Salalah Independent Water Project
Sultanate of Oman

Environmental and Social Impact Assessment

Volume 2 (Main Text, Tables & Figures)

Prepared for:

ACWA Power

January 2018

DOCUMENT INFORMATION

Project	Salalah Independent Water Project
5C's Project Number	1305/001/040
Report Title	Environmental & Social Impact Assessment - Volume 2 (Main Text, Tables & Figures)
Client	ACWA Power
Project Manager	Max Burrow
Project Director	Ken Wade

DOCUMENT CONTROL

Version	Version Date	Description	Author	Reviewed	Approved
1	24/10/2017	ESIA - Volume 2 (Draft)	DM	MKB/AGL	KRW
2	21/11/2017	ESIA - Volume 2 (Draft #2)	DM	MKB/AGL	KRW
3	09/01/2018	ESIA Volume 2	DM	MKB/AGL	KRW
4	07/03/2018	Update on LTA Comments	MKB	MKB	KRW

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CONTENTS

LIST OF ABBREVIATIONS

Abbreviation	Meaning
BMP	Best Management Practice
BOP	Balance of Plant
BS	British Standards
CESMP	Construction Environmental Social Management Plan
dB(A)	A-weighted decibels
dB(C)	C-weighted decibels
ESMS	Environmental and Social Management System
EPs	Equator Principles
EPC	Engineering, Procurement and Construction
EPFIs	The Equator Principle Financial Institutions
ESIA	Environmental and Social Impact Assessment
H&S	Health and Safety
IFC	International Finance Corporation
IWP	Independent Water Project
IWPP	Independent Water & Power Project
Leq(A)	A-weighted Equivalent Continuous Sound Level
Lmax(A)	A-weighted Maximum Sound Level
MECA	Ministry of Environment & Climate Affairs
MOHC	Ministry of Heritage and Culture
MSDS	Material Safety Data Sheet
NOC	No Objection Certificate
O&M	Operation and Maintenance
OESMP	Operational Environmental and Social Management Plan
OPWP	Oman Power and Water Procurement Company
SEP	Stakeholder Engagement Plan
SWRO	Sea Water Reverse Osmosis
TPH	Total Petroleum Hydrocarbons
VOC	Volatile Organic Compounds
WHO	World Health Organisation
5 Capitals	5 Capitals Environmental and Management Consulting

Note: For the purpose of this document the term ESIA is considered to be inclusive of the EIA requirements of MECA as well as the ESIA requirements of the lenders. As such, references to the impact assessment of Environmental and Social parameters are termed as ESIA.

1 INTRODUCTION

The Oman Power & Water Procurement Company (OPWP) has awarded the Salalah Independent Water Project (Salalah IWP) to the consortium of ACWA Power, Veolia and DIDIC (The Project Sponsors). The project is a 25 MIGD seawater reverse osmosis facility with potable water storage facility and will be located in Dhofar Governorate, Sultanate of Oman. OPWP will purchase water from the project under a Water Purchase Agreement with Dhofar Desalination Company SAOC (the Project Company).

This Environmental & Social Impact Assessment (ESIA) has been prepared by 5 Capitals Environmental and Management Consulting (5 Capitals) a registered environmental consultant with the Ministry of Environment & Climate Affairs (MECA), the environmental regulator in Oman. 5 Capitals prepared the project's Environmental Scoping Study (ref. Appendix A), which was submitted to MECA on 4th June 2017 and approved by MECA in June 2017 (ref. Appendix B for approval letter).

The project sponsors are seeking funding from a group of International Financial Institutions (IFIs) which are expected to be signatories of the Equator Principles (EP), a voluntary set of principles established to manage environmental and social investment risks. As such, this ESIA has been conducted to align with both the Omani regulations and the requirements of the IFI's; expected to align with the EP's, IFC Performance Standards and IFC EHS Guidelines. This includes consideration of potential 'social' impacts attributable to the Project, and the on-going management of these impacts & risks.

1.1 Project Information

Table 1-1 Key Project Information

Project Title	Salalah Independent Water Project
Project Sponsor (Primary Contact)	ACWA Power: Business Gate Office Complex, Building 5, P.O. Box 22616 Riyadh, 11416, Kingdom of Saudi Arabia Tel: +966 11 2835555, Fax: +966 11 2835500
Point of Contact	Janaki Kannan: Manager - Business Development, ACWA Power
Project Company	Dhofar Desalination Company SAOC; Commercial Registration No: 1292748
EPC Contractor	SIDEM
O&M Company	To Be Confirmed
MECA Registered Environmental Consultant	5 Capitals Environmental and Management Consulting PO Box 119899, Dubai, UAE Tel: +971 (0) 4 343 5955, Fax: +971 (0) 4 343 9366 www.5capitals.com
Point of Contact	Ken Wade: Director - Environmental Planning

1.2 Objectives of the ESIA

This ESIA document has several objectives in relation to its preparation, use and application for the proposed project. Such objectives include and are not limited to the following:

- The assessment of baseline conditions prior to the project;
- The consideration of, inclusion and consultation with potentially affected stakeholders;
- Review of compliance obligations, including applicable national regulation and lender requirements;
- Determination of the project's environmental & social potential impacts for the construction (including commissioning) and operational phases;
- Assessment of the projects significant environmental & social potential impacts;
- Determination of mitigation measures to ensure that potential impacts are avoided and minimised to acceptable levels, or compensated when residual impacts remain at considerable significance; and
- Exploration of alternatives that can be used for the project leading to greater social and environmental gains.

1.3 Structure of the ESIA

The ESIA has been prepared in accordance with the requirements for environmental & social assessment in Oman and to international best practices required by the lenders. In order to present the ESIA in a logical format, it has been divided into several Volumes:

- **Volume 1:** Non-Technical Summary
- **Volume 2:** Main Text, Tables, Figure and Plates
- **Volume 3:** Outline Environmental and Social Management & Monitoring Plan
- **Volume 4:** Appendices

Volume 1 provides a Non-Technical Summary of the ESIA, including the main outcomes, and conclusions.

Volume 2 comprises the main text of the ESIA and full impact assessment, with mitigation, management and monitoring measures identified. Volume 2 follows the general structure:

- Introduction;
- Regulatory Framework;
- ESIA Process;
- Project Information;

- Air Quality; (the following subchapters are repeated for all environmental and social issues)
  - Introduction
  - Applicable Regulation and Standards
  - Baseline Environmental Conditions
  - Outcome of Scoping Report
  - Methodology
  - Sensitive Receptors
  - Impact Assessment & Significance
  - Mitigation & Management Measures
  - Residual Impacts
  - Monitoring Measures
- Noise and Vibration
- Terrestrial Ecology
- Soil, Geology and Groundwater;
- Marine Environment
- Surface Water Environment
- Water and Wastewater Management;
- Archaeology and Cultural Heritage
- Landscape and Visual Impacts
- Socio-Economics
- Community, Health, Safety and Security
- Labour and Worker Conditions
- Cumulative Impact Assessment

Volume 3: provides a framework for the development of the Construction Environmental & Social Management Plan (CESMP) by the EPC Contractor; and the Operational Environmental & Social Management Plan (OESMP) to be developed by the Operation and Maintenance Company (O&M).

Volume 4 comprises all Appendices (i.e. consultation meeting, baseline survey reports, laboratory results, predictive modelling studies and other Technical Studies).

2 PROJECT INFORMATION

2.1 Project Background & Rationale

OPWP has planned a water desalination project in on the outskirts of Salalah with a planned commercial operation date of early 2019. The project will help meet the future water demand in the Dhofar region, increasing over 8% (source: OPWP 7 Year Statement, June 2016),

The project is structured as a Build-Own-Operate Independent Water Project (IWP) with OPWP purchasing the Potable Water produced by the operator under a 20-year Water Purchase Agreement.

The scope of the project includes the design, financing, construction, ownership, operation and maintenance of high efficiency desalination facilities based on seawater reverse osmosis technology with a capacity of 25 MIGD of Potable Water output (113,650 m^3 per day of Potable Water output in nominal conditions, and 120,000m^3 per day during high demand periods).

The scope of the Project includes not only the development of the main Potable Water production facilities, but also the supply of all equipment and services necessary for the operation of each Plant including the Seawater Intake/Outfall Facilities and Access Road from the public highway.

Electricity supply to the project will be provided via an 11kV connection from the Dhofar Power Company.

2.2 Project Location

The project will occupy an area of approximately 5.83 hectares, located approximately 30km east of Salalah, as presented in the figure below.

Figure 2-1 Project Location

The co-ordinates of the proposed project site and project components are presented in Appendix C.

The main project facilities will be located on the cliff top approximately 50m from the shoreline and located adjacent to an existing IWPP facility. The project will link to the sea, via dedicated intake and outfall pipelines. The proposed project will be accessible from the north-west via a new access road, to be constructed as part of the project and connecting with the existing IWPP access road, as shown in Figure 4-2 below.

Figure 2-2 Project Land Uses

2.3 Land Use and Site Condition

2.3.1 Land Ownership

The project's land is owned by the Ministry of Housing. The project will use this land under a Land Lease Agreement to be arranged with the Ministry of Housing for the duration of construction and operations.

The Krooki, for the projects land area (issued by the Ministry of Housing) is presented in Appendix D.

2.3.2 Land Use

The land is currently unused, but was previously used as the construction laydown, staging and administration area for the adjacent IWPP project. The previous land use included the location of various temporary construction facilities, material staging areas and administration offices. This included the storage of small quantities of fuels, hazardous materials and chemicals to facilitate construction, as well as septic tank storage of sanitary wastewater. The temporary construction facilities have been demobilised and the site has since been rehabilitated.

