REPORT

Liwa Plastics Industries Complex (LPIC): Environmental and Social Impact Assessment

Non-Technical Summary

Client: Oman Oil Refineries and Petroleum Industries Co., ORPIC

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<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIA</td>
<td>Cumulative Impact Assessment</td>
</tr>
<tr>
<td>Orpic</td>
<td>Oman Oil Refineries and Petroleum Industries Company</td>
</tr>
<tr>
<td>EIA</td>
<td>Environmental Impact Assessment</td>
</tr>
<tr>
<td>NGL</td>
<td>Natural Gas Liquids</td>
</tr>
<tr>
<td>LPIC</td>
<td>Liwa Plastics Industries Complex</td>
</tr>
<tr>
<td>SIPA</td>
<td>Sohar Industrial Port Area</td>
</tr>
<tr>
<td>ECA</td>
<td>Export Credit Agencies</td>
</tr>
<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
</tr>
<tr>
<td>IFC</td>
<td>International Finance Corporation</td>
</tr>
<tr>
<td>ESIA</td>
<td>Environmental and Social Impact Assessment</td>
</tr>
<tr>
<td>EHS</td>
<td>Environment, Health and Safety</td>
</tr>
<tr>
<td>DGEA</td>
<td>Directorate General of Environmental Affairs</td>
</tr>
<tr>
<td>MECA</td>
<td>Ministry of Environment and Climate Affairs</td>
</tr>
<tr>
<td>NTS</td>
<td>Non-Technical Summary</td>
</tr>
</tbody>
</table>
1 Introduction

1.1 Overview of the Project

1.1.1 Oman Oil Refineries and Petroleum Industries Company

Oman Oil Refineries and Petroleum Industries Company (Orpic) is one of Oman’s largest industrial companies and a rapidly growing business in the Middle East’s oil industry. Orpic currently operates oil refineries (the Mina Al Fahal, Muscat and Sohar), an aromatics plant and a polypropylene plant at its complex located within the Port of Sohar, Oman. Orpic is committed to operating safely and reliably, while paying due care to the environment and the communities within which it operates.

1.1.2 The Liwa Plastics Industries Complex (LPIC)

The Liwa Plastics Industries Complex (LPIC) is a new project (hereafter referred to as the ‘Project’) by Orpic and is currently subject to lenders’ due diligence/review procedures. The LPIC Project comprises a steam cracker facility (a facility in which feedstocks are thermally cracked through the use of steam to produce lighter fuels). The facility will process light ends produced in Orpic’s Sohar Refinery and its Aromatics plant, as well as optimise Natural Gas Liquids (NGL) extracted from currently available natural gas supplies. The NGL will be extracted from a plant at Fahud and transported via a pipeline to a Petrochemical Complex (PC) at Sohar. The overall project location is illustrated in Figure 1-1.

Figure 1-1: Overview of LPIC Project
Further details of the project are provided in Section Error! Reference source not found..

1.2 Purpose of the Non-Technical Summary

In 2015, Opric completed an Environmental and Social Impact Assessment (ESIA) to assess the potential impacts of the Project and to develop appropriate management plans for the mitigation of potential adverse impacts.

The LPIC Project has been subject to the provision of additional environmental and social information to meet international standards. This is part of the requirement to satisfy lenders to the Project as part of the loan agreement.

The current status of the ESIA is summarised below in Section 1.3.

This Non-Technical Summary (NTS) provides an overview, in layman's terms, of the main findings of the ESIA process to date. It is important to note that this NTS does not, and is not intended to, convey all of the information relating to the Project and its potential social and environmental effects. Its intention is to convey key findings and conclusions, enabling the reader to understand the significant environmental and social effects of the proposed development from a standalone document, without needing to refer to the detailed assessments.

By necessity, the text provided herein is a summary of the detailed assessments discussed in the supporting documentation. Therefore, for fully detailed information pertaining to any part of this NTS, please refer to the references provided in Section 8.

The Project’s Environmental and Social Action Plan (Nexant, 2016a - Appendix A Error! Reference source not found.) requires that the NT, and other supporting documentation, is publically disclosed on Orpic’s website and copies made available in appropriate languages on request and at publically accessible locations. An electronic copy of this NTS can be downloaded at the following location:

http://www.orpic.om/media-center/publications

1.3 Status of the Project

The information presented in this NTS is current at March 2016 and is based on project documentation available at the time of writing. The ESIA and supplementary information is largely complete, however, the process on a complex project like this is evolutionary as practical information is sought from appointed contractors. There are a number of additional (i.e. repeat) sampling campaigns within surveys and assessments, ongoing, for instance along the pipeline route and at the NGLE Plant location at Fahud. The resulting information can be included in updated versions of ESIA related documentation.

An Environmental Impact Assessment (EIA) was completed in 2015 by HMR Environmental Engineering Consultants (HMR) for each of the LPIC project components: the NGL Extraction (Fahud), the PP (Sohar) and the NGL Pipeline (Fahud to Sohar) (HMR 2015a, 2015b and 2015c respectively). The preliminary EIA studies were completed to meet compliance criteria set by the Ministry of Environment and Climate Affairs (MECA) and Omani regulations. HMR also completed a preliminary Social Impact Assessment (SIA) and a Stakeholder Engagement Plan (SEP) in 2015. MECA granted permission for the project to go ahead subject to a number of conditions.
In 2015, Nexant, the Lender’s independent environmental & social consultant was appointed to prepare detailed environmental and social due diligence (E&S DD) assessments for potential lenders to the Project. Nexant identified that the Environmental, Health, Safety and Social (EHS&S) aspects of the project did not meet the requirements of latest international standards (as described in Section Error! Reference source not found.). Nexant identified a number of gaps in the EIA and SIA process, and detailed a programme of work to address these shortfalls. These actions are detailed further in an Environmental and Social Action Plan (ESAP).

In December 2015, international consulting group Royal HaskoningDHV was appointed by Orpic to provide support and assist HRM in addressing the first tier of critical gaps identified in the previous work. A number of updated documents (e.g. Scopes of Work for enhanced environmental baseline surveys, Cumulative Impact Assessment Scoping Report) were prepared for Orpic in January 2016. These documents informed an updated E&S DD assessment (Nexant [January] 2016b). In addition to this, Nexant prepared the ESAP defining the requirement, deliverables and programme for ongoing actions required to meet international standards.

Nexant’s 2016 E&S DD report stated that the Project is “now compliant with international standards given the stage in the development of the works. Full compliance can be achieved through completing the ESAP items in the timescales stated”.

2 Project Description

2.1 Need for the Project

Consumers demand for high and low density polyethylene is increasing worldwide, particularly within Asia, where the product represents an important polymer in the manufacture of various plastic products for both domestic and industrial uses.

The LPIC Project, Orpic’s latest expansion, forms part of the Sultanate’s programme to reduce overall reliance upon the export of natural gas and crude oil, and instead further develop Oman’s downstream industry. The Project offers the country an opportunity to employ globally-recognised state-of-the-art petrochemical technology, foster operational expertise, and deliver strong marketing proficiency. Overall, this reflects the continuing efforts by the Government of Oman to develop both locally and nationally by promoting foreign investment to encourage the enhanced utilisation of Oman’s natural resources and employment prospects.

At a local level, the Project offers potential industrial and economic growth, initiating both significant short and long-term employment, and further business opportunities and development within the area.

Furthermore, this Project is anticipated to facilitate the development of industries in Oman which utilise polyethylene for the manufacture of a range of industrial and consumer products, and the subsequent employment opportunities that this brings.

2.2 Project Components

The LPIC Project, involving the overall development of a new petrochemical complex, comprises three main components:

- **A natural gas liquid extraction plant and associated off-site works and utilities in Fahud** with the function of recovering ethane and heavier components from natural gas. This plant will be located near the existing Fahud Compressor Station, and will be fed by rich natural gas from the Government Gas Plant in Yibal and Central Processing Plant in Saih Rawl.

- **A 300km pipeline between Fahud and Sohar Industrial Port Area (SIPA)** to transport the extracted NGL to the Sohar refinery within the existing Oman Gas Company's 32” natural gas pipeline.

- **A petrochemical plant and associated off-site works and utilities at SIPA**, including steam cracker, polyethylene, and polypropylene units integrated within the existing Sohar Refinery, Aromatics Plant and Polypropylene Plant in the Sohar Industrial Port Area, Oman.

Construction of the Project is expected to take five years (2016 – 2020) with a design life of 18 years.

