	AMINE REGEN REBOILER	0119-XX-061	HP FLARE STACK/TIP
AMINE STORAGE – 0123		0119-XX-062	IGNITION PACKAGE
0123-XX-029	AMINE STORAGE TANK	0119-XX-063	LP FLARE KO DRUM
0123-XX-030	AMINE STORAGE TANK MIXER	0119-XX-064A/B	LP FLARE KO DRUM PUMP
0123-XX-031A-D	AMINE TRANSFER PUMPS	0119-XX-065	LP FLARE STACK/TIP
0123-XX-032	AMINE DRAIN VESSEL	0119-XX-067	CO2 VENT STACK
0123-XX-033	AMINE DRAIN VESSEL HEATER	HEATING MEDIUM SYSTEM – 0128	
0123-XX-034A/B	AMINE DRAIN PUMPS	0128-XX-068	HEATING MEDIUM FIRED HEATER
DEHYDRATION UNIT – 0103		0128-XX-069A/B/C	HEATING MEDIUM CIRCULATION PUMP
0103-F-1410	TEG CONTACTOR FILTER COALESCER	0128-XX-070	HEATING MEDIUM EXPANSION DRUM
0103-D-1406	TEG CONTACTOR	0128-XX-071	HEATING MEDIUM SUMP PUMP
0114-E-1411	EXPORT GAS/SWEET GAS HEAT EXCHANGER	0128-XX-072	HEATING MEDIUM DRAIN SUMP
0114-V-1405	SWEET GAS KO DRUM	0128-XX-073	HEATING MEDIUM DUMP COOLER
TEG REGENERATION UNIT – 0105		COOLING SYSTEM – 0102	
0105-XX-035	LEAN GLYCOL AIR COOLER	0102-XX-0122	REFRIGERANT RECEIVER DRUM
0105-XX-036	GLYCOL REGEN CONDENSER	0102-XX-0123	1ST STAGE SUCTION DRUM
0105-XX-038	GLYCOL/GLYCOL HEAT EXCHANGER	0102-XX-0125	CONDENSER (AIR COOLER)
0105-XX-03039A/B	GLYCOL PARTICLE FILTER	0102-XX-0126	1ST STAGE COMPRESSOR
0105-XX-040	GLYCOL CHARCOAL FILTER	0102-XX-0127	2ND STAGE COMPRESSOR
0105-XX-041A/B	LEAN GLYCOL PUMP	POWER GENERATION UNIT – 0108	
0105-XX-042	REGENERATION COLUMN	0108-XX-074	GAS TURBINE GENERATOR
0105-XX-043	GLYCOL FLASH DRUM	0108-XX-076	GAS TURBINE GENERATOR
0105-XX-044	GLYCOL SURGE DRUM	0108-XX-079	EMERGENCY DIESEL GENERATOR
0105-XX-047	GLYCOL REBOILER	0108-XX-080	DIESEL FILTER/COALESCER
GLYCOL STORAGE – 0126		0108-XX-081	DIESEL STORAGE TANK
0126-XX-051	GLYCOL DRAINS VESSEL	0108-XX-082	DIESEL TRANSFER PUMP
0126-XX-052A/B	GLYCOL DRAINS PUMP	CLOSED/OPEN DRAINS SYSTEM – 0118	
0126-XX-053	GLYCOL STORAGE TANK	0118-XX-083	CLOSED DRAIN TRANSFER PUMP
0126-XX-054A/B	GLYCOL TRANSFER PUMPS	0118-XX-084	CLOSED DRAINS VESSEL
0126-XX-120	GLYCOL STORAGE TANK HEATER	INSTRUMENT AIR UNIT – 0115	
DEW POINT UNIT – 0120		0115-XX-085	AIR COMPRESSOR
0120-E-1501	EXPORT GAS/DRY GAS HEAT EXCHANGER	0115-XX-086	PLANT AIR RECEIVER
0120-E-1502	DRY GAS CHILLER	0115-XX-087	AIR DRIER PACKAGE
0120-V-1503	COLD SEPARATOR	0115-XX-088	INSTRUMENT AIR RECEIVER
OFF-GAS COMPRESSOR UNIT – 0101		FIREWATER UNIT – 0104	
0101-V-1301A/B/C	1ST STAGE OFF-GAS COMP SUCTION SCRUBBER	0104-XX-089	FIREWATER STORAGE TANK
0101-K-1302A/B/C	1ST STAGE OFF-GAS COMP	0104-XX-090	FIREWATER STORAGE TANK
0101-E-1306A/B/C	1ST STAGE OFF-GAS COMP DISCH COOLER	0104-XX-091	FIREWATER JOCKEY PUMP
0101-V-1307A/B/C	2ND STAGE OFF-GAS COMP SUCT SCRUBBER	0104-XX-092	DIESEL FIREWATER PUMP PACKAGE
0101-K-1308A/B/C	2ND STAGE OFF-GAS COMP	0104-XX-093	ELECTRIC FIREWATER PUMP PACKAGE
0101-E-1309A/B/C	2ND STAGE OFF-GAS COMP DISCH COOLER	FUEL GAS UNIT – 0127	
0101-P-1303A-D	CONDENSATE RECYCLE PUMPS	0127-XX-095	FUEL GAS HEATER
EXPORT GAS METERING UNIT – 0402		0127-XX-096	HP FUEL GAS KO DRUM
0402-J-1504	EXPORT GAS FISCAL METERING PACKAGE	0127-XX-097	FUEL GAS FILTER/SEPARATOR
GAS PIPELINE – 0403		0127-XX-098	LP FUEL GAS KO DRUM
0403-SP-1801	EXPORT GAS PIG LAUNCHER	NITROGEN UNIT – 0122	
AQUIFER, FRESH WATER, POTABLE & DEMINERALISED WATER – 0117		0122-XX-620	NITROGEN GENERATOR PACKAGE
INCLUDES:–	AQUIFER FILTERS, AQUIFER STORAGE TANK, AQUIFER WATER PUMPS,CHLORINATION UNIT, PW STORAGE TANK,PW PUMPS, PW RO TREATMENT PACKAGE, STERILISATION UNIT, CHEMICAL DOSING, DEMIN WATER POLISHING, DEMIN WATER PUMPS, DRINKING WATER TREATMENT, SEWAGE PUMPS & WASTE WATER TREATMENT PACKAGES	0122-XX-630	NITROGEN RECEIVER
		CHEMICAL (PROCESS) – 0121	
		0121-XX-117	CHEMICAL INJECTION PACKAGE
		0121-XX-118	CHEMICAL INJECTION PACKAGE