On the day of the initial site visit in summer 2016, bulldozers, excavators and tipper trucks were active, associated with the demobilisation and rehabilitation of the pre-existing site compound (for the Salalah IWPP) at the project area. At the time of the ESIA site visit in July 2017, all restoration works had been completed and the site had no on-going activities taking place. The same observation of a clear site with no visible land uses was confirmed during a visit in December 2017, as shown below.

Plate 2-1 Salalah IWP site (17th December 2017)

The previous temporary telecommunications tower that was in place previously has been removed from the site and is now located approximately 800m to the west close to the western boundary of the Salalah IWPP.

2.3.3 Site Condition

The project site comprises sandy beach, sloped rocky cliff (with minimal vegetation coverage) and open cliff top plain free of vegetation coverage of any kind. The adjacent IWPP, located to the west, is the most notable feature within the immediate landscape, which includes two rock groynes for buried intake and outfall pipeline protection, as observed in the plate below.

Plate 2-2 View to the South-East and South-West (respectively) from Cliff Edge


To the north of the project site is a large steep sided and wide wadi that dominates the local landscape. It is noted that the wadi, nor its sides will be affected by the project footprint or associated facility works.

Plate 2-3 View of Wadi Channel to the North of the Project

Plate 2-4 View to the North over the area for the Proposed Project Desalination Facilities

Plate 2-5 View of Proposed Access Road Corridor North of the Salalah IWPP

2.3.4 Local Facilities and Receptors

Existing Salalah IWPP

There is an operational IWPP project developed by Sembcorp located adjacent to the western boundary of the proposed project area. The existing Salalah IWPP is a natural gas fired power and water plant with a total gross capacity of 490 MW and a seawater desalination production capacity of 15 MIGD (69,000 m^3/d).

Plate 2-6 View of existing IWPP from the Proposed Site

Camel Shelters

Several small shelters and pens utilised for camels and their herders are located approximately 2.25km to the west of the project site in proximity to the existing hardstanding access road. The pens and shelters are understood to be owned by local tribal groups who employ people to tend to these camels.

It is recognised that the presence of the camels and their herders in this area is seasonal, whereby they tend to only be present during the Khareef season. This was confirmed by Salalah IWPP staff and observations on-site during the ESIA consultation exercise in December 2017.

Plate 2-7 Temporary Pens & Shelter for Camels & Herders (July 2017)

Plate 2-8 Demobilised Pens & Shelters for Camels & Herders (December 2017)

Scout Camp

A scout camp is located approximately 1km to the west of the Project site on open land adjacent to the Salalah IWPP. The Scout camp consists of several 1-storey separate buildings. During the ESIA visit to the site in July 2017, informal consultation with scout camp staff indicated that the camp is used as temporary residences for approximately 2 weeks per year, but this depends on demand. This was further confirmed by Salalah IWPP staff during the ESIA consultations in December 2017.

Plate 2-9 Scout Camp

Worker Accommodation & Construction Laydown Area (for separate highway project)

A worker accommodation area operated by Galfar Engineering & Contracting SAOC has been established approximately 1.3km from the site and is being used to accommodate workers for a nearby Highway Construction Project. The area also includes a laydown for construction equipment. It is understood that the area will be decommissioned once the highway project is complete, expected in March 2018 (information obtained from the Galfar Project Manager during the ESIA Consultations in December 2017). During the ESIA Consultation visit in December 2017, the extent of the accommodation and laydown areas had visibly reduced and It was evident that demobilisation of the camp had begun. It is likely that the camp will be fully demobilised prior to commencement of Salalah IWP works.

Plate 2-10 Temporary Worker Accommodation and Construction Laydown Area

Figure 2-3 Location of Local Facilities and Receptors

2.4 Project Description

The Salalah IWP project includes the following key facilities:

- Sea water intake system;
- Sea water discharge system;
- Pumping station, including screening equipment;
- Chlorination facilities (pre-chlorination and disinfection);
- Pre-treatment system;
- SWRO system;
- Post treatment system;
- Potable Water Storage Facilities;
- Waste water treatment system;
- Instrument and service air system;
- Fire protection and detection system;
- Ventilation and air conditioning;

- General buildings (e.g. security gate house and administration buildings);
- Access roads;

Figure 2-4 Salalah IWP Main Entrance View

Figure 2-5 Salalah IWP Overview

The historical sea water conditions and the particularities of the region have been considered in the design and dimensioning of the desalination plant, with the aim of complying with the technical and operational expectations and requirements of OPWP. Further, the design of the plant and the related buildings have been developed focusing on the combination of operational suitability and efficiency while ensuring minimization of the environmental and visual impact, by utilizing cultural features in design.

Figure 2-6 Salalah IWP Cultural Building Design

Figure 2-7 Salalah IWP General Layout

In summary, the project design aims to achieve the following objectives:

- Ensure the guaranteed water capacity, availability and quality as required by OPWP;
- Optimise energy consumption;
- Design the plant considering the operation and maintenance period and the whole life of the project;
- Optimise the quality of the installed equipment with the best and most reliable suppliers and technologies;
- Optimise the layout of the plant to ensure a proper accessibility to equipment for a correct operation and maintenance;
- Reduce operational noise and vibration levels;
- Ensure the maximum flexibility in operation by implementing optimal automation processes;
- Minimize the environmental and visual impact during plant execution and operation.

The Salalah IWP SWRO desalination plant has been designed to provide full capacity with the required quality considering the specific conditions of sea water in the region and the algal bloom and red tide phenomena which are likely to occur periodically.

2.4.1 Capacity

The total production capacity of the seawater desalination plant will be 113,650 m^3/day in nominal conditions. The plant has been designed to produce the full plant capacity operating either 5 RO trains or 4 trains with one train out of service for maintenance. A design capacity of 22,730 m^3/day +0.5% of extra production for internal consumption has been considered. A maximum capacity of 28,413 m^3/day per train can be produced when one RO train is in maintenance.

During high demand periods, the plant will be able to produce 120,000 m^3/day working with 5 trains, each producing 24,000 m^3/day.

The configuration will enable the Project Company to produce the maximum capacity, optimizing the scheduled outages in order to ensure the optimal operational conditions considering the operational and maintenance requirements to ensure the most efficient operation for the 20 years of the concession.

2.4.2 Intake & Outfall

The intake and outfall will consist of buried pipelines sub-surface of 500m and 800m in length respectively. They will be aligned in the same trench to minimise earthworks and seabed disturbance.

The proposed intake and outfall alignment is shown in the following figure.

Figure 2-8 Proposed Intake & Outfall Alignment

The intake head will rise from the seabed at 10m depth and will take in water at approximately 7m depth. The intake velocity will be 0.15m/s (maximum) and will have a 100mm mesh screen to minimise entrainment of marine fauna.

The outfall will consist of a series of diffusers rising from the seabed at over 13m deep.

Indicative designs of the intake head and outfall diffusers are shown in the following figures.

Figure 2-9 Intake Head Design

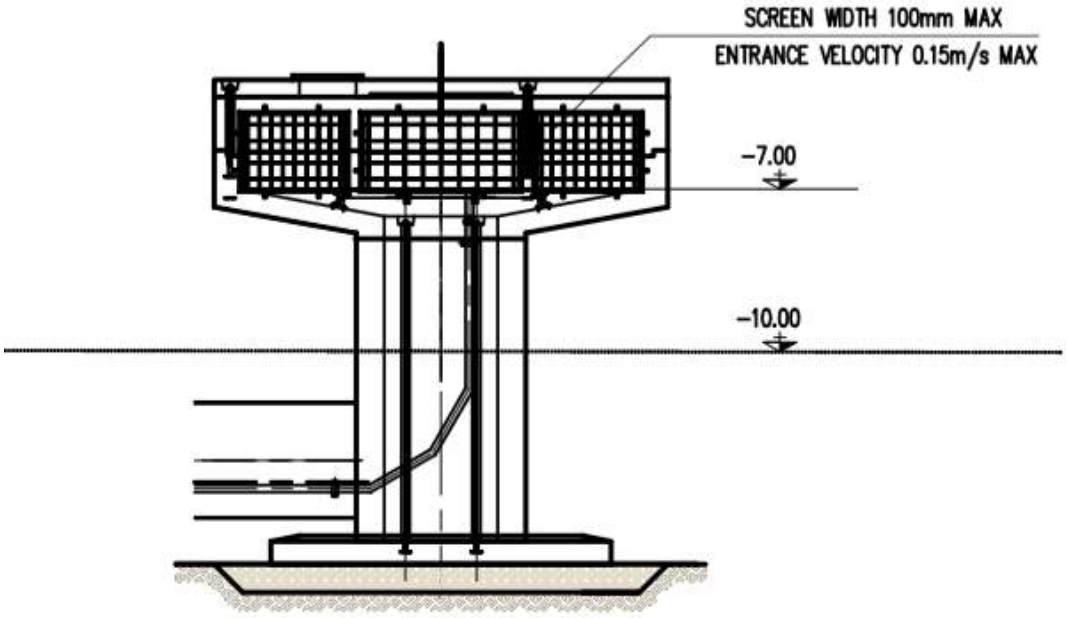
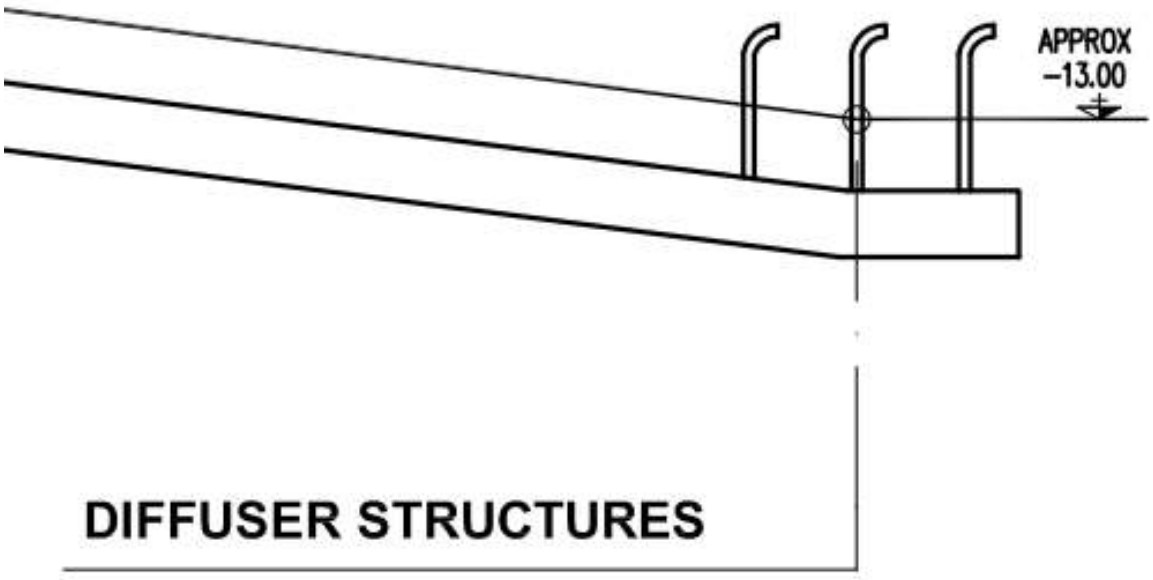