2.3 Associated Facilities

Integrated in the Project is a series of associated facilities, essential to the functioning of the new facility. **Table 2-1** below provides a summary of the associated facilities.
Table 2-1: Associated facilities

<table>
<thead>
<tr>
<th>Associated facility</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jetty area</td>
<td>Modification of the existing facility by installing two pumps, storage tanks for condensate for feeding into the steam cracker unit, liquefied petroleum gas (LPG) storage tanks for feedstock for the steam cracker unit, associated piping and tie-ins.</td>
</tr>
<tr>
<td>Nitrogen gas supply</td>
<td>The LPIC nitrogen supply will be sourced from a third party.</td>
</tr>
<tr>
<td>Sea cooling water – Polymer complex</td>
<td>Installation of two pumps to connect to the existing grid will allow the provision of sea water to the required quantity for the polymer complex.</td>
</tr>
<tr>
<td>Sea cooling water – Steam cracker unit complex</td>
<td>Construction of a seawater intake pump station, comprising two pumps, associated piping, substation and seawater return system.</td>
</tr>
<tr>
<td>Treated industrial effluent and recovered process water</td>
<td>Construction of a new common Biological treatment unit, Reverse Osmosis unit, and associated piping for process water recovery.</td>
</tr>
<tr>
<td>Electric supply</td>
<td>Expansion of electric supply, comprising two connection points from the grid to the LPIC main receiving station, to meet the electricity supply requirements.</td>
</tr>
<tr>
<td>New gate</td>
<td>A study has been undertaken as to the potential for a new gate to serve the port area.</td>
</tr>
</tbody>
</table>

2.4 Assessment of Alternatives

An assessment of alternatives was undertaken in order to establish the relative potential environmental and social impacts associated with the development, design and construction options for each respective component of the Project. Table 2-2 below outlines the main alternatives studied by the developer where environmental considerations were taken into account in choosing the preferred option.

Table 2-2: Project component alternatives

<table>
<thead>
<tr>
<th>Project element</th>
<th>Sohar</th>
<th>Fahud</th>
<th>Fahud to Sohar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Need for the Project</td>
<td>Project selected over 'Do nothing' – reduces reliance on the export of crude oil and natural gas.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Location</td>
<td>No alternative sites considered – various factors taken into consideration such as proximity to the port minimising the costs and environmental impacts associated with import of materials and export of products (Sohar), availability of facilities for disposal of wastewater in an environmentally acceptable manner (Fahud), and avoiding the pipeline route through sensitive areas (Fahud to Sohar). The Fahud to Sohar pipeline also considered specific pinch point/obstruction locations for minor alternative routing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sourcing of Utilities (including during construction phase)</td>
<td>Sourcing of water (Sohar) – on-site facility to desalinate water is chosen over importing due fluctuating water demand. Cooling water system (Sohar) – closed pump around system chosen in part due to environmental consequences associated with other options (e.g. freshwater consumption and use of chemicals). Fuel (Sohar) – natural gas chosen in part due to environmental benefits arising from negligible sulphur content and low carbon content. Power (Sohar) – import from local grid chosen (where possible) over diesel generators due to environmental considerations. Water (Sohar) – low groundwater availability, therefore a plant or tanker required. Water (Fahud) – import from external sources preferred over extraction from local groundwater sources due to water availability. Power (Fahud to Sohar) – sourcing of power from grid is assessed to be preferable due to environmental considerations, however power from on-site diesel generator is selected during pipeline construction due to the remoteness of the works.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project element</td>
<td>Sohar</td>
<td>Fahud</td>
<td>Fahud to Sohar</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>--------------------------------------------</td>
<td>--------------------------------------------</td>
<td>-----------------------------------------</td>
</tr>
<tr>
<td>Air Pollution Control Systems</td>
<td>Project designs for limiting air emissions.</td>
<td>Cryogenic expansion process is the preferred option over the absorption method due to energy efficiency.</td>
<td></td>
</tr>
<tr>
<td>Extraction Process Technology</td>
<td>-</td>
<td>Gas technology selected due to energy efficiency, where other options would impact air emissions (diesel engine), and water availability (steam turbine).</td>
<td>-</td>
</tr>
<tr>
<td>Power Sourcing and Power Plant Technology</td>
<td>-</td>
<td>Wastewater – The adsorption of wastewater through bed guards is the preferred option over transport to an external facility for treatment, as the contaminants will be treated and will be disposed as per the regulation. Hazardous waste – resource recovery is chosen where possible due to being the best option environmentally.</td>
<td>-</td>
</tr>
<tr>
<td>Wastewater / Hazardous Waste Treatment and Disposal</td>
<td>-</td>
<td>-</td>
<td>Over-ground pipelines selected over buried pipelines due to reasons including ecological sensitivity.</td>
</tr>
<tr>
<td>Laying of Pipeline</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>
3 Project Environmental, Health and Social Performance Requirements

3.1 International Standards Requirements

The LPIC Project will gain financing from various sources, including Export Credit Agencies (ECAs) and commercial banks. As Oman is listed as a non-OECD country, compliance with international standards driven by the International Finance Corporation (IFC) Performance Standards and Equator Principles must be achieved to attain funding from these streams.

The IFC, part of the World Bank Group, has established Performance Standards on Environmental and Social aspects, as part of their Sustainability Framework (IFC, 2012), to outline their strategic commitment to sustainable development. A total of eight Performance Standards detail the precedents and core criteria that must be met by a project throughout its lifetime of investment by the IFC. Each of these standards is defined by clearly stated objectives, which in turn are further detailed by scope of work and explicit requirements to meet compliance.

The following IFC Performance Standards are relevant to this Project:\note{1}:

- Performance Standard 1: Assessment and Management of Environmental and Social Risks and Impacts
- Performance Standard 2: Labor and Working Conditions
- Performance Standard 3: Resource Efficiency and Pollution Prevention
- Performance Standard 4: Community Health, Safety, and Security
- Performance Standard 6: Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 8: Cultural Heritage.

The Equator Principles, launched in 2003, have now been adopted by 82 financial institutions made up of private banks as well as ECAs across 36 countries (The Equator Principles Association, 2016). These principles are the finance industry’s guidelines for managing social and environmental risk in project financing, updated in 2013 to align with the IFC Performance Standards.

3.2 National Standards Requirements

The Project has been designed to comply with the applicable Omani environmental laws and regulations, permitting and licensing requirements, and occupational health and safety policies.

The Directorate General of Environmental Affairs (DGEA), a division of MECA, provides Guidelines on Environmental Assessment which supplement the international regulations held by lending bodies, specifying the regional Omani regulations on environmental protection and pollution prevention.

\note{1} Through study and assessment, Performance Standard 5: Land Acquisition and Involuntary Resettlement and Performance Standard 7: Indigenous Peoples, have been scoped out of the Project.
MECA is responsible for issuing regulations, standards and guidelines for the implementation of environmental protection, control and management laws, as represented within Omani law under the “Law for the Conservation of the Environment and the Prevention of Pollution” and the “Law on Protection of Potable Water Sources from Pollution”. These laws provide a framework for all other laws and regulations regarding environmental conservation and water resource protection in Oman.

Orpic and the selected contractor are responsible for obtaining a Preliminary Environmental Permit, including a detailed evaluation of the environmental impacts and identified control measures to mitigate significant impacts, and Construction and Operations Permits from MECA and other relevant authorities.

Various Omani laws and regulations enforce specific working conditions for facilities in Oman, with associated consideration of noise exposure, radioactive materials and chemicals.
4 Environmental and Social Impact Assessment Process

4.1 Environmental Impact Assessment

4.2 Introduction

EIA studies were originally completed by HRM Consultants between August 2014 and February 2015. Three separate EIA reports were prepared for the following project components:

- NGLE Facility (Fahud) – see Section 4.3
- NGL Pipeline (Fahud to Sohar) – see Section Error! Reference source not found.
- Petrochemical Complex (Sohar) – see Section Error! Reference source not found.

The scope of work for the EIA was developed in line with Omani regulatory requirements, as specified in the “Guideline on Environmental Impact Assessment” issued by the Directorate General of Environmental Affairs (DGEA) in the Ministry of Environment and Climate Affairs (MECA).

The three EIAs followed the same methodology and rating system; the impacts have been rated as ‘negligible’, ‘low’, ‘medium’ or ‘high’. For planned impacts, this rating is based on two parameters, severity of the impact and duration of occurrence, as shown in the impact matrix in Table 4-1.

<table>
<thead>
<tr>
<th>Severity of impact</th>
<th>Momentary 1 week</th>
<th>Short Term &lt; 1 year</th>
<th>Medium Term 1-10 year</th>
<th>Long Term &gt; 10-50 year</th>
<th>Very Long Term &gt; 50 years</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive Effect</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Slight Effect</td>
<td></td>
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<tr>
<td>Minor Effect</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate Effect</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major Effect</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>Massive Effect</td>
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</tbody>
</table>

A similar matrix was developed for unplanned aspects, using the same impact ratings (although with slightly different parameter definitions). These are described fully in the EIA reports.

Following a review of the EIA process, the following additional studies were recommended by Nexant to ensure the project meets international performance standards:

- Preliminary Social Impact Assessment including the first collection of available data.
- Supplementary Social Impact Assessment including generation of further baseline data and addressing gaps highlighted in the preliminary Social Impact Assessment.
- Development of Stakeholder Engagement Plan and commencement of consultations.
- Development of Scope of Works for Cumulative Impact Assessment
- Enhanced scoping study for Cumulative Impact Assessment (Early Assessment report)
- Scope of Works for additional air quality baseline measurements
- Scope of Works of additional noise baseline measurements
• Scope of Works of additional soil and groundwater baseline measurements
• List of project associated facilities
• Best Available Technique documents on water resource
• More detailed reviews of work carried out for GHG and air emissions estimation developed originally in the initial EIAs.