NOTES
1. SEE DRG. No.NA-PEL-CPF-0000-ME-DRW-0001 FOR PROCESS AREA EQUIPMENT NUMBERING
2. THIS PLOT PLAN IS PRELIMINARY AND PRODUCED FOR COST ESTIMATION PURPOSES. TO BE FURTHER DEVELOPED DURING PHASE 2.

10 0 20 40 60 80 100 METRES
1:1250 SCALE BAR

REV	DESCRIPTION	ORIG	DRWN	CK'D	APP'D	DATE
001	ISSUED FOR INFORMATION	MF	MF	DAH	DAH	27.04.2012
000	ISSUED FOR REVIEW	MF	MF	DAH	DAH	23.03.2012
A01	ISSUED FOR IDC	MF	MF	DAH	DAH	30.02.2012

LEGEND
- Trial Pit
- BoreHole

CPF boreHole and Pit location

Petrofac

PETROFAC JOB NO. : JU09570A
ORIGINAL DWG SIZE : A1
SCALE : 1:1250

OVERALL PLOT PLAN CPF SITE AT NAWARA

CLIENT: OMV (TUNESIEN) PRODUCTION GMBH
ELECTRONIC FILE : NA-PEL-CPF-0000-ME-DRW-0002 REV 001.dwg
DWG.NA-PEL-CPF-0000-ME-DRW-0002 SH.1 of 1 REV001

S:\Projects\JU09570A OMV Nawara FEED\6.0 ENGINEERING\6.7 Cad\Layout\NA-PEL-CPF-0000-ME-DRW-0002 REV 001.dwg

Appendix VII Request for the authorization of the National Institute of Heritage

Move & More. OMV

Int. CC: GM, HSSE, LEG

Ni.Fr_20131104_Letter2225

OMV Exploration & Production

Reinhard Josef Oswald
General Manager

Reinhard.Oswald@omv.com
71 162 000
71 162 555

OMV (Tunesien) Production GmbH

Immeuble Waterside
Impasse du Lac Turkana
Les Berges du lac, 1053, Tunis

Registered Office:

Trabrennstrasse 6-8 1020 Vienna Austria
Registration:

MF: 504991/A
RC: B156351997

www.omv.com

تونس في 4 نوفمبر 2013

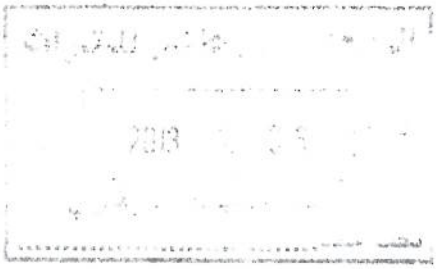
من المدير العام لشركة OMV (تونس)

إلى السيد المدير العام للمعهد الوطني للتراث
4 ساحة القصر 1008 تونس

الموضوع: حول التراث الثقافي والأثري لحقل **نوارة** بأقصى الجنوب التونسي.

سيدي،

في إطار مشروع تطوير حقل **نوارة** لإنتاج النفط و الغاز بالجنوب التونسي بالتعاون مع الشركة التونسية للأنشطة البترولية ETAP قامت EAM بإعداد الدراسة الأولية للتاثير البيئي لهذا المشروع لفائدة شركة OMV و قد تضمنت هذه الدراسة ملفاً حول التراث الثقافي و الأثري (تجدون تقريرا في الغرض صحبة هذا).



لذا نرجو من سيادتكم عدم الاعتراض على إنجاز هذا المشروع و مدنا إن أمكن بمكتوب في هذا الغرض.

و السلام.