Figure 2-10 Outfall Diffuser Design



2.4.3 Pre-Treatment

The pre-treatment process comprises a Dissolved Air Flotation (DAF) system, gravity filters, pressurized filters and cartridge filters. It has been designed to remove suspended solids to ensure that the water entering the RO process complies with membrane requirements and, therefore, product water quality can be guaranteed without reducing the plant availability. The complete pre-treatment process consists of the following:

- Chemical dosing for coagulation and flocculation
  - Ferric chloride for coagulation: two (2) dosing tanks (with 50% of the required capacity each) and three (3) dosing pumps of 50% of capacity each (2 operating +1 in stand by unit) will be installed;
  - Sulphuric acid: two (2) dosing tanks (with 50% of the required capacity each) and three (3) dosing pumps of 50% of capacity each (2 operating +1 in stand by unit);
  - Flocculation system: two (2) automatic systems (with 100% of capacity each) and three (3) dosing pumps of 50% of capacity each (2 operating +1 in stand by unit) will be installed.

2.4.4 Dissolved air flotation system (DAF)

This system has also been designed complying with the energy efficiency and flexibility-in-the-operation philosophy of the whole plant. The DAF, which has been designed to treat the full plant capacity, will operate when required as per sea water conditions and will be by passed if no flotation is needed. The system will comprise five (5) lines, and four (4) can treat 100% of flow when one unit is out of service/maintenance.

2.4.5 Gravity multimedia filters

Fourteen (14) filtration cells will be installed. Designed for filtering velocities below 8.3$m^3/m^2/h$ in nominal conditions and 9$m^3/m^2/h$ with 1 unit in backwash. With anthracite and sand, gravity filters are expected to remove more than 85% of the TSS in the inlet water before RO. Filtered water will be conducted to the intermediate filtrate water tank, which is split in two tanks.

Intermediate pumping station to RO system. Consisting of 6 horizontal centrifugal pumps (5 operating +1 in stand by unit) which will pump filtered water to pressurized filters and RO process.

2.4.6 Pressurized multimedia filters

Eleven (11) filters will be installed. Designed for filtering velocities below 14.27 m3/m2/h in nominal conditions and 15.7 m3/m2/h with 1 unit in backwash. With anthracite and sand, pressurized filters are expected to remove more than 70% of the TSS in the inlet water.

2.4.7 Chemical storage and dosing

For each chemical compound used in the plant, two storage tanks (50% of required capacity) with filling and transfer pumps will be installed. The capacity of chemical storage tanks has been calculated to maintain a spare time of storage of fourteen (14) days. Redundancy has also been considered for both filling pumps (1operating +1 stand by unit) and transfer pumps (1operating+1 stand by unit).

2.4.8 SWRO system

The reverse osmosis is the core of the desalination process. The process, from the intake of sea water, has been engineered and designed to guarantee the product water quality. RO membranes are designed to operate under very specific conditions. The process prior to the RO shall ensure an adequate removal of suspended solids to avoid membrane damage.

Apart from the suspended solid removal, an adequate RO requires chemical balance (with sodium bisulphite and anti-scalant) and high pressure to induce the reverse osmosis process.

2.4.9 Chemical dosing

Dosing tanks and dosing pumps will be installed for each of the chemical compounds used in the RO process. The volume of dosing tanks has been calculated to ensure availability even in case of supply cuts. In particular:

- For sodium metabisulphite, two (2) dosing tanks (with 100% of the required capacity each) and three (3) dosing pumps (with 50% of capacity each (2 operating +1 in stand by unit)) will be installed.
- For anti-scalant, two (2) dosing tanks (with 100% of the required capacity) and three (3) dosing pumps (with 50% of the required capacity each (2 operating +1 in stand by unit)) are designed for the RO system.

2.4.10 Cartridge filters

Used to retain and remove any remaining suspended solid in the inlet water and protect the RO membranes from damage. A total number of five (5) units will be installed (4 operating + 1 in stand by unit).

2.4.11 Reverse Osmosis Trains

The RO trains are the core of the desalination process. The size and number of trains have been chosen in order to be consistent with the overall philosophy of the desalination plant. Five (5) RO trains with 1,656 RO membranes each will be installed. The RO system has been designed to produce the full plant required capacity with five RO trains working or four working and one in standby. The RO process is designed to work with low flux (~14lmh) with five RO trains

Low fluxes allow to work with lower pressures and head losses and, therefore, to optimize the energy consumption and life cycle and efficiency of RO membranes.

Each of the RO trains includes:

- 1 Energy Recovery Device (ERD) system;
- 1 ERD booster pump;
- 1High Pressure Pump (HPP);
- 1RO rack with 1,656 RO membranes;

2.4.12 Cleaning In place (CIP)

The Cleaning in Place (CIP) and waste water neutralization system for membrane chemical cleaning, consisting of:

- CIP tank with 100% of the required capacity required to clean 1 RO train;
- Two (2) CIP pumps (1 operating + 1 stand by unit) with 100% of required capacity each one to clean 1 RO train;
- One (1) cartridge filter for chemical cleaning;
- One chemical preparation (dissolving and mixing) tank with two loading pumps (1W+1S).
- One (1) permeated/flushing water tank, split into independent chambers, connected to the CIP pumps.

2.4.13 Post treatment system

After reverse osmosis, permeated water requires a post-treatment and re-mineralization treatment which will provide the water with the adequate pH levels and chemical and mineral composition for final consumption. The post-treatment and re-mineralization process consists of:

- CO_2 dosage system for pH regulation and preparation of water for re-mineralization. The system will include a storage and dosing system with two (2) units (1 operating + 1 in standby) and two (2) storage tanks of 50% capacity.
- Limestone filters for re-mineralization: for the guaranteed capacity, fourteen (14) units will be installed;
- Chemical dosing: final chemical tuning to the final product water parameters will be done with sodium hydroxide, sodium hypochlorite and sodium fluoride:
  - The sodium hydroxide dosing system will consist of two (2) dosing tanks (50% of the required capacity each) and three (3) dosing pumps (50% of capacity each);
  - The sodium hypochlorite dosing system, consisting of two (2) dosing tanks (50% of the required capacity each) and three (3) dosing pumps (50% of capacity each); and
  - The sodium fluoride dosing system, consisting of two (2) dosing tanks (50% of the required capacity each) and three (3) dosing pumps (50% of capacity each).

2.4.14 Potable Water Storage Facility

A potable water storage facility capable of storing 90,909m^3 will be constructed as part of the project. The storage facility will include inlet and outlet pipes which will convey water to the storage facility and onwards to the potable water connection pipeline (see associated facilities).

2.4.15 Potable Water Pump Station

A Potable Water Pump Station with three pumps (2 working + 1 in standby) and a potable water connection pipeline with a 100% of capacity until Connection Point at the Site boundary.

2.4.16 Wastewater Treatment

The wastewater treatment systems comprise:

- A backwash wastewater basin;
- Two (2) feeding pumps to coagulation chambers;
- Coagulation, flocculation and lamella settling tanks: two (2) lines installed;
- A sludge homogenization tank;
- Sludge dewatering line, consisting of two (2) sludge feeding pumps of 50% of the maximum required capacity, two (2) screw press of 50% of the maximum required capacity and two (2) dewatered sludge pumps to silos.
- Two silos for sludge storage until final removal;
- A clarified water tank;
- Four (4) clarified water pumps (3 operating units and 1 in stand-by);

2.4.17 Other Facilities

- Instrument and service air systems.
- Fire protection and detection systems.
- Ventilation and air conditioning.
- Administration and Operations Buildings
- Warehouse(s).
- Security Building.