These studies have been incorporated into the ESAP, which identifies specific actions, action owners, evaluation criteria and timescales for delivery. The following sections summarise the key outcomes of the EIA process (including baseline, impacts, and mitigation) for the following environmental parameters:

• Air Quality
• Noise
• Ecology
• Archaeology and Heritage
• Geology and Soils
• Hydrology and Groundwater

Whilst not considered as specific chapters, at a strategic level it is recognised that the Project will have impacts on natural resources (i.e. energy and water), although efforts have been made to reduce resource consumption (see below sections). Furthermore, it is recognised that the project is likely to result in increased traffic congestion (and possibly accidents), and place some pressure on existing transport infrastructure. However, the level of impact has yet to be defined as the location of labour camps/work force requirements have not been fully defined. The Cracker Unit at Sohar is being built first and the appointed contractor has confirmed that existing Workers’ Camps will be utilised.

4.3 Petrochemical Complex (Sohar)

4.3.1 Air Quality

Baseline
The development of the facility within SIPA is in a large designated industrial zone with a high number of existing air pollutant sources, and where there are more significant residential receptor locations within the influence of the project emissions.

Through monitoring at three locations, ambient air quality was found to be compliant with national air quality standards, except regarding PM$_{10}$ levels which is attributed to heavy construction industry in the area and surrounding natural winds. Ozone levels were recorded as being above WHO standards at two out of the three monitoring locations (to the west and south of the site), which is likely to be as a result of other industry and traffic in the area. Dust levels at all three monitoring locations were much higher than the WHO standard.

Impacts
Machinery, diesel generators, construction vehicles, earthworks and fuel storage will be the main source of air emissions during construction of the PC. These sources will emit pollutants such as NO$_x$, SO$_2$, CO, unburnt hydrocarbons and particulate matter.
Air emissions during the operational phase will be primarily from the 14 stationary point sources of the LPIC complex. NOx emissions have been assessed as meeting local regulations. However, NO\textsubscript{x} emissions may still be close to, or exceed IFC standards, in which case further mitigation will be required.

Further work is required to assess off-site impacts by the consideration of emissions, dispersion and effects beyond the site itself. This work is currently underway.

Mitigation

The heaters and incinerator will employ the low nitrogen oxide burners in order to minimise the release of NO\textsubscript{x} into the atmosphere. NO\textsubscript{x} emissions from the gas turbine and steam boilers will be controlled by the use of a Dry Low NO\textsubscript{x} combustion system.

In order to minimise pollution from the flare, it is proposed that the flare will be designed to ensure that the smoke opacity will not be higher than Ringlemann 1. The flare will have continuous pilot flame to prevent any cold venting, and will combust over 99 percent of hydrocarbons. In order to reduce thermal NO\textsubscript{x}, the fuel-air ratio will be optimised and will be steam assisted. Spent caustic wastes containing high levels of pollutants will be oxidised to convert organic compounds to CO2 and sulphates.

The storage tanks for feedstock, product and intermediates will be provided with nitrogen blanketing and floating roof. Further the vent gas from the storage tanks will be routed to the vent gas incinerator.

4.3.2 Noise

Baseline

HMR conducted ambient noise level measurements as part of the Environmental Impact Assessment for the Petrochemical Plant (Sohar) – June 2015. Measurements were made within the vicinity of the Sohar Petrochemical complex at two locations for day, evening and night time periods in accordance with the requirements of MD 79/94 for 15 minutes in each period. Measured noise levels were within the 70 dBA limit for day and night. The highest measured noise level was 67.2 dB L\textsubscript{eq} which occurred during the day time. Noise levels within the site ranged from 54.9 to 67.2 dB L\textsubscript{eq} in the day time reference period (7am to 6pm), from 53.2 to 57.4 dB L\textsubscript{eq} in the evening reference period (6pm to 11pm) and from 50.1 to 55.2 dB L\textsubscript{eq} during the night time reference period (11pm to 7am). With comparison to noise thresholds presented in the Environmental, Health and Safety (EHS) Guidelines\textsuperscript{2} the measured noise levels are within the 70 dBA limit.

Noise measurements were made at locations within two local surrounding villages, Ghadfan and Khuwariya to assess the baseline noise levels. Measured noise levels were within the limit of 55 dBA as stipulated in MD 79/94 ranging from 48.5 to 50.2 dB L\textsubscript{eq} in the day time reference period, from 49.9 to 50.6 dB L\textsubscript{eq} in the evening reference period and from 48.9 to 49.9 dB L\textsubscript{eq} in the night time reference period.

HMR noted that fluctuations in daytime noise levels could have been attributed to the various industrial activities that were happening in the area.

HMR has completed a further baseline noise survey as part of the LPIC Project. Noise monitoring was undertaken at five locations, representing noise sensitive receptors in the Sohar area. Measurements were conducted in each of the five locations for day, evening and night periods as stipulated in MD 79/94. Measurements were made for 60 minutes in the day and 30 minutes during the evening and night time.

\textsuperscript{2} International Finance Corporation - Environmental, Health, and Safety (EHS) Guidelines GENERAL EHS GUIDELINES: ENVIRONMENTAL NOISE MANAGEMENT
periods. Additionally, in four of the five locations, noise measurements were made for 2 periods in the day time, known as rush hour and non-rush hour, reflecting the difference in ambient noise levels when people are travelling to/from work. The rush hour periods are from 7am to 10am and from 2pm to 5pm.

The results showed that noise levels measured during rush hour and during non-rush hour did not differ greatly with the largest difference being 3.7 dB $L_{eq}$ (at location NM18). Noise levels were 3.1 dB $L_{eq}$ higher during the non-rush hour period at location NM19.

Measured $L_{Aeq}$ noise levels exceeded the criteria for noise in Oman as stipulated in MD 79/94 in each measurement period at each location save for two occasions; during non-rush hour and evening time at measurement location NM18.

International standards for noise limits in the Environmental, Health and Safety (EHS) Guidelines provide noise threshold limits for daytime and night time periods. In comparison with the EHS limit the majority of day time measurements are within the threshold limits whereas the night time values for the most part exceed the limit. It should be noted that the IFC guidance states that the threshold limits for noise should not be exceeded or the impact should not result in an increase in noise levels greater than 3 dB $L_{Aeq}$.

**Impacts**

Sources of noise for the construction phase within the Sohar Petrochemical complex site are considered to be from generators, construction machinery and vehicles. Certain operations are expected to be limited to the day time which includes excavators, compactors, compressors and trucks which are anticipated to generate noise levels ranging from 70 to 80 dBA. Operations from diesel generator units are expected to occur for 24 hours a day and generate noise levels of 75 to 85 dBA.

Noise impacts to local communities are anticipated to come from movements of HGVs in and around the area. Impacts from noise to the ambient environment during the construction stage are anticipated to be Low with a minor severity and medium term duration.

Impacts to the work place in terms of noise are anticipated to be Low with medium term duration and moderate severity.

During the operational phase, certain noise sources are expected to be continuous such as gas turbine generators, steam boilers, compressors, generators, air coolers, pumps and flares used for normal conditions with noise levels ranging from 80 to 90 dBA. Noise from flares during upset conditions is anticipated to be rare with noise levels up to 115 dBA.

As stated in the EIAs, high levels of noise are anticipated from equipment and vehicles which have the potential to cause disturbance to the local communities and also pose a health risk to workers. In addition to this, vehicle movements are anticipated to impact fauna within the area. An increase in congestion on the roads can be caused by the increase of HGV’s which has the potential to cause noise within a locality close to a road.

The impact to ambient noise levels within the Sohar area is anticipated to be Low with medium term duration and minor severity.

The impact of noise to the work place is anticipated to be Medium with medium term duration and moderate severity.
Mitigation
During the construction stage machinery must be fitted with suitable noise attenuation and appropriate silencers. Activities likely to cause high levels of noise are to be limited to the day time period and workers are required to have adequate ear protection so as not to be exposed to noise levels of 85 dBA and higher in accordance with MD 80/94.

During the operational phase it is anticipated that the equipment used on site will be modern and thus have suitable noise attenuation fitted. Workers are required to be provided with adequate hearing protection. Provision for periodic noise monitoring within the site is provided as part of the EMP.

Movement of vehicles associated with the development along the local roads is anticipated to cause congestion and increased noise levels. Construction activities will be limited to the day time and authorities in the Sohar Industrial Area to minimise nuisance caused during the night time.

Plant equipment that forms part of the site is to be designed so as to limit noise levels below 85 dBA L_{eq} at 1m distance from each piece of equipment. Where equipment noise cannot be reduced to below 85 dBA warning signs will be in place to ensure people within the locality wear adequate hearing protection. Equipment will be located so that noise at the boundary of the site does not exceed the 70 dBA limit as stipulated in MD 79/94.

4.3.3 Terrestrial Ecology

Baseline
The natural landscape in SIPA is heavily altered due to industrial developments since its inception in 2002. The proposed terrestrial site does not have any plant species or communities that are rare or threatened or endangered in Oman and the Arabian Peninsula. All species found at the site are of common occurrence across the country and none have restricted distribution. No reptiles or mammal fauna of great ecological or conservation significance have been found in the study area. The geckos and birds that were observed at the site during the study are common species, which have wide ranging distribution across the country.

The proposed PP does not have any direct interaction with the marine environment.

Impacts
The impacts on ecology will be largely due to activities like site clearing and levelling during the construction phase. All vegetation within the site is likely to be cleared. Further disturbance will result from increase in noise during construction activities and vehicle movements.

Based on the low sensitivity of the site, and mitigation identified below, HRM identified a ‘low’ impact rating of construction/operation of the PP on ecology.