899943

المدير العام لشركة OMV (تونس)

Appendix VIII Analysis Certificate of Groundwater Sample

greenLab
Laboratoire d'analyses environnementales, agricoles et industrielles

50, rue de l'artisanat 2035, Charguia 2, Tunis
Tél. : +216 71 942 518 - 71 942 528, Fax : +216 71 942 604
E-mail: contact@greenlab.com.tn, Site web: http://www.greenlab.com.tn

RAPPORT D'ESSAIS

Identification : 01/1116/0613

Date de réception : 25/06/13

Green Lab 50, Rue de l'Artisanat Charguia II, 2035 TUNIS

1- DEMANDEUR

OMV South Tunisia Ltd
Imm Waterside, Impasse Turkana
Les Berges du Lac 1053, Tunis
Tél. : +216 71 162 000
Fax : +216 71 162 555

2- DESCRIPTION DE(s) L'OBJET(s) SOUMIS A L'ESSAI

- Deux échantillons d'eau de forage :

- Echantillon n°1 : Eau de forage : Acose well
- Echantillon n°2 : Eau de forage : Waha well

- Un échantillon d'eau de forage pétrolier : : After filter

3- ESSAI(s) DEMANDE(s)

pH, Résidu Sec, Chlorures, Cuivre, Fer, Manganèse, Zinc, Arsenic, Cadmium, Plomb, Sélénium, Antimoine, Argent, Aluminium, Bore, Etain, Chrome, Molybdène, Cobalt, Baryum, Béryllium, Nickel, Titane, Mercure, Indice des hydrocarbures.

4- METHODE(S) D'ANALYSE(s)

Essai (s)	Méthode (s)	Référence (s)
pH	Electrochimie	NF T 90-008 (2001)
Résidu Sec	Gravimétrie	NF EN 90-029 (2002)
Chlorures	Titrimétrie	NF ISO 9297 (2000)
Cuivre, Fer, Manganèse, Zinc, Arsenic, Cadmium, Plomb, Sélénium, Antimoine, Argent, Aluminium, Bore, Etain, Chrome, Molybdène, Cobalt, Baryum, Béryllium, Nickel, Titane	Digestion avec l'eau régale	NT ISO 15587-1 (2009)
	Spectrométrie d'émission atomique ICP	NT ISO 11885 (2007)
Mercure	Spectrométrie d'émission atomique ICP avec système d'hydrures	PERKIN ELMER (2008)
Indice des hydrocarbures	- Extraction Liquide/ Liquide au solvant - Chromatographie en Phase Gazeuse	NF EN ISO 9377-2 (2000)

Green Lab 50, Rue de l'Artisanat Charguia II, 2035 TUNIS

greenLab
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RAPPORT D'ESSAIS

Identification : 01/1116/0613

Date de réception : 25/06/13

5- RESULTAT(s)

Essai (s)	Unité	Date d'exécution	OMV Eau de forage		Limites admissibles de la norme NT 106.02	
			Acose well	Waha well	Canalisation publique	DPH [1]
pH	-	25/06/13	7,70 à 24,0°C	7,05 à 23,8°C	6,5 à 9	6,5 à 8,5
Résidu Sec	g/L	26/06/13	4,61	6,61	-	
Chlorures	g/L	29/06/13	1,94	2,68	700	600
Indice des hydrocarbures	mg/L	27/06/13	0,15	0,13	10	2
Aluminium	mg/L	02/07/13	0,282	0,230	10	5
Cadmium	mg/L		<0,0027	<0,0027	0,1	0,005
Cobalt	mg/L		<0,0070	<0,0070	0,5	0,1
Cuivre	mg/L		<0,0097	<0,0097	1	0,5
Fer	mg/L		0,281	4,45	5	1
Plomb	mg/L		<0,010	<0,010	1	0,1
Manganèse	mg/L		0,049	0,218	1	0,5
Nickel	mg/L		<0,010	0,422	2	0,2
Zinc	mg/L		<0,0059	4,16	5	5
Chrome total	mg/L		<0,0071	<0,0071	CrVI : 0,5 CrIII : 2	CrVI : 0,01 CrIII : 0,5
Etain	mg/L		0,071	<0,025	2	2
Arsenic	mg/L	12/07/13	< 0,0071	< 0,0071	0,1	0,05
Sélénium	mg/L	12/07/13	<0,025	<0,025	1	0,05
Bore	mg/L	08/07/13	0,764	0,866	2	2
Molybdène	mg/L	12/07/13	< 0,0079	< 0,0079	5	0,05
Baryum	mg/L	08/07/13	<0,040	<0,040	10	0,5
Argent	mg/L	02/07/13	<0,0070	<0,0070	0,1	0,05
Béryllium	mg/L	12/07/12	< 0,0007	< 0,0007	0,05	0,01
Antimoine	mg/L	02/07/13	0,048	<0,025	0,2	0,1
Titane	mg/L	08/07/13	0,009	0,004	0,01	0,001
Mercure	µg/L	01/07/13	0,316	0,741	10	1

Green Lab 50, Rue de l'Artisanat Charguia II, 2035 TUNIS