2.4.18 Energy Efficiency and Energy Recovery

Apart from the robust-flexible design of the pre-treatment, the process has been adjusted to optimize the power consumption and maximize the efficiency. This optimization is achieved by developing a comprehensive plant design which includes, among others, the following equipment and systems:

- Installation of turbine in brine discharge line for effluent energy recovery.
- Isobaric chambers for energy recovery in each RO train.
- Variable frequency drives in all main pumps: sea water intake pumps, intermediate pumps, high pressure pumps and booster pumps, product water pumps, allowing controlling the system with optimal power consumption. Also, VFD in others minor pumps such as DAF pumps recirculation, CIP pumps, have been included.
- Design of the DAF and gravity filters line to work by gravity with low head loss.
- Optimization of the pump operation and efficiency by reaching the duty point of each and all pump in the process.

2.4.19 Redundancy

The design of the plant has been developed taking into account the availability and reliability requirements and in order to achieve the expectations, the following spare systems will be installed:

- - One spare pump per each pumping system;
- - One spare unit of each treatment system as follows:
  - 1 DAF line (equivalent design);
  - 1 gravity filter unit (equivalent design);
  - 1 pressurized filter unit (equivalent design);
  - 1 spare cartridge filter prior to SWRO system;
  - 1 RO train with booster pump to HPP, HPP pump, booster and energy recovery system (equivalent design);
  - 2 bulk storage tanks per each chemical product to be dosed (2 x 50% of capacity considering the whole plant);
  - 2 dosing tanks where required (2 x 50% of capacity considering the whole plant) with 3x50% dosing pumps;

2.4.20 Greenhouse Gas Emissions

The project will not be a direct emitter of Scope 1 Greenhouse Gas (GHG) emissions, as its primary production processes do not include the combustion of hydrocarbon fuels. Electrical energy will be sourced for the project in order to enable operations and desalination of seawater. Electrical energy will be taken form the Dhofar grid, via a connection to the DPC substation.

The EPC Contractor has prepared calculations of the expected Scope 2 GHG emissions, for normal daily and annual production, as well as for exigency periods. The calculations are shown in the table below.

Table 2-1 Salalah IWP - Scope 2 Greenhouse Gas Emissions Calculations

Salalah Greenhouse Gases Estimated Calculation		
	Normal Conditions	**Exigency period**
Desalination plant production m^3/día	113.000	120.000
Desalination plant productiona m^3/año	41.245.000	43.800.000
Power Consumption kWh/m3	3,54	3,73
Total Consumtion (kWh)	146.007.300	163.374.000
Fe (Emision Factor Oman 2014) tonnes CO 2 / terajoule	58,8	58,8
kwh=3,6 10^6 J TJ=10^{12}J		
tn CO2	**30.906,83**	**34.583,01**

The calculations estimate that under normal operation, the project will result in 30,906.83 tonnes of CO2 equivalent. If exigency operation is sustained for a year, this would result in a worst case of 34,583.01 tonnes of CO2 equivalent.

2.4.21 Associated Facilities

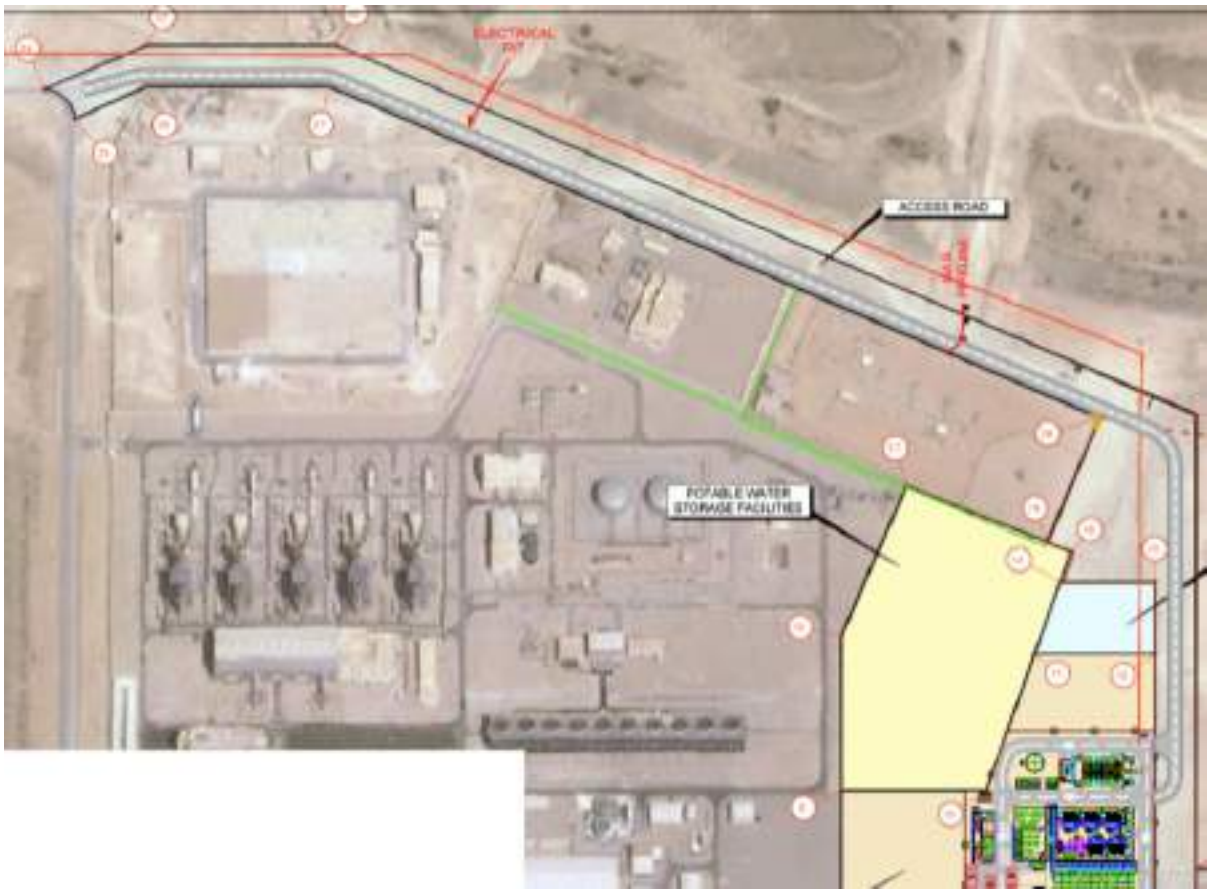
Access Road

The primary associated facility of the project is the access road that will be constructed by the EPC but owned and maintained by Dhofar Governorate. The access road will connect to the northern extent of the Salalah IWP project, passing to the immediate north of the existing Salalah IWPP and adjoining to the existing hardstanding access road which leads from Highway 49 to the Salalah IWPP.

The access road will have a length of approximately 1Km and 10m wide. The road will have lateral hard shoulders of 1.5 meters and two lanes (for dual flow) of 3.5 meters. No lighting or other road features/street components will be included.

The proposed access road alignment is shown in the figure below.

Figure 2-11 Project Access Road Area

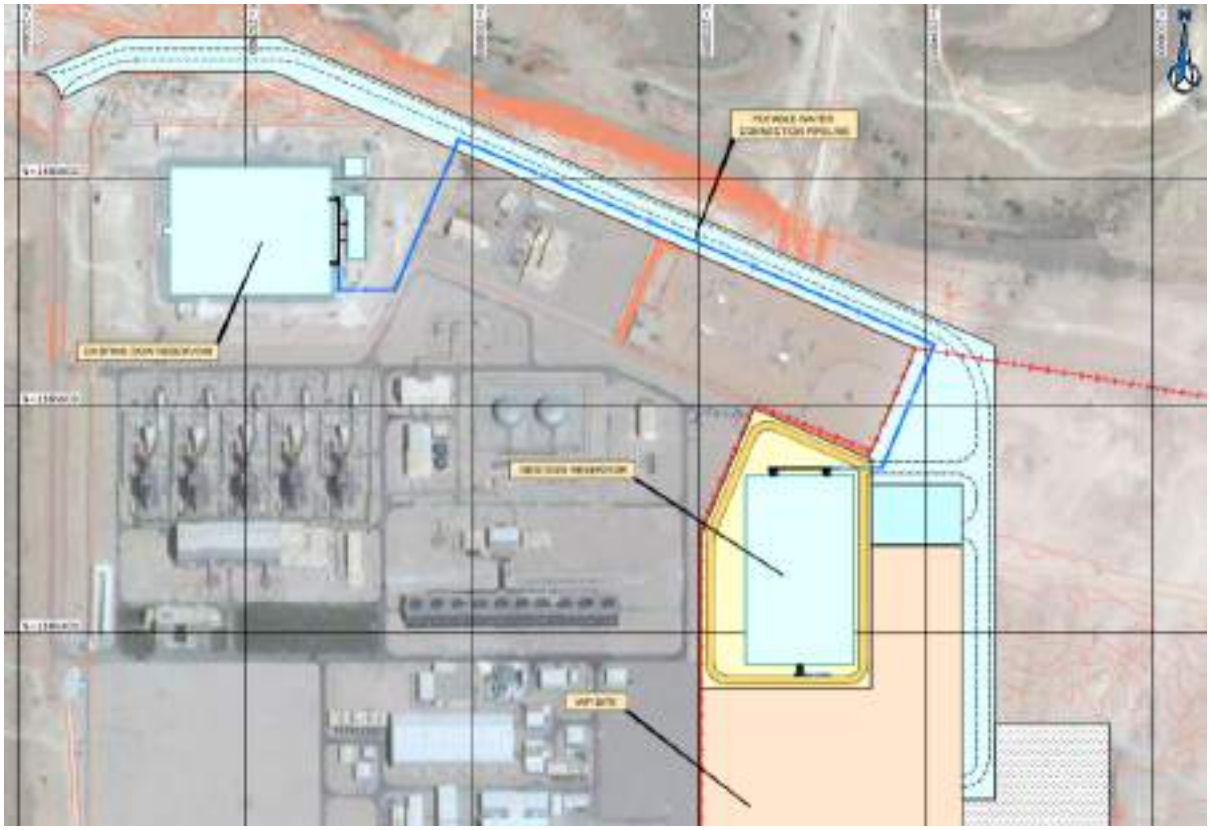


Potable Water Connection Pipeline

A potable water connection pipeline will be constructed as part of the project to connect the on-site potable water storage facility with the existing potable water reservoir, located at the Salalah IWPP.