Mitigation
A green belt using native plant species will be established around the periphery of proposed plant. In addition, whenever applicable the century old stands of Ghaf Tree (P. cineraria) will be incorporated in the landscape design within the footprint of the Project.
4.3.4  Archaeology and Heritage

Baseline
The final EIA report found that no sites or objects of archaeological importance are expected to occur within the project site, being as it is, located within a dedicated industrial area.

Impacts
No impacts are anticipated, however, as for other scheme components, a Chance Find Procedure has been developed.

Mitigation
As described under Section 4.3.5, a Chance Find Procedure has been developed (Royal HaskoningDHV, 2016).

4.3.5  Geology and Soils

Baseline
The geology of the area is characterised by an extensive sand and gravel plain with aeolian sands, clay and silt deposits, and wadi beds comprising un-cemented boulders, gravels and silty sands of variable composition. A thin layer of beach sand stretches along the foreshore. The bedrock geology comprises Tertiary limestones, which dip northwards from the Hajar mountains, reaching 1,500-2,000m thickness at the coast.

As a result of the full review, additional soil sampling has been proposed.

Impacts
Potential impacts during construction, as identified in the original EIA, include on-site/off-site soil contamination via discharges of liquid effluents, including the discharge of equipment washings, hydrotest water, domestic wastewater, dewatering effluents, and accidental spillages of hazardous liquid or materials, the management of solid wastes, and the handling, storage and transport of hazardous substances. The potential impacts to soil due to the management of wastes and accidental releases are assessed to be low.

During operation, industrial and domestic wastewater management such as accidental spillage of hazardous liquids, the management of non-hazardous (industrial and domestic) and hazardous waste such as the improper transport and disposal of the wastes, and the storage, management and disposal of non-hazardous wastes. The potential impacts to soil due to the management of wastes are assessed to be medium, whilst the impact from improper handling and disposal of waste and wastewater is considered to be low.

Mitigation
Management procedures will be in place to mitigate the potential for impacts on soils due to accidental releases and the management of wastes. These procedures include the provision of appropriate facilities and methods for handling the materials and wastes, as well as suitable management of the waste streams.
4.3.6 Hydrology and Groundwater

Baseline
Groundwater flow is driven by recharge in the Al Hajar mountains, resulting in northward flow towards the sea in the Al Batinah region and south westward flow in Ad Dhahirah. At the Sohar development sites, groundwater levels varied by approximately one metre above and below MSL during investigations. Near the coast groundwater level is likely to be tidally influenced.

Groundwater is an important water resource, whereby water is obtained from superficial deposits such as drawing from wadi baseflows, or at depth from the limestone bedrock. In the area, significant groundwater resources are found in the much thicker (>300m) alluvial deposits found in the alluvial fan/plain zone.

As a result of the review, further groundwater sampling has been proposed, comprising the installation of three new boreholes to enable the monitoring of groundwater flow direction and potential off-site migration.

Impacts
Potential impacts during construction, as identified in the original EIA, include on-site/off-site groundwater contamination via discharges of liquid effluents, including the discharge of equipment washings, hydrotest water, domestic wastewater, dewatering effluents, and accidental spillages of hazardous liquid or materials, the management of solid wastes, and the handling, storage and transport of hazardous substances. The potential impacts to groundwater due to the management of wastes and accidental releases are assessed to be low.

During operation, industrial and domestic wastewater management such as accidental spillage of hazardous liquids, the management of non-hazardous (industrial and domestic) and hazardous waste such as the improper transport and disposal of the wastes, and the storage, management and disposal of non-hazardous wastes. The potential impacts to groundwater due to the management of wastes are assessed to be medium, whilst the impact from improper handling and disposal of waste and wastewater is considered to be low.

Mitigation
Mitigation to avoid impacts to groundwater include the management of domestic sewage via a pipeline, for appropriate holding and treatment, the processing and storage of surface water run-off, and the routing and treatment of effluents. Furthermore, the storage and handling of hazardous materials, the discharge of liquid effluents and the disposal of hazardous wastes all follow appropriate practise measures.

4.4 NGL Pipeline (Fahud to Sohar)

4.4.1 Air Quality

Baseline
The development of the petrochemical plant facility within SIPA is in a large designated industrial zone with a high number of existing air pollutant sources. There are also a greater number of residential receptor locations within the influence of the project emissions.

Through monitoring at three locations, ambient air quality was found to be compliant with national air quality standards, with the exception of PM$_{10}$ levels which is attributed to heavy construction industry in the area and natural ground, soil and meteorological conditions. O$_3$ levels were recorded as being above
WHO standards at two of the three monitoring locations (to the west and south of the site), which is likely to be as a result of other industry and traffic in the area. Dust levels at all three monitoring locations were above the WHO air quality standard.

Impacts

Machinery, diesel generators, construction vehicles, earthworks and fuel storage will be the main source of air emissions during construction of the petrochemical plant. These sources may emit pollutants such as NO\textsubscript{x}, SO\textsubscript{2}, CO, unburnt hydrocarbons and PM\textsubscript{10}. Dust may also be generated as a result of construction activities and resuspension from vehicles travelling along unpaved roads.

It is considered that construction phase impacts will be localised in nature and will last for a period of not more than 20 months. In addition, human receptors are not located within the site boundary. As such, air quality impacts during the construction phase are considered to be low.

Air emissions during the operational phase will be primarily from stationary point sources of the LPIC complex. Pollutant emissions were modelled and met Omani regulations.

HMR undertook a dispersion modelling assessment to consider the maximum ground level concentration of pollutants outside the PP boundary. Pollutant concentrations were predicted to be below the relevant air quality standards during normal operations. Further work is required to assess impacts in the Sohar region by the consideration of emissions, dispersion and effects beyond the site itself. This work involves a baseline monitoring survey and further dispersion modelling.

Mitigation

Control measures to minimise construction phase impacts will be detailed in an Environmental Management Plan report.

The heaters and incinerator will employ the low nitrogen oxide burners in order to minimise the release of NO\textsubscript{x} into the atmosphere. NO\textsubscript{x} emissions from the gas turbine and steam boilers will be controlled by the use of a Dry Low NO\textsubscript{x} combustion system.

The flare will be designed to prevent cold venting, and combust over 99 percent of hydrocarbons. NO\textsubscript{x} emissions will be reduced by steam assistance and optimising the fuel-air ratio. Waste gases containing high levels of pollutants will be converted to CO\textsubscript{2} and sulphates.

The storage tanks for feedstock, product and intermediates will be provided with nitrogen blanketing and floating roof. Furthermore, the vent gas from the storage tanks will be routed to the vent gas incinerator.

4.4.2 Noise

Baseline

HMR undertook an assessment of baseline noise levels in November 2014 along the pipe alignment that stretches from Fahud to Sohar as part of the Environmental Impact Assessment Report for the NGL Pipeline (Fahud to Sohar), June 2015. In addition to undertaking a noise survey of the area to determine the background noise conditions, previous EIAs and other work undertaken by HMR for third parties in the area was also drawn upon.

Ambient noise levels were measured in 15 minute intervals for the day, evening and night time periods in accordance with the requirements stipulated in MD 79/94. Noise measurements were undertaken at a
total of ten locations. Ambient noise levels ranged from 35.9 to 64.7 dB \( L_{eq} \) during the day time period (7am to 6pm) and from 32.1 to 44.9 dB \( L_{eq} \) during the evening period (6pm to 11pm). No night time data was presented. With comparison to noise thresholds presented in the Environmental, Health and Safety (EHS) Guidelines the measured noise levels are within the 70 dBA limit.

Variations present in the baseline noise data were attributed to overhead planes and vehicles passing periodically. Roads in the region lead to the Petroleum Development Oman (PDO) facilities such as the waste scrap yard and land farm. Daily traffic due to the development is not expected to exceed 100 vehicles per day and is considered to be insignificant.

HMR has completed a further baseline noise survey in March 2016 as part of the LPIC Project. In the region between Fahud and Sohar where the pipeline will run, there are a total of 13 locations at which noise monitoring has been undertaken. Monitoring was performed for day, evening and night time periods for duration of 30 minutes at each location. At the time of this report, HMR are still analysing the results and have not released them in the report.

**Impacts**

HMR undertook an assessment of the impacts of noise and vibration during the construction stage as part of the June 2015 Environmental Impact Assessment Report for the NGL Pipeline (Fahud to Sohar) based on information available at the time. Construction activities such as bulldozing and piling are anticipated to generate high levels of noise within the area.

The equipment and processes will be operational during the day time only. The highest levels of noise are anticipated to come from excavators, bulldozers, compactors, trucks and welding activities which are expected to generate noise levels ranging from 70 to 80 dBA \( L_{eq} \). Rock breaking activities are anticipated to be intermittent and generating noise levels of up to 105 dBA \( L_{eq} \). Power generators are anticipated to be in operation continuously with noise levels ranging from 80 to 85 dBA \( L_{eq} \).

The severity of construction phase noise and vibration impacts was anticipated to be moderate, with medium term duration and an overall impact rating of medium.

For the operational phase no major or continuous noise sources were anticipated by HMR with the only source of noise being movements of HGV’s along the local roads. Gas emissions and mobile flares could generate noise but these events will be sporadic, only occurring during upset conditions.

**Mitigation**

During the construction stage noise levels are anticipated to exceed 85 dBA \( L_{eq} \) during day time hours and workers are required to have adequate hearing protection as in compliance with MD 80/94 and also guidance in the Environmental, Health and Safety (EHS) Guidelines from the International Finance Corporation (IFC). Works involving noisy machinery are to be avoided during the night time and plant equipment should be up-to-date and used appropriately (i.e. minimise revving of engines which generate high levels of noise). Adequate noise enclosures, silencers and shielding to be provided for noisy equipment to minimise spread of noise.

A requirement to conduct periodic noise monitoring is in place to ensure that boundary noise levels comply with requirements in MD 79/94 of 70 dBA and also guidance in the Environmental, Health and Safety (EHS) Guidelines from the International Finance Corporation (IFC). Effort will be made to minimize vehicle noise through reduction of speed and keeping roads well maintained as well as ensuring that all vehicles have functioning silencers.
4.4.3 Terrestrial Ecology

Baseline
Between Fahud and Ibri (approx. 100km to the north), the route passes through a mainly gravelly plain with small hillocks and wadis. This area comprises some important areas of open acacia woodland. The plains contain some limited vegetation (clusters of shrubs), which are impacted by existing anthropogenic activities such as trampling and littering near settlements. Invasive species (*Prosopis juliflora* – a small tree, and *calotropis procera* – a flowering plant) were identified in a survey completed by HMR.

Between Ibri to Al Ain the area is comparatively uninhabited and relatively devoid of flora/fauna. Most of the area has uniform wadi vegetation interspersed with barren hilly slopes. On the western slopes of the Hajar mountains there are a number of ephemeral (transient) pools which sustain moisture for periods and therefore support a more diverse range of flora/fauna. Faunal species in the area include agamas and sand lizards.

Between Al Ain to Liwa the pipeline passes through the Hajar mountains. Most of this elevated area is completely barren with sparse vegetation. The fauna occurring in this area includes hare, fox, girbils and jirds.

The pipeline does not pass through any designated nature conservation areas.

Impacts
The requirement of a 50m Right of Way (RoW) throughout the pipeline corridor represents a significant impact to habitat when considering the total length of the pipeline. Further (temporary) habitat loss will occur during construction through the construction of compounds and office facilities. However, after construction vegetation will colonise the area. Fauna is likely to be disturbed by noise, vibration, dust and human activity (vehicle movements, lighting etc.), however this would only be temporary during the construction.

The HMR EIA identified a ‘medium’ impact to ecology from the construction/operation of the pipeline.

Mitigation
The working corridor will be strictly adhered to, to avoid further damage/disturbance to surrounding flora/fauna.

4.4.4 Archaeology and Heritage

Baseline
As a result of the new NGL Pipeline following the route of an existing pipeline and associated corridor, the HMR EIA report concluded that there are not any sites of archaeological or cultural interest along the pipeline route and hence no impacts.

The Nexant review identified some compliance concerns with respect to IFC PS8 Cultural Heritage, many of which centred on a previously identified Grave Site Wall within records of consultations, and a perceived lack of detail surrounding the nature, location of and potential impacts on this heritage receptor in relation to the proposed LPIC Project. As such Orpic conducted additional site visits to determine the location of the grave wall and its distance from the pipeline. The further investigations confirmed that there will be no impact on the cemetery from the LPIC project.
Impacts

No impacts are anticipated. If features are found during construction, the Chance Find Procedure will be adhered to (see description/reference under Section 4.5.4).

Mitigation

The Chance Find Procedure will be adhered to.

4.4.5 Geology and Soils

Baseline

The area covered by the pipeline route can be broadly classified into four distinct regions:

- Central Plains: comprising limestone covered by drift deposits that are products of weathered limestone, and soils that are subsequently unconsolidated and sandy.
- Northern Foothills and Plains: comprising broad expanses of gravel within palaeo and recent alluvial fans with limestone, mudstone, sandstone and chert washed out from the western Hajar mountains that lie to the north, as well as minor aeolian dune systems close to major wadis. Soils consist primarily of gravels and limestone with sand and silt, whilst the larger wadis contain unconsolidated coarse alluvial gravels.
- Northern Mountains: limited to wadi bed alluvium
- Al Batinah Region: consists of alluvial gravel sequences under laid by carbonates and mudstone, where the base of alluvium dips northward from the foothills of Hajar Mountains towards the coast.

As a result of the Nexant and Royal HaskoningDHV reviews, soil sampling was proposed, comprising fifteen new sample points, using a shallow auger, in order to provide baseline data in the vicinity of the pipeline corridor, labour camps and settlements.

Impacts

Potential impacts during construction, as identified in the HMR EIA, include on-site/off-site soil contamination via discharges of liquid effluents, including hydrotest water and accidental spillages of hazardous liquid or materials, the management of solid wastes, and the handling, storage and transport of hazardous substances. The potential impacts to soil due to the management of wastes is assessed to be low, whilst the potential impact due to accidental release is considered to be medium due to the major severity of impact if it were to happen.

During operation, there is the potential for accidental damage to pipeline and associated environmental releases, although this is assessed to be very unlikely, and the potential for soil contamination via the handling, storage and transportation of non-hazardous and hazardous substances.

Mitigation

Management procedures will be in place to mitigate the potential for impacts on soils due to accidental releases and the management of wastes. These procedures include an evaporation pond for the storage of the hydrotest water, and an emergency response plan in the scenario of a spill from the pipeline.
4.4.6 Hydrology and Groundwater

Baseline

Groundwater flow is driven by recharge in the Al Hajar mountains, resulting in northward flow towards the sea in the Al Batinah region and south westward flow in Ad Dhahirah. In the Al Batinah region groundwater levels range from 5m BGL within 5km of the coast to 60m BGL in the piedmont region. Near the coast groundwater level is likely to be tidally influenced.

Groundwater is an important water resource, whereby water is obtained from superficial deposits such as drawing from wadi baseflows, or at depth from the limestone bedrock.

As a result of the Nexant and Royal HaskoningDHV reviews, further groundwater sampling has been proposed, comprising continued sampling at existing wells to provide baseline data in the vicinity of the labour camp, of the Western Gravel Aquifer, within the pipeline corridor in the vicinity of settlements, and to provide confidence in and continuity with existing data for the Central Plains region.

Impacts

Potential impacts during construction, as identified in the HMR EIA, include the stress on water supply resources via the utilisation of groundwater resources for construction water and domestic/potable water at the site, discharges of liquid effluents, including hydrotest water and accidental spillages of hazardous liquid or materials, the management of solid wastes, and the handling, storage and transport of hazardous substances. The potential impacts to groundwater due to the management of wastes is assessed to be low, whilst the potential impact due to accidental release is considered to be medium due to the major severity of impact if it were to happen.

During operation, there is the potential for accidental damage to pipeline and associated environmental releases, although this is assessed to be very unlikely, and the potential for groundwater contamination via the handling, storage and transportation of non-hazardous and hazardous substances. Furthermore, the utilisation of groundwater resources for potable water during operation could impact the groundwater resources due to the additional water usage.

Mitigation

There is a high potential for the infiltration of wastewaters and liquid spills into groundwater at the site. Management procedures will be in place to mitigate the potential for impacts on groundwater due to accidental releases and the management of wastes, such as the appropriate handling, transport and storage of liquid effluents. Nexant state that in addition, the operating company, Oman Gas Company (OGC), will have to update its emergency response plans (ERP) to take into account the additional gas volumes in particular close to inhabited areas, such as Al Jal village.

4.5 NGLE Facility EIA (Fahud)

4.5.1 Air Quality

Baseline

A Continuous Ambient Air Quality Monitoring Station was deployed within the project site to determine baseline air quality conditions. The baseline air quality monitoring survey recorded concentrations of carbon monoxide (CO), nitrogen dioxide (NO2), Ozone (O3), Sulfur Dioxide (SO2), and particulate matter (PM10). Measured concentrations were compared to the Omani Ambient Air Quality Standards (OAAQS)
and the United States Environmental Protection Agency (USEPA) National Ambient Air Quality Standards (NAAQS).

In line with Item 3 'incomplete baseline data' of the ESAP, further monitoring is being undertaken at the NGLE site as a result of the Nexant / Royal HaskoningDHV review. Data from the additional location is currently being collected, which will inform a supplementary Air Quality Addendum Report.

**Impacts**

The main sources of air emissions during the construction of the NGLE facility are anticipated to be diesel generators, construction machinery and vehicles, fuel oil storage tanks, traffic on graded roads and earthworks. The principal pollutants from these sources are expected to be oxides of nitrogen (NOx), SO₂, CO and un-burnt hydrocarbons.

HMR undertook an assessment of construction phase emissions for the ESIA. A number of assumptions were made regarding the quantification of pollutant emissions due to a lack of available data at the time of the assessment. HMR concluded that adverse construction phase impacts would be highly localised, and unlikely to affect the surrounding populations located more than 15km away. Air quality impacts were therefore considered to be ‘medium’ (the results of the HMR construction phase air quality assessment are subject to review following the completion of additional work).