The pipeline will be of 1,200mm diameter and will be aligned underground within the same corridor of land as the projects proposed access road, as shown in blue in the figure below. The length of the pipeline will be approximately 800m.

Figure 2-12 Project Potable Water Facilities



Electrical Connection Facility

DCP will be building a new 33/11 kV substation next to the site. The IWP will be connected to the DPC substation with two redundant 11 kV feeders.

2.5 Construction of the Plant

2.5.1 Construction Facilities

Temporary Laydown Area

The construction phase will require temporary laydown areas to provide materials storage, & administration preparation areas for the EPC Contractor and sub-contractors works. The project is expected to require a 17,500m^2 area and will be located on land immediately east of the project site (also owned by the Ministry of Housing), as shown in the Figure below.

Manpower

Final manpower requirements are yet to be clarified. The EPC Contractor is still developing their organisational chart. However, based on experience of similar sized SWRO projects in the Middle East, it is estimated that there will be between 500-1000 workers at peak periods.

It is expected that there will be approximately 15 EPC Contractor employees based on-site. Other staff will make up the sub-contractor workforce during construction.

Construction Utilities

During construction, electricity will be supplied to the offices and working areas by temporary generators installed by the EPC Contractor and sub-contractors. The generators are expected to operate on diesel fuel (supplied and distributed by road tanker) and will supply electricity for temporary construction facilities and any works on-site. Permanent facilities resulting from the construction of the project, will be transferred to the permanent power supply form the electrical connection (see project associated facilities), at a later stage of construction.

Temporary sanitation facilities will be available on-site during construction and will collect wastewater in septic tanks, for collection and removal form the site by a licensed contractor.

Water for the project will be delivered by road tanker form a registered supplier, for potable supply.

Worker Accommodation

Requirements for worker accommodation have not been finalised, but will likely be provided on a contractor by contractor basis. These areas are unlikely to be at the project site, but may be situated locally in a nearby town.

The EPC Contractor has confirmed that the standards of facilities for worker accommodation will be in accordance with the IFC/EBRD Worker Accommodation Guidelines.

2.6 Project Alternatives

In accordance with good practice methodologies for ESIA, the evaluation of various project design and activity alternatives should be considered, in order to ensure that the objectives of the proposed project have accounted for social, environmental, economic and technological options.

Given that the project has been awarded under a very structured bidding process with defined technical requirements, there have been few opportunities to modify the design. For instance, it has not been possible to consider other land areas for the project based on the stipulated use of this land in the bidding process.

As part of the ESIA an overview assessment of project alternatives has been considered for:

- No Project Alternative;

2.6.1 No Project Alternative

The potable water generating capacity of the Project will be 22 MIGD. The 'no project' option is considered not viable given the requirement for additional potable water in Oman as per the project's rationale. The table below presents a basic comparison of the anticipated impacts from the development of the proposed project versus the option of 'no project'.

Table 2-2 Evaluation of the 'No Project' alternative vs Proposed Project

Environmental Issue	No Project	Construction Phase	Operational Phase
Air quality	No change=0	Negative = -1	0
Noise	0	-1	0
Soil & Groundwater	0	-1	0
Terrestrial Ecology	0	0	0
Marine Environment	0	0	-1
Transport	0	0	0
Resource & Utilities	-1	-1	+1
Socio-Economic	-1	Positive = +1	+1
Cultural Heritage	0	0	0
Landscape & Visual	0	0	0
Total	**-2**	**-3**	**+1**

Although the construction phase of the Project will likely result in an overall negative impact, the operational phase will likely result in a slight overall positive impact, particularly due to the development of utilities and socio-economic benefits.

3 REGULATORY FRAMEWORK

3.1 Requirements for Environmental & Social Assessment

3.1.1 National Requirements

Environmental Regulator

The environmental regulator in Oman is the Ministry of Environment and Climate Affairs (MECA).

Royal Decree No. 90/2007 established the Ministry for Environment and Climate Affairs (MECA), where environment-related works, allocations and assets were transferred from the responsibility of the Ministry of Regional Municipalities, Environment and Water Resources. Omani legislation relating to the requirement for environmental assessment followed the issuance of Royal Decree No 114/2001 entitled 'Law on Conservation of the Environment and Prevention of Pollution'.

The responsibilities of MECA include:

- The environmental regulator is the designated competent agency to preside over and implement the laws in relation to the environment.
- The environmental regulator has the right to implement laws, fine violators and suspend or close facilities not complying to the applicable environmental laws.
- The environmental regulator has the authority to approve the environmental aspects related to projects and permit their construction and operational activities.
- The environmental regulator also has the authority to allow deviations from the standards, under agreed circumstances.

Project Requirements

Prior to the issue of the request for proposal at the bidding stage, OPWP consulted with MECA regarding the development of IWPs at the proposed project site.

A preliminary in-principle application based on tentative conceptual plants and process designs had been submitted by OPWP to MECA as a basis for securing an initial "No Objection Letter" for development of the proposed project site.

In accordance with the "No Objection Letter" the successful bidder (i.e. the project sponsors) are required to undertake an EIA in accordance with the Omani Environmental requirements and regulations. As such, the projects sponsors are ultimately responsible for obtaining an environmental permit from MECA and complying with any conditions to such environmental permit for the applicable Project.

EIA Regulatory Considerations

Environmental requirements developed and implemented by MECA classify projects into eight groups according to the technical aspects of their construction and operation. Any project that falls into any of these MECA categorizations will require an Environmental Permit. It is anticipated that the proposed project will be classified under Group One: Industrial Project, Category 'C' Water Purification and Desalination Plants. The existing "No Objection Certification" confirmed that an EIA would be required in order to permit the project.

This EIA forms a principle component of the application package for an Environmental Permit. After review is complete, MECA will either:

- Accept the conclusions of the EIA and issue an Environmental Permit,
- Request further study through clarifications, or
- Request re-application for an alternative proposal. Once the permit is issued, the submitted EIA document becomes a part of the permit and any changes to the EIA require amendment to the Permit.

3.1.2 Lender Requirements

It is understood that project sponsors are seeking project finance from international lenders who are expected to be signatories of the Equator Principles. As such there are a number of requirements for ESIA as set out below, particularly in regard to Equator Principle 2 - Environmental and Social Assessment.

A key difference between the Omani and lender EIA/ESIA requirements is the extent of Social Assessment required by the lenders. Hence the impact assessment required by the international lenders is termed as an ESIA (Environmental and Social Impact Assessment). This assessment therefore considers the project's environmental and social requirements to satisfy the requirements of MECA and the lenders.

The Equator Principles

On 4th June 2003, ten banks from seven countries signed up to the Equator Principles (EPs), a voluntary set of guidelines for assessing and managing environmental and social risks in project financing. Currently, over seventy-five major financial institutions from around the world have adopted the EPs. These financial institutions operate in more than 100 countries worldwide. As a result, the Equator Principles have become the project finance industry standard for addressing environmental and social issues in project financing globally. The Equator Principles were updated in 2006 (EP II) to include projects with a capital cost of US$10 million or more across all industry sectors and these are the prevailing applicable conditions for this project.

The Equator Principles Financial Institutions (EPFIs) reviewed the Equator Principles in 2011 and approved the latest version, EP III on 26th April 2013. These became effective from 4th June 2013 and have been fully implemented since 31st December 2013.

The EPs establish the minimum standards to be adopted by the EP Financial Institution (EPFI) as those from IFC Performance Standards and/or the relevant host country laws, regulations and permits that pertain to environmental and social issues.

The Equator Principles consist of the following 10 Principles:

Table 3-1 Equator Principles III (2013)

Equator Principle	Details
Principle 1	**Review and Categorisation** EPFIs will categorise a project proposed for financing based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the International Finance Corporation (IFC). These categories are: • ***Category A***- Projects with potential significant adverse social or environmental risks and/or impacts that are diverse, irreversible or unprecedented; • ***Category B*** – Projects with potential limited adverse social or environmental risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures; and • ***Category C*** – Projects with minimal or no social or environmental risks and/or impacts.
Principle 2	**Environmental and Social Assessment** For all Category A and Category B Projects, the EPFI will require the client to conduct an Assessment process to address, to the EPFI's satisfaction, the relevant environmental and social risks and impacts of the proposed Project (which may include the illustrative list of issues found in Exhibit II). The Assessment Documentation should propose measures to minimise, mitigate, and offset adverse impacts in a manner relevant and appropriate to the nature and scale of the proposed Project. The Assessment Documentation will be an adequate, accurate and objective evaluation and presentation of the environmental and social risks and impacts, whether prepared by the client, consultants or external experts. For Category A, and as appropriate, Category B Projects, the Assessment Documentation includes an Environmental and Social Impact Assessment (ESIA). One or more specialised studies may also need to be undertaken. Furthermore, in limited high-risk circumstances, it may be appropriate for the client to complement its Assessment Documentation with specific human rights due diligence. For other Projects, a limited or focused environmental or social assessment (e.g. audit), or straightforward application of environmental siting, pollution standards, design criteria, or construction standards may be carried out.
Principle 3	**Applicable Environmental and Social Standards** The Assessment process should, in the first instance, address compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. EPFIs operate in diverse markets: some with robust environmental and social governance, legislation systems and institutional capacity designed to protect their people and the natural environment; and some with evolving technical and institutional capacity to manage environmental and social issues.