The major sources of continuous emissions during the operational phase of the NGLE facility are likely to be four gas turbine stacks and one flare stack. Intermittent emissions will also arise from point and area sources (e.g. from diesel pumps used during emergencies), however these are not considered to be significant. From the stacks, products from the combustion of fuels and off gasses will primarily result in CO₂ and water emissions, in addition to air pollutants (NO₂, SO₂, CO and PM₁₀). Orpic has specified a turbine which emits NOx below a limit set out in the IFC EHS General Guidelines (2007), although actual outputs will need to be confirmed following detailed design.

Oil fired diesel generators will generate nitrogen oxides (NOx) for short periods (during start up and emergency shut downs of the power plant). The generators are anticipated to produce low SO₂ emissions due to the use of low sulphur diesel.

Dispersion modelling was undertaken by HMR for the ESIA to predict the maximum ground level concentration outside the NGLE boundary as a result of emissions from the turbine stacks and flare. All predicted ground level concentrations were predicted to be below the relevant air quality standards.

**Mitigation**

The project Environmental Management Plan (EMP) states that dust risings will be reduced through grading, soil compaction and spraying during construction. During operation, air emissions have been mitigated largely through the design process (i.e. gas turbine specification, stacks designed to ensure plumes achieve maximum dispersion). Furthermore, the emissions from the stacks will be continuously monitored (online) for specific pollutants. As a preventative measure, occasional ambient air quality monitoring is also proposed near to and away from the project to pick up on any abnormal air quality issues.
4.5.2 Noise

Baseline
Noise monitoring was undertaken by HMR in and around the project area at Fahud in order to establish the baseline noise situation within the locality as part of the June 2015 Environmental Impact Assessment Report for the Natural Gas Liquid Extraction (NGLE) (Fahud). A small number of potentially noise sensitive receptors were identified within the area and these receptors were the focus of the noise survey. Measured noise levels were compared to the criteria for noise in Oman as stipulated in Ministerial Decision 79/94 relating to noise from road traffic and also from industrial activity. Ministerial Decision 80/94 relates directly to noise exposure for workers during construction and operational activities and asserts a noise limit of 85 dBA $L_{eq}$ for workers exposure.

Daily traffic levels are not expected to exceed 100 vehicles per day on the roads around the project site which cater for the various PDO facilities. HRM made an assessment that these contributions to the average $L_{Aeq}$ noise levels will be insignificant.

Noise measurements were made for ten minutes in five locations around the Fahud site. Noise levels ranged from 39.8 to 55.7 dBA $L_{eq}$ during the day time period (7am to 6pm), from 44.9 to 50.2 dBA $L_{eq}$ during the evening period (6pm to 11pm) and from 39.2 to 47.1 dBA $L_{eq}$ during the night time period (11pm to 7am). These are within the limits as stipulated in MD79/90 and variations in measured values are attributed to passing vehicles and overhead planes. The HMR noise survey stated typical ambient noise levels for populated areas being between 50-56 dBA $L_{eq}$. With comparison to noise thresholds presented in the Environmental, Health and Safety (EHS) Guidelines the measured noise levels are within the 70 dBA limit.

Noise monitoring has also been undertaken at one location in the vicinity of the proposed NGLE plant. Monitoring was performed for day, evening and night time periods for duration of 30 minutes in each time period. At the time of issuing this report, HMR are still analysing the results and have not released them in the baseline report.

Additional noise monitoring has been undertaken in the Fahud area following the review (by Royal HaskoningDHV and Nexant) of the noise baseline measurement survey methodology. The additional survey was undertaken in accordance with the detailed scope of works outlining the methodology and in accordance with international standards.

Impacts
The main sources of noise anticipated to be present during the construction of the NGLE facility are from movements of heavy goods vehicles, noise from earth works such as piling and site clearance and noise from mechanical plant used in the process of construction such as generators and compressors.

An assessment of the construction noise was made by HMR to determine the impact to the surrounding area. The sources of noise identified to be significant during the construction phase were activities such as bull dozing, piling and also diesel generators used for auxiliary/emergency power supply. In addition to this, vehicle movements on site and workers shouting/talking will be sources of significant noise during construction. Equipment such as excavators, compactors, concrete mixers, compressors and trucks are anticipated to be operational in the day time only and generating noise levels ranging from 65 to 80 dB $L_{eq}$. Diesel generators and pipe flushing machines are anticipated to be intermittently operational and generating 80 – 100 dB $L_{eq}$ noise levels.
The impact to ambient noise levels in the Fahud area during the construction phase is anticipated to be low with a medium term duration and minor severity.

The impact for work place ambient noise during construction is anticipated to be medium with medium term duration and moderate severity.

During the operational phases the equipment on site is expected to generate high noise levels as part of the operation. The pieces of equipment expected to generate the highest noise levels were identified by HMR as Gas-turbine-generators, compressors, generator air coolers, pumps and flares used for normal conditions which are expected to generate noise levels ranging from 75 to 90 dB $L_{eq}$ and be in continuous operation. Flares used for upset conditions are anticipated to generate noise levels reaching 115 dB with intermittent and infrequent operation. Impacts to the ambient noise levels from the operational phase are anticipated to be Low. The impact to workplace noise is anticipated to be medium.

The EIA concluded that very low sensitivity receptors are in and around the site, which results in the anticipated impact to be negligible.

**Mitigation**

In compliance with MD 70/94 and MD 80/94 noise levels at the boundary limit of the facility will be maintained under 70 dBA and workers within the facility will be provided with ear protection to prevent exposure to 85 dBA and higher. Boundary noise monitoring is to be undertaken at a monthly/quarterly frequency.

### 4.5.3 Terrestrial Ecology

**Baseline**

The majority of the study area is devoid of any plant or animal life. This is due to extremely low rainfall, very high temperatures, poor soil quality and high prevalent winds. The study area is a plain of gravelly areas intermixed with sandy runnels. The study area is practically devoid of any large woody trees, although there are isolated pockets of shrubs and herbs. The area is represented by gecko and lizards but by very low abundance. Smaller mammals, namely gerbils and jirds, are present but in low numbers. No rare, endangered, or threatened species (flora or fauna) have been identified in the study area.

**Impacts**

Site clearance and grading will be conducted as part of the construction, which will result in removal of small areas of vegetation. Some disturbance to reptiles, mammals and birds will take place during construction and operation (vehicle movements, noise, dust generation etc.). A ‘low’ impact was identified during construction and operation.

**Mitigation**

Due to the ‘low’ impact, no specific mitigation has been proposed for the NGLE facility for terrestrial ecology.

### 4.5.4 Archaeology and Heritage

**Baseline**

The HMR EIA report states that there are no cultural or archaeological resources within the project site.
Impacts

No impacts are anticipated, however there remains a possibility of adverse impacts upon as yet unknown and unrecorded sites/artefacts of cultural heritage and archaeological interest. These sites/artefacts, including the potential for skeletal remains, discovered during construction or operation activities are referred to as ‘chance finds’, for which specific mitigation has been identified (see below) across all aspects of the LPIC project.

Mitigation

A preliminary Chance Find Procedure has been developed for Orpic, and outlines the steps to be taken by Project personnel, including all contractors and sub-contractors, in order to effectively manage previously unknown and/or unrecorded cultural heritage as required by the Lenders with respect to the construction of the LPIC Project.

4.5.5 Geology and Soils

Baseline

The superficial (unconsolidated sediments over bedrock) deposits of the Fahud/Central Plains region comprise aeolian (wind-blown) sands, weathering products, and unconsolidated soils with alluvial (river deposited) sand/silt with a low organic content and high permeability. Fine alluvial gravel and silt is present in the smaller drainage channels, whilst coarse alluvial gravel is a feature within major wadis (dry river beds). The bedrock geology is characterised by limestone.

Impacts

There is the potential for the accidental spills of liquid effluents during construction and operation phases of the project, which may result in soil contamination, for example exceedances in hydrocarbon and heavy metal thresholds in the soil, at the site. Due to the moderate severity and likely chance of spills during construction, a medium impact rating was established by the HMR EIA. Soil may also be impacted by waste management during construction, although this impact was anticipated to be low due to the provision of control measures. The impact of wastewater and waste management during operation is anticipated to be medium, whilst the impact on soils from improper handling and disposal of waste and wastewater is considered to be unlikely and therefore low.

Mitigation

Management procedures will be in place to mitigate the potential for impacts on soils due to accidental releases from the major sources of liquid effluents, such as by the discharge of wastewaters on land, spillage of oil and chemicals from bulk storage facilities onsite, and the disposal of wastes on land. These procedures include measures for the disposal of wastewaters and wastes, and the containment protocol of accidental spills.

4.5.6 Hydrology and Groundwater

Baseline

Groundwater flow is driven by recharge (where water moves from surface water to groundwater) in the Al Hajar mountains, resulting in northward flow towards the sea in the Al Batinah region and south westward flow in Ad Dhahirah. In the Fahud area, the predominantly limestone bedrock forms a barrier to south westward groundwater flow, and as a result the groundwater level is approximately 150m above mean sea level.
level (MSL) (approximately 50m below ground level (BGL)) in south Fahud and slightly higher at 165m above MSL in central Fahud.

Groundwater is an important water resource, whereby water is obtained from superficial deposits such as drawing from wadi baseflows, or at depth from the limestone bedrock. Due to salinity levels in the area, quaternary alluvium and wadis often provide the most useful supplies.

As a result of the Nexant and Royal HaskoningDHV reviews, further groundwater sampling has been proposed, comprising continued sampling at an existing well, and the installation of a new borehole positioned to allow for long-term monitoring of the NGLE Plant site, which will be required by both the construction and operational Environmental Management Plans (EMPs).

Impacts
There is the potential for impact mechanisms such as the infiltration of wastewaters discharged on land, the infiltration of oil and chemicals via spills from bulk storage facilities, and the leaching from wastes disposed on land during the construction and operation phases of the project. The impact of accidental spills during construction is considered by the HMR EIA to be likely and of moderate severity, resulting in a medium impact rating. The impact from normal waste management during construction is anticipated to be low due to the provision of control measures. The impact of wastewater and waste management during operation is anticipated to be medium, whilst the impact on groundwater from improper handling and disposal of waste and wastewater is considered to be unlikely and therefore low.

Furthermore, the utilisation of groundwater resources for construction water and potable water at site and in the labour camp during construction, and for freshwater purposes during operation, could impact the groundwater resources due to the additional water usage.

Mitigation
There is a high potential for the infiltration of wastewaters and liquid spills into groundwater at the site. Mitigation to avoid includes utilising overhead pipelines to carry the process wastewater containing chemicals, allowing easy examination for deterioration and repairs, compared to buried sewers, and the appropriate treatment and disposal of effluents.

4.6 Social Impact Assessment

4.6.1 Introduction
The Social Impact Assessment (SIA) for the LPIC project was developed in November 2015 as part of the process of fulfilling lenders’ requirements to attain international standard reporting. The SIA provides additional information to support the original Environmental and Social Impact Assessment (ESIA) process and resultant reports.

To comply with the investors’ requirements and policies, a socio-economic survey was carried out by the Orpic Team with the following objectives:

- To obtain an understanding of the potential impact of the LPIC Project on local communities in the study area
- To learn about the communities’ attitude towards, and expectations from, the LPIC Project, and
- To create a socio-economic baseline against which impacts triggered by the Project, can be measured in the future and to ensure that mitigation measures are adequate.
Two rounds of survey (January and February 2016) were completed, the second with design input from Royal HaskoningDHV to capture qualitative and quantitative data and to ensure easier analysis of data. Schools, hospitals, different governmental offices, supermarkets, clubs, mosques and garden centres were all visited during the second survey. The target respondents for the second socio-economic questionnaire were from 31 villages and settlements. The outcomes of the survey are summarised in Section Error! Reference source not found..

4.6.2 Socio-economic Baseline

At the NGLE site in Fahud, the pipeline crosses three regions and five prominent villages. The population numbers are sparse (estimated from National Centre for Statistics and Information (NCSI) data (2014) and limited windshield surveys), and most villages are located several kilometres away from the pipeline route. Key villages along the route include Al Saghah (population 60), Khashishat Al Melh (58), Al Jaylah (50), Al Jall (40), and Wili. The closest village to the pipeline route is Al Jall, some 40 km south-east of Sohar. One of the properties is located at 15m distance from the pipeline RoW. The PC will be located within the well-known formal and designated existing industrial area at Sohar.

The socio-economic baseline has been characterised through desk-based assessment and local survey, as described previously. In total, close to 390 people were approached to complete the questionnaire second questionnaire completed in February 2016. Approximately 100 people declined to take part in the second survey and at the end 289 completed questionnaires were obtained by Orpic (response rate of 74%) and translated into English.

Most of the second survey respondents were under 40 years old and after the 1970 education reforms in Oman, most people in this age group are now enjoying the benefits of good education and relatively well-paid jobs.

Out of those respondents who were aware about the Project, over 69% stated that they have a positive attitude towards the project, and over 16% have a negative attitude and 14% were neutral.

49% of those who support the Project explained that they feel positive about it because they expect Orpic to provide new job opportunities in the area.

Among those respondents who do not support the development, 51% said that potential pollution is their main concern, while another 25% said that they are worried about potential influx of workers in the area.

Importantly, the survey provided a valuable insight into the project-related issues and concerns among local communities. Based on the survey results, the issues of most interest to the respondents are:

1. Air emissions and pollution generated by the project.
2. How the influx of workers will be managed by the project.
3. Creation of new job.
4. Training to be provided for young adults in the project area.

These four social parameters, will be incorporated into the Social Management Plan, monitored by Orpic throughout the project life-cycle and reported to the Lenders.

4.6.3 Potential Impacts on Local Communities in the Project Area

Construction of the NGLE and PC facilities, and connecting pipeline, will create a construction corridor where the main civil activities will take place. Based on the current design, a construction corridor will be set around the pipeline and the NGLE and PC facilities and it is expected that the construction activities in
a given location will not take more than four to six weeks. Orpic will be able to manage its Contractors and third-party suppliers through the use of a Construction Environmental and Social Management Plan (CESMP) to further minimise potential negative impacts on local communities and avoid unnecessary delays and land take during the construction stage.

The local communities along the suggested pipeline and also close to the NGLE and PC facilities could also be potentially affected by the proximity of workers’ camps. Each workers’ camp is envisaged to accommodate up to 1,000 workers.

Based on the available design, the pipeline will be laid down in Sohar, in the area where the land is mostly of industrial use and currently not used for any agricultural facilities. The proximity to the natural gas pipeline was one of the main considerations aimed at reducing any potential negative impact on local communities. The area has been historically used for industrial development, including the earlier development of the OGC pipeline to SIPA which was finished in 2005.

Where the pipeline is closest to residential property, the history is that two households opportunistically developed residences in close proximity to the pipeline, being fully aware about potential safety risks but in violation of the National Law on the 25m safety zone around any Oil & Gas Pipeline in Oman.

These two adjacent properties and other local settlements along the pipeline route could be affected by the RoW required for construction. As the land required for the construction of the pipeline is designated for industrial use, no land acquisition or changes in land usage will be made during either the construction or operation stages. At the same time, regular communication with the two adjacent property owners will continue, where they will be kept informed by Orpic’s Community Liaison Officers about the schedule of works and other relevant issues. These and other residents of local communities will have access to the Orpic’s Grievance Mechanism. The detailed Grievance Mechanism process is described in Annex A and will be accessible to both local residents and workers engaged on the project.

In addition to the ongoing stakeholder consultations, in particular with institutional/government agencies, OGC conducts awareness campaigns twice a year.

4.6.4 Mitigation

A number of steps will be taken to minimise adverse impacts such as disturbance and nuisance during the construction phase of the Project. Taking such proactive measures will include avoiding construction during prayer times, hiring local people, and procuring local goods and services from sellers and providers in the community. The duration of construction works through Al Jall village is estimated to be short at an estimated three weeks. During this time, an HSE manager will be available to coordinate between workers and the local villages, and ensure adherence to HSE and social management plans.

4.7 Cumulative Impacts

A Cumulative Impact Assessment has been completed by Royal HaskoningDHV. A summary of the key findings is presented here.

This assessment identified that whilst many negligible and minor negative cumulative impacts could occur, only a small number of potentially significant cumulative impacts were identified on the basis of the conservative assessment. The potentially significant cumulative impacts are:
- Socio-economic impacts related to employment and societal cohesion during construction but reducing to minor during operation.
- Road traffic congestion cumulative impact was predicted to be moderate, however it could potentially be higher depending on the traffic volumes and how the other projects influence traffic around the area.
- Air quality and impact on health of local communities’ health particularly during operation.
- Noise and impact on local communities, particularly during construction but also potentially during operation.

The cumulative impact of noise is most likely to come from increased flows of construction vehicles and heavy goods vehicles on the roads, particularly during construction. Residential receptors that are the most sensitive to noise will be moved further away from the sources of noise and therefore the significance of impact will reduce even further during the time period around 2020 to 2021.

On review of the potential effects during decommissioning of the LPIC Project, it is anticipated that the impacts would not be as severe as those during construction, but would be greater than those during operation. However, the decommissioning phase impacts would for the significant part be reversible and would end on completion of the LPIC Project decommissioning phase.

The CIA recommended that air quality modelling of the LPIC Petrochemical Plant location and other projects at least within 5km is undertaken to gain an understanding over the potentially significant nature of the cumulative impact on air quality and impacts on local residents and settlements, including at Liwa City.

Given the lack of transport and traffic information (baseline and quantified assessment) and given the widespread risks to both traffic infrastructure, congestion, and road traffic accident risk outside of the SIPA, the CIAs proposed that baseline traffic counts are undertaken within an appropriate transport study area and assessment made of potential conflicts and levels using modelling in order to identify risk areas and propose other associated development (road infrastructure work) to reduce potential impacts and risks.
5 Environmental and Social Management Plans

Under international performance standards, the developer is required to develop and implement an adequate Environmental and Social Management Plan (ESMP). The purpose of the ESMP is to implement the mitigation measures identified during the ESIA process. The ESMP is required to be split into three sections covering the life cycle of the project:

- Construction Phase Management Plan
- Operation Phase Management Plan
- Decommissioning and Site Restoration Phase Management.

HMR has developed three Environmental Management Plans (EMPs) on behalf of Orpic, one for each of the three project components (see Sections 6.1 to 6.3). The results of the Social Impact Assessment have been incorporated into an outline Social Management Plan (see Section 6.4). The intention is that the EMPs will be further developed with detail provided by the EPC contractors to form Construction Environmental Management Plans (CEMPs) prior to construction.