Equator Principle	Details
	The EPFI will require that the Assessment process evaluates compliance with the applicable standards as follows: 1. For Projects located in Non-Designated Countries, the Assessment process evaluates compliance with the then applicable IFC Performance Standards on Environmental and Social Sustainability (Performance Standards) and the World Bank Group Environmental, Health and Safety Guidelines (EHS Guidelines) (Exhibit III). 2. For Projects located in Designated Countries, the Assessment process evaluates compliance with relevant host country laws, regulations and permits that pertain to environmental and social issues. Host country laws meet the requirements of environmental and/or social assessments (Principle 2), management systems and plans (Principle 4), Stakeholder Engagement (Principle 5) and, grievance mechanisms (Principle 6). The Assessment process will establish to the EPFI's satisfaction the Project's overall compliance with, or justified deviation from, the applicable standards. The applicable standards (as described above) represent the minimum standards adopted by the EPFI. The EPFI may, at their sole discretion, apply additional requirements.
Principle 4	**Environmental and Social Management System and Equator Principles Action Plan** For all Category A and Category B Projects, the EPFI will require the client to develop or maintain an Environmental and Social Management System (ESMS). Further, an Environmental and Social Management Plan (ESMP) will be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards. Where the applicable standards are not met to the EPFI's satisfaction, the client and the EPFI will agree an Equator Principles Action Plan (AP). The Equator Principles AP is intended to outline gaps and commitments to meet EPFI requirements in line with the applicable standards.
Principle 5	**Stakeholder Engagement** For all Category A and Category B Projects, the EPFI will require the client to demonstrate effective Stakeholder Engagement as an on-going process in a structured and culturally appropriate manner with Affected Communities and, where relevant, Other Stakeholders. For Projects with potentially significant adverse impacts on Affected Communities, the client will conduct an Informed Consultation and Participation process. The client will tailor its consultation process to: the risks and impacts of the Project; the Project's phase of development; the language preferences of the Affected Communities; their decision-making processes; and the needs of disadvantaged and vulnerable groups. This process should be free from external manipulation, interference, coercion and intimidation. To facilitate Stakeholder Engagement, the client will, commensurate to the Project's risks and impacts, make the appropriate Assessment Documentation readily available to the Affected Communities, and where relevant Other Stakeholders, in the local language and in a culturally appropriate manner. The client will take account of, and document, the results of the Stakeholder Engagement process, including any actions agreed resulting from such process. For Projects with environmental or social risks and adverse impacts, disclosure should occur early in the Assessment process, in any event before the Project construction commences, and on an on-going basis.
Principle 6	**Grievance Mechanism** For all Category A and, as appropriate, Category B Projects, the EPFI will require the client, as part of the ESMS, to establish a grievance mechanism designed to receive and facilitate resolution of concerns and grievances about the Project's environmental and social performance. The grievance mechanism is required to be scaled to the risks and impacts of the Project and have Affected Communities as its primary user. It will seek to resolve

Equator Principle	Details
	concerns promptly, using an understandable and transparent consultative process that is culturally appropriate, readily accessible, at no cost, and without retribution to the party that originated the issue or concern. The mechanism should not impede access to judicial or administrative remedies. The client will inform the Affected Communities about the mechanism in the course of the Stakeholder Engagement process.
Principle 7	**Independent Review** ***Project Finance*** For all Category A and, as appropriate, Category B Projects, an Independent Environmental and Social Consultant, not directly associated with the client, will carry out an Independent Review of the Assessment Documentation including the ESMPs, the ESMS, and the Stakeholder Engagement process documentation in order to assist the EPFI's due diligence, and assess Equator Principles compliance. The Independent Environmental and Social Consultant will also propose or opine on a suitable Equator Principles AP capable of bringing the Project into compliance with the Equator Principles, or indicate when compliance is not possible. ***Project-Related Corporate Loans*** An Independent Review by an Independent Environmental and Social Consultant is required for Projects with potential high-risk impacts including, but not limited to, any of the following: • adverse impacts on indigenous peoples • Critical Habitat impacts • significant cultural heritage impacts • large-scale resettlement In other Category A, and as appropriate Category B, Project-Related Corporate Loans, the EPFI may determine whether an Independent Review is appropriate or if internal review by the EPFI is sufficient. This may take into account the due diligence performed by a multilateral or bilateral financial institution or an OECD Export Credit Agency, if relevant.
Principle 8	**Covenants** An important strength of the Equator Principles is the incorporation of covenants linked to compliance. For all Projects, the client will covenant in the financing documentation to comply with all relevant host country environmental and social laws, regulations and permits in all material respects. Furthermore, for all Category A and Category B Projects, the client will covenant the financial documentation: a) To comply with the ESMPs and Equator Principles AP (where applicable) during the construction and operation of the Project in all material respects; and b) To provide periodic reports in a format agreed with the EPFI (with the frequency of these reports proportionate to the severity of impacts, or as required by law, but not less than annually), prepared by in-house staff or third-party experts, that i) document compliance with the ESMPs and Equator Principles AP (where applicable), and ii) provide representation of compliance with relevant local, state and host country environmental and social laws, regulations and permits; and c) To decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan. Where a client is not in compliance with its environmental and social covenants, the EPFI will work with the client on remedial actions to bring the Project back into compliance to the extent feasible. If the client fails to re-establish compliance within an agreed grace period, the EPFI reserves the right to exercise remedies, as considered appropriate.

Equator Principle	Details
Principle 9	**Independent Monitoring and Reporting** ***Project Finance*** To assess Project compliance with the Equator Principles and ensure on-going monitoring and reporting after Financial Close and over the life of the loan, the EPFI will, for all Category A and, as appropriate, Category B Projects, require the appointment of an Independent Environmental and Social Consultant, or require that the client retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFI. ***Project-Related Corporate Loans*** For Projects where an Independent Review is required under Principle 7, the EPFI will require the appointment of an Independent Environmental and Social Consultant after Financial Close, or require that the client retain qualified and experienced external experts to verify its monitoring information which would be shared with the EPFI.
Principle 10	**EPFIs Reporting** ***Client Reporting Requirements*** The following client reporting requirements are in addition to the disclosure requirements in Principle 5. For all Category A and, as appropriate, Category B Projects: • The client will ensure that, at a minimum, a summary of the ESIA is accessible and available online4. • The client will publicly report GHG emission levels (combined Scope 1 and Scope 2 Emissions) during the operational phase for Projects emitting over 100,000 tonnes of CO_2 equivalent annually. Refer to Annex A for detailed requirements on GHG emissions reporting. ***EPFI Reporting Requirements*** The EPFI will report publicly, at least annually, on transactions that have reached Financial Close and on its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations. The EPFI will report according to the minimum reporting requirements detailed in Annex B.

The Categorisation of the Project with regards to the Equator Principle 1 will be determined by the projects lenders, however based on the type of project and surrounding environment it is expected to be "Category B" as there is potential for *'limited adverse social or environmental risks and/or impacts that are few in number, generally site-specific, largely reversible and readily addressed through mitigation measures.'*

The expectation of a Category B project is based on the extent of development already established by the adjacent Salalah IWPP and the lack of key receptors in the projects area of impact. As the adjacent facility is an operational desalination plant, the impact is not considered unprecedented, and the diversity of impacts is generally low (i.e. primary operational environmental impacts relating to brine discharge).

IFC Performance Standards on Environmental and Social Sustainability

The IFC Performance Standards are a key component of the IFC's Sustainability Framework and directed towards clients (i.e. party responsible for implementing and operating the project that is being financed), providing guidance on how to identify risks and impacts. The IFC

Performance Standards are designed to help avoid, mitigate, and manage risks and impacts throughout the life of a project as a way of doing business in a sustainable way, including stakeholder engagement and disclosure obligations of the client in relation to project-level activities.

The 2006 version of the IFC Performance Standards was reviewed and made applicable to all new projects from 1st January 2012. The updated IFC PSs reflect IFC's stronger commitment to climate change, business and human rights, corporate governance and gender equality as well as strengthening the due diligence process for IFIs. Such updates include comparable labour terms for migrant and non-migrant workers, clarification of levels of stakeholder engagement, monitoring of supply chains and an enhanced focus on energy efficiency, etc.

The following presents the IFC Performance Standards and their main characteristics:

Table 3-2 IFC Performance Standards (2012)

Performance Standard	Details and Requirements
PS 1	**Assessment and Management of Environmental and Social Risks and Impacts** It underscores the importance of managing environmental and social performance throughout the life of a project. It requires the Client to conduct a process of environmental and social assessment, and establish and maintain an Environmental and Social Management System (ESMS) appropriate to the nature and scale of the project and commensurate with the level of its environmental and social risks and impacts. The ESMS must be a dynamic and continuous process initiated and supported by management, and involves engagement between the client, its workers, local communities directly affected by the project (the Affected Communities) and, where appropriate, other stakeholders. • Requires stakeholder engagement beyond Affected Communities; • Clarifies levels of stakeholder engagement under different circumstances; • Requires development of a formal environmental and social policy reflecting principles of the Performance Standards; • Introduces participatory monitoring (when appropriate) as an option during implementation; and • Requires periodic performance reviews by senior management.
PS 2	**Labour and Working Conditions** Recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental1 rights of workers. The requirements set out in this PS have been in part guided by a number of international conventions and instruments, including those of the International Labour Organization (ILO) and the United Nations (UN) • Establishes requirement for comparable terms and conditions for migrant workers compared to non-migrant workers; • Introduces quality requirements for workers' accommodation; • Requires ongoing monitoring of working conditions for workers under the age of 18 years old; • Requires establishing policies and procedures to manage and monitor compliance of third parties with this PS; • Requires alternatives analysis in case of retrenchment; and

Performance Standard	Details and Requirements
	• Requires ongoing monitoring and "safety' trigger in primary supply chain.
PS 3	**Resource Efficiency and Pollution Prevention** Outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices. During the project life-cycle, the client will consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid, or where avoidance is not possible, minimize adverse impacts on human health and the environment.3 The principles and techniques applied during the project life-cycle will be tailored to the hazards and risks associated with the nature of the project and consistent with good international industry practice (GIIP). • Introduces a resource efficiency concept for energy, water and core material inputs; • Strengthens focus on energy efficiency and greenhouse gas measurement; • Reduces greenhouse gas emissions thresholds for quantification and reporting to IFC from 100,000 tons of CO_2 to 25,000 tons of CO_2 per year; • Introduces concept of "duty of care" for hazardous waste disposal; and • Requires determination of accountability with regards to historical pollution.
PS 4	**Community Health, Safety and Security** Addresses the client's responsibility to avoid or minimize the risks and impacts to community health, safety, and security that may arise from project related-activities, with particular attention to vulnerable groups. This PS addresses potential risks and impacts to the Affected Communities from project activities. Occupational health and safety requirements for workers are included in PS 2, and environmental standards to avoid or minimize impacts on human health and the environment due to pollution are included in PS 3. • Requires evaluation of the risks and impacts to the health and safety of the Affected Communities during the project life- cycle and the establishment of preventive and control measures consistent in line with GIIP • Considers risks to communities associated with use and/or alteration of natural resources and climate change through an ecosystems approach.
PS 5	**Land Acquisition and Involuntary Resettlement** Recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use. Where involuntary resettlement is unavoidable, it should be minimized and appropriate measures to mitigate adverse impacts on displaced persons and host communities3 should be carefully planned and implemented. • Extends scope of application to restrictions on land use; • Strengthens requirements regarding consultations; and • Introduces a requirement for a completion audit under certain circumstances.
PS 6	**Biodiversity Conservation and Sustainable Management of Living Natural Resources** Addresses how clients can sustainably manage and mitigate impacts on biodiversity and ecosystem services throughout the project's lifecycle in order to protect and

Performance Standard	Details and Requirements
	conserve biodiversity; to maintain the benefits from ecosystem services; and to promote the sustainable management of living natural resources through the adoption of practices that integrates conservation needs and development priorities. • Clarifies definitions of and requirements for various types of habitats; • Introduces stronger requirements for biodiversity offsets; and • Introduces specific requirements for plantations and natural forests as well as for management of renewable natural resources.
PS 7	**Indigenous People** It requires clients to anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts and to promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. It also requires the client to establish and maintain an on-going relationship based on Informed Consultation and Participation (ICP) with the Indigenous Peoples affected by a project throughout the project's life-cycle. • Expands consideration of Indigenous Peoples' specific circumstances in developing mitigation measures and compensation; • Introduces requirement for land acquisition due diligence with regards to lands subject to traditional ownership or under customary use; and • Introduces the concept of Free, Prior and Informed Consent under certain circumstances.
PS 8	**Cultural Heritage** Aims to ensure that clients protect cultural heritage from the adverse impacts of project activities and support its preservation and promote the equitable sharing of benefits from the use of cultural heritage in line with the Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage,

It is further noted that the IFC is a shareholder in ACWA Power, and therefore all ACWA Power projects must comply with the IFC Performance Standards and IFC EHS Guidelines.

4 ESIA PROCESS

4.1 Delineation of Study Boundaries

The proposed project will be located to the immediate east of the existing Salalah IWPP facility (The projects layout is presented in Appendix D). The figure below the project location and immediate surroundings, including the temporary construction land and the projects access road.

Figure 4-1 Project Plan

4.2 Scope of Assessment

4.2.1 Construction & Operation of the Project

Project Area for Assessment

The analysis of potential impacts upon environmental & social parameters has considered impacts affecting receptors within the project footprint as well as those receptors within the projects area of influence (refer to each chapter for delineation), relating to the expected extent of project impacts (i.e. for brine discharges and noise).

Study areas for the ESIA have been defined according to the potential impacts associated with each of the environmental or social discipline under consideration (e.g. study area for air quality impacts has been determined by defined emissions dispersion modelling).

Associated Facilities for Assessment

Access Road

The primary associated facility for the project is the access road that will be constructed by the EPC Contractor but owned and maintained by Dhofar Governorate. The access road is included in the ESIA scope, as it will link the project site to an existing hardstanding road, at the Salalah IWPP entrance.

The access road is included to the scope of this ESIA.

Water Connection Facility

The water connection facility that connects the projects potable water storage facility to the existing Salalah IWPP potable water reservoir, is considered in this assessment. It is noted that this underground pipeline will be aligned within the proposed access road corridor and land at the Salalah IWPP.

Electrical Connection Facility

The Electrical Connection Facility to provide a power supply to the project will be built and operated by DPC. Where information is available in regard to the connection facility, this will be assessed in the ESIA as an associated facility.

4.2.2 Associated Construction Facilities

Temporary Laydown and Staging Areas

The ESIA includes consideration of the land that has been set aside for the construction staging and administration area; and the respective processes and activities in these areas. This area is located to the immediate east of the proposed project footprint.

Construction Worker's Accommodation Facilities

This ESIA includes management measures for worker accommodation areas. the final location of which not been defined at this stage. This is because the majority of the workforce will be accommodated by sub-contractor companies, who will not be appointed until the project is approved for construction. As such, it has not been possible to assess specific impacts of such facilities at this stage; however, required management measures for such accommodation areas have been included to filter into the projects ESMS for the construction phase.

4.2.3 Decommissioning

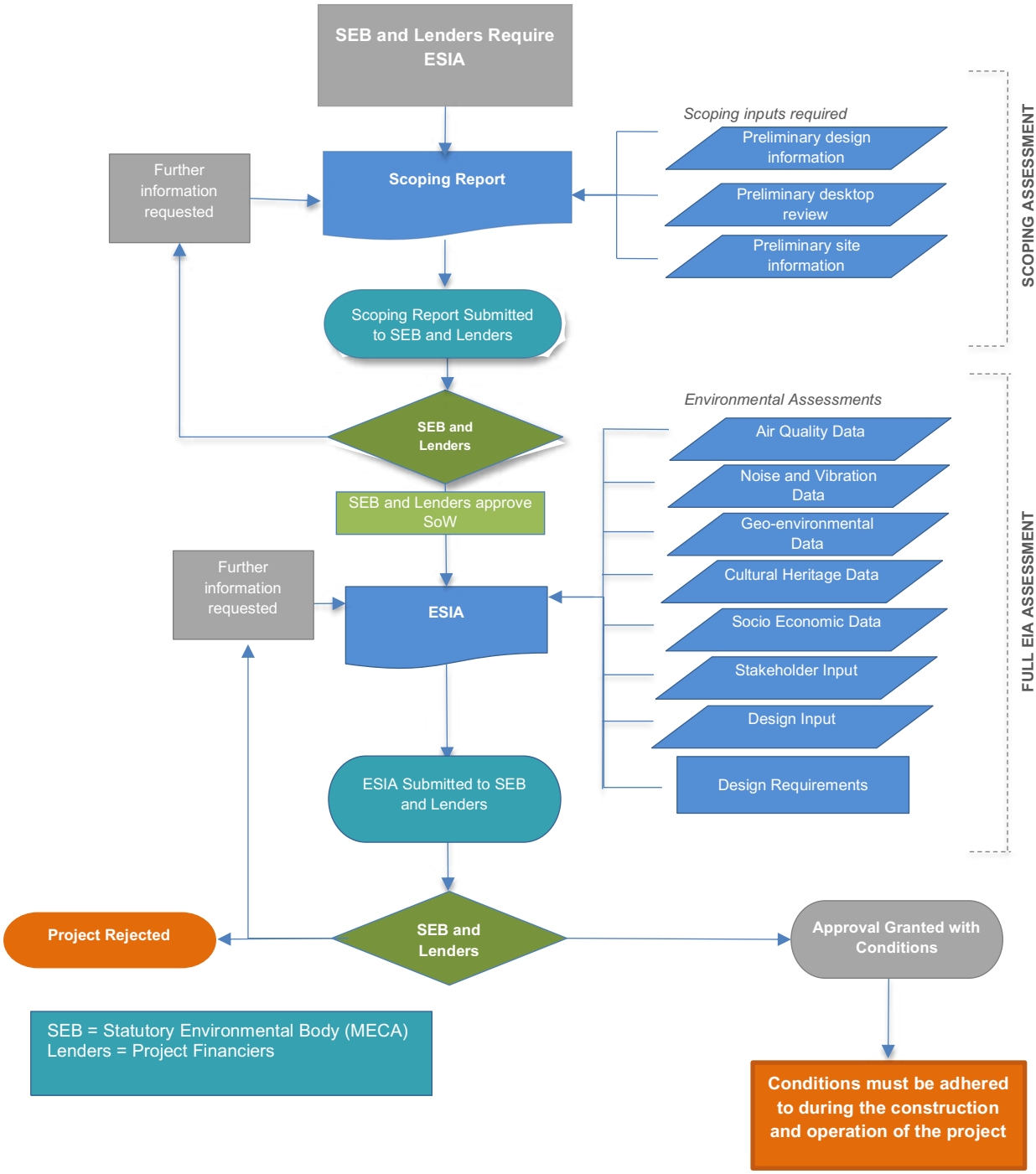
Potential impacts relating to decommissioning are expected to be similar to those encountered during the construction phase. Given that the decommissioning phase is not expected for at least 20 years (in accordance with the term of the water supply agreement), it is not practical to speculate on future environmental & social conditions including the sensitivity of current or future receptors at this time. It is considered that impacts relating to decommissioning will be best mitigated and managed via a specific decommissioning plan prepared closer to the time of decommissioning. A plan prepared at this time would be able to account for changes in regulation (e.g. requirements for specific decommissioning methodologies), improvements in technology (e.g. ability to re-use or recycle waste) and methods of demobilisation.