5.1 Environmental Management Plans

An EMP has been developed for the NGLE facility, which covers construction, operation and decommissioning phases. In addition to providing guidance on organisation and responsibilities, site security and site preparation, the EMP provides guidance on environmental issues specific to the NGLE facility, including air quality, noise, wastewater, waste, and traffic management (these mitigation measures have been described in Section 4).

The EMPs state that new labour camps will be in accordance with local town planning restrictions and will also be based on the workers accommodation guidance by IFC and the World Bank. The EMPs deals specifically with camp health and hygiene. An initial and overarching traffic management plan for the LPIC project has been provided and this is expected to be developed into a specific plan for the construction of the scheme components.

No social management plan elements are currently included and these should be added to the detailed CEMP and OEMP. CEMPs are still to be fully developed by the EPC contractor.

The EMPs identifies a number of parameters requiring monitoring during construction and operation. These are summarised in Table 5.1.
### Table 5-1: Environmental Monitoring and Reporting

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Scope of Monitoring</th>
<th>NGLE (Construction)</th>
<th>NGLE (Operation)</th>
<th>Pipeline (Construction)</th>
<th>Pipeline (Operation)</th>
<th>PC (Construction)</th>
<th>PC (Operation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Accidental spills</td>
<td>Inspection of storage, handling construction areas</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Air Quality</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO₂ and SO₂</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ambient Air Quality</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Point source emissions.</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Particulate Matter</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chemical storage</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Environmental Auditing</td>
<td>Management system monitoring</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explosives</td>
<td>Quality of explosives used</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Groundwater</td>
<td>Chemical analysis</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater abstraction</td>
<td>Quantity and quality.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hazardous wastes</td>
<td>Quantity of each category of waste disposed from site</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Health and Safety</td>
<td>Hygiene, use of PPE, first aid kit, site HSE procedures</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Hydrotstest water</td>
<td>Quality of hydrotstest water generated</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Noise Levels</td>
<td>Sound pressure levels at several locations within/around site</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resource consumption</td>
<td>Use of diesel fuel and natural gas</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Sewage</td>
<td>Quality of raw sewage disposed from labour camps. Quantity during operation.</td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Waste</td>
<td>Quality of each category of waste disposed from work sites and labour camps.</td>
<td>✓</td>
<td></td>
<td>✓</td>
<td></td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Wastewater (sanitary and process)</td>
<td>Flow volume and analysis for parameters</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>✓</td>
</tr>
</tbody>
</table>
6 Findings and Conclusions

6.1 EIA Findings

A summary of the key findings of the EIA and SIA process is provided in the following sections:

6.2 NGLE Facility

<table>
<thead>
<tr>
<th>Impact</th>
<th>Severity</th>
<th>Likelihood/Duration</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Groundwater</td>
<td>Moderate</td>
<td>Medium Term</td>
<td>Impact from accidental releases, infiltration of oil and chemicals spills from bulk storage facilities, and leaching from wastes disposed on land.</td>
</tr>
<tr>
<td>Soil</td>
<td>Moderate</td>
<td>Likely</td>
<td>Impacts from discharge of wastewaters on land, and spillage of oil and chemicals from bulk storage facilities onsite, and disposal of wastes on land.</td>
</tr>
<tr>
<td>Noise</td>
<td>Moderate</td>
<td>Medium</td>
<td>Noise generated from heavy equipment used in construction work, the diesel generators used for on-site power generation and the vehicles used for transportation of material/labour to site.</td>
</tr>
<tr>
<td>Air Quality</td>
<td>Moderate</td>
<td>Medium Term</td>
<td>Generation of dust from earthwork, movement of vehicles on unpaved surfaces and the release of engine emissions.</td>
</tr>
<tr>
<td>Traffic</td>
<td>Moderate</td>
<td>Likely</td>
<td>Traffic congestion / accidents are likely due to the increased levels of traffic on the current infrastructure. The levels of impact of this are however hard to determine accurately as the location of the construction camps has yet to be defined and the movement of workers to and from these camps are likely to contribute to significant quantities of traffic.</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Soil and Groundwater</td>
<td>Moderate</td>
<td>Long Term</td>
<td>Normal wastewater and waste management as a result of wastewaters discharged on land; and infiltration of oil and chemicals spilled from bulk storage facilities.</td>
</tr>
<tr>
<td>Water (supply-demand)</td>
<td>Moderate</td>
<td>Long Term</td>
<td>Emissions of greenhouse gases and gaseous pollutants from four gas turbine stacks and one flare stack.</td>
</tr>
</tbody>
</table>

All other impacts have been assessed by HMR as either low, or positive, and no impact have been judged to have a high impact. Nexant’s due diligence assessment concurred with this assessment.
6.3 NGL Pipeline

Table 6-2: Summary of impacts with a medium impact classification identified in HMR EIA

<table>
<thead>
<tr>
<th>Impact</th>
<th>Severity</th>
<th>Likelihood / Duration</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Air Quality</td>
<td>Moderate</td>
<td>Medium Term</td>
<td>Emissions from earthworks, excavations and construction machinery and vehicles could impact upon ambient air quality due to dust and pollutants.</td>
</tr>
<tr>
<td>Noise</td>
<td>Moderate</td>
<td>Medium Term</td>
<td>Noise levels are anticipated likely to surpass threshold values due to the use of heavy equipment requiring on-site personnel to wear ear protective devices in certain locations.</td>
</tr>
<tr>
<td>Soil and Groundwater</td>
<td>Major</td>
<td>Unlikely</td>
<td>The accidental release of wastewater for hydrostatic testing could impact the quality of soil and groundwater.</td>
</tr>
<tr>
<td>Flora and fauna</td>
<td>Moderate</td>
<td>Medium Term</td>
<td>Impacts from the direct loss of habitat via the installation of the pipeline corridor, temporary office camps and storage yards, and from noise, dust, accidental spills and activities associated with the construction works. Indirect impacts may also arise from poor site practise.</td>
</tr>
<tr>
<td>Settlements</td>
<td>Major</td>
<td>Unlikely</td>
<td>Accidental releases could impact upon local settlements.</td>
</tr>
<tr>
<td>Traffic</td>
<td>Localised</td>
<td>Likely</td>
<td>The movement of heavy traffic and machinery during construction may impact on existing traffic density and safety.</td>
</tr>
<tr>
<td>Infrastructure</td>
<td>Localised</td>
<td>Medium Term</td>
<td>The construction activities may impact local infrastructure such as roads, accommodation facilities, and hospitals.</td>
</tr>
</tbody>
</table>

All other impacts have been assessed by HMR as either low, or positive, and no impacts have been judged to have a high impact. Nexant's due diligence assessment concurred with this assessment.
### 6.4 Petrochemical Complex

**Table 6-3: Summary of impacts with a medium impact classification identified in HMR EIA**

<table>
<thead>
<tr>
<th>Impact</th>
<th>Severity</th>
<th>Likelihood / Duration</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Construction</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Noise</td>
<td>Moderate</td>
<td>Medium Term</td>
<td>Noise levels are anticipated likely to surpass threshold values requiring on-site personnel to wear ear protective devices in certain locations.</td>
</tr>
<tr>
<td>Traffic</td>
<td>Moderate</td>
<td>Likely</td>
<td>The movement of heavy traffic and machinery during construction may impact on land use and local communities due to congestion / accidents, and nuisance from increased activities and traffic.</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water supply</td>
<td>Moderate</td>
<td>Long Term</td>
<td>Once constructed, the plant is expected to be a significant user of water and hence add stress to water supply and demand.</td>
</tr>
<tr>
<td>Air Quality</td>
<td>Moderate</td>
<td>Long Term</td>
<td>Dispersion modelling of pollutants shows a moderate, long term, impact of air quality, greenhouse gas emission and gaseous pollutants from stationary sources.</td>
</tr>
<tr>
<td>Soil and Groundwater</td>
<td>Moderate</td>
<td>Long Term</td>
<td>Impacts from the wastewater and waste management, such as during the management of domestic sewage, surface water runoff and the treatment of effluents.</td>
</tr>
</tbody>
</table>

All other impacts have been assessed by HMR as either low, or positive, and no impacts have been judged to have a high impact. Nexant’s due diligence assessment concurred with this assessment.

### 6.5 Conclusions

An EIA has been completed for each of the three project components, assessing the respective environmental impacts and subsequent required mitigation measures. A review by Nexant and Royal HaskoningDHV has identified several gaps in the EIA scope and methodology, such as the provision of additional information and the undertaking of additional environmental measurements which require completion to fully comply with the necessary Equator Principles and IFC requirements. Once these omissions have been addressed, a secondary review of the impact assessment will be undertaken in order to establish potential updates in light of new information. Following this, any necessary updates to the EMPs for the respective project elements will be undertaken.

It is then considered that through the effective implementation of the EMPs, and careful design, engineering, planning, construction and operation considerations, the impacts associated with the project components will be minimised, where no significant, long term and irreversible change on the environment and the local community will occur.
7 References

HMR (2015a-c). Environmental Impact Assessment Report, NGL Pipeline (Fahud to Sohar) / Natural Gas Liquid Extraction (Fahud) / Petrochemical Plant (Sohar), on behalf of Orpic


HMR and Royal HaskoningDHV (2016). Liwa Plastic Industries’ Complex; Additional Environmental & Social Information for Lenders; Supplementary Social Impact Assessment Report