4.3 ESIA Flow

Note: The previous chapter has identified the environmental & social assessment requirements required both in Oman and by the projects lenders. With the respect to the requirements for 'Environmental & Social' assessment by the lenders, this document is herein referred to as an 'ESIA'. It is emphasised that this ESIA includes all requirements of an EIA, as required by Omani regulation.

The illustration in the Figure below provides an overview of the scoping and ESIA process for the project.

Figure 4-2 Scoping/ESIA Process



It is noted that conditions of the ESIA approval/acceptance are likely to be established by both MECA and the IFIs. Any stipulated conditions must be adhered to during the respective project phase, to ensure that permits and approvals remain valid.

4.4 Scope of Work and Key Deliverables

The main deliverables of the ESIA process are:

- Environmental & Social Scoping (ESS) Report; and
- Environmental & Social Impact Assessment (ESIA) Report.

4.4.1 Scoping

Scoping is a key stage in the ESIA process; it draws upon an understanding of the Project, available environmental baseline data and relevant regulations. With an understanding of these components, the aim of the scoping process is to identify potentially significant environmental impacts and evaluate whether they will be scoped in or out of the full assessment. This will ensure that only the impacts of potential significance will be assessed at the ESIA stage. This report includes the scoping assessment for each chapter herein.

An 'Environmental Scoping Study and ESIA Terms of Reference' report was prepared and submitted to MECA in early June 2017 (see Appendix A for the scoping report). The ESS was approved by MECA without comment. The ESS approval is provided in Appendix B.

Where potential project impacts have been scoped out during the scoping exercise, further data collection, quantitative analysis or detailed assessment has not been undertaken as part of the ESIA. Despite this, applicable mitigation and management measures have been included within this report in an attempt to reduce any adverse impacts, but also to ensure good practices are followed through into the respective Construction and Operational Environmental & Social Management Plans (i.e. CESMP and OESMP).

4.5 ESIA Methodology

4.5.1 Impact Assessment Significance Criteria

In order to obtain a credible assessment of environmental impacts, the assignment of 'effect significance' to each identified impact needs to be a robust, consistent and transparent process. The methodology to assess 'effect significance' is outlined below and follows an International Best Practice[1] based on the assumption that the significance of an impact on resources or receptors is considered to result from an interaction between three factors:

- The nature and magnitude of the impact (i.e. a change in the environment, social and/or health baseline conditions);

[1] See for example Scottish Natural Heritage (2009) A handbook on environmental impact assessment or Highways Agency (2008) Assessment and Management of Environmental Effects design manual for roads and bridges HA 205/08 Volume 11, Section 2, Part 5.

- The number of resources or receptors affected (i.e. humans and the environment);
- The environmental value or sensitivity of those resources or receptors to the change.

A three-step approach has been used to determine the significance of environmental effects, as follows:

- Step 1 – Evaluation of value/sensitivity of resource or receptor;
- Step 2 – Assessing the magnitude of the impact on the resource or receptor; a
- Step 3 – Determining the significance of effects.

4.5.2 Identification and Evaluation of Sensitive Receptors

Sensitive receptors are defined as:

- Elements of the ***environment*** that are of value to the functioning of natural systems (i.e. areas or elements of ecological, landscape or heritage value, species, habitats and ecosystems, soil, air and water bodies or land-use patterns);
- ***Human*** receptors, such as stakeholders (i.e. users of dwellings, places of recreation, places of employment, community facilities or household relocation) and human systems (e.g. employment market, population disease susceptibility and disease communicability, exposure to toxicity of chemicals).

The environmental value (or sensitivity) of the resource or receptor has been defined by using the criteria below.

Table 4-1 Environmental Value of Receptor or Resource

Value (sensitivity)	Description of Value
Very High	• High importance and rarity on an international scale and limited or no potential for substitution. • The receptor has already reached its carrying capacity, so any further impact is likely to lead to an excessive damage to the system that it supports. • Locations or communities that are highly vulnerable to the environmental impact under consideration or critical for society (e.g. indigenous peoples, hospitals, schools).
High	• High importance and rarity on a national scale, and limited potential for substitution. • The receptor is close to reaching its carrying capacity, so a further impact may lead to a significant damage to the system that it supports. • Locations or communities that are particularly vulnerable to the environmental impact under consideration (e.g. residential areas, vulnerable/marginalized groups).
Medium	• High or medium importance and rarity on a regional scale, limited potential for substitution. • The receptor is already significantly impacted, but it is not close to reaching its carrying capacity. Further impacts will get increase the stress of the underlying system, but evidence does not suggest that it is about to reach a critical point. • Locations or groups that are relatively vulnerable to the environmental impact under consideration (e.g. commercial areas).
Low (or Lower)	• Low or medium importance and rarity on a local scale. • The receptor is not significantly impacted and shows a large spare carrying capacity. Impacts are not likely to generate any noticeable stress in the underlying system. • Locations or groups that show a low vulnerability to the environmental impact under consideration (e.g. industrial areas).
Very Low	• Very low importance and rarity on a local scale. • The receptor is not impacted and shows a very large spare carrying capacity. Impacts are very unlikely to generate any noticeable stress in the underlying system. • Locations or groups that show a very low vulnerability to the environmental impact under consideration (e.g. industrial areas).

The existence of receptors that are legally protected (e.g. designated areas, protected habitats or species) will be taken into consideration for the assessment of the sensitivity of the receptors.

4.5.3 Identification and Evaluation of Environmental Impacts

The following types of impacts have been considered in line with 5 Capitals assessment methodology:

- *Direct Impacts* - Potential impacts that may result from the construction and occupation of the Project acting directly on an environmental or social receptor (e.g. land take for construction of the camps);
- *Indirect Impacts* – Potential impacts which are not a direct result of a Project activity, often produced later in time or further removed in distance, but are normally a result

of a complex pathway (e.g. dust deposition on vegetation which causes reduction in photosynthetic rates);

- *Beneficial Impacts* – Impacts that have a positive, desirable or favourable effect on the sensitive resources or receptors (e.g. landscape providing artificial habitat for a variety of species, creating jobs during the construction and/or occupation phases of a project);
- *Adverse Impacts* – Impacts that are detrimental and have a negative influence on sensitive resources or receptors;
- *Secondary Impacts* - Potential impacts that may result from the implementation of protection measures applied to mitigate potential direct impacts;
- *Event Related Impacts* - Potential unplanned or accidental impacts stemming from an unintentional event such as fire, explosion, oil spill, etc.;
- *Cumulative Impacts* - The additive potential impacts that may result from the incremental potential impacts of the planned Project plus the potential impacts of reasonably anticipated future projects or future phases of a same development.

The magnitude of the impact is defined where possible in quantitative terms. The magnitude of an impact has a number of different components, for example: the extent of physical change, the level of change in an environmental condition, its spatial footprint, its duration, its frequency and its likelihood of occurrence where the impact is not certain to occur. The criterion that has been used for assessing the magnitude of impacts includes the geographical scale of the impact, the permanence of impact and the reversibility of the impacted condition. A brief description of the magnitude of the impacts is provided in the table below.

Table 4-2 Criteria for Magnitude of Impacts

Magnitude of Impact	Description of Magnitude
Major	*Adverse:* Loss of resource and/or quality and integrity; severe damage to key characteristics, features or elements. A major impact is usually large scale, permanent and irreversible. *Beneficial:* Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality.
Moderate	*Adverse:* Significant impact on the resource, but not adversely affecting the integrity; Partial loss of/damage to key characteristics, features or elements. Moderate impacts usually extend above the site boundary, and are usually permanent, irreversible or cumulative. *Beneficial:* Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Minor	*Adverse:* Some measurable change in attributes quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements. Minor impacts usually are only noticeable within the site and are temporary and reversible. *Beneficial:* Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	*Adverse:* Very minor loss or detrimental alteration to one or more characteristics, features or elements. *Beneficial:* Very minor benefit to or positive addition of one or more characteristics, features or elements.
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.

4.5.4 Criteria for Likelihood of Occurrence of Environmental and Social Effects

'Event related impacts' are potential unplanned impacts that are dependent on the occurrence of an event that has a finite probability such as an accidental, uncontrolled release of hydrocarbons that might occur under non-routine operating condition. Because event-related impacts may not occur, assessment of potential impacts that are event-related may take into consideration the **'likelihood of occurrence'**.

Likelihood of an unplanned event can be derived from historical information, modelling, industry data, stakeholder interviews and professional judgment. In addition, likelihood takes into account anticipated or planned mitigation measures, engineering controls and procedures in place to prevent or reduce the probability of the identified event taking place.

Table 4-3 Criteria for Likelihood of Impacts

Magnitude of Impact	Description of Likelihood
Likely	The consequence can reasonably be expected to occur on this project during the lifecycle of the facility
Occasional	The consequence may occur on this project during the lifecycle of the facility
Seldom	The consequence could occur on this project during the lifecycle of the facility but only under exceptional conditions
Unlikely	The consequence has occurred in the industry in the past but is not likely to occur on this project during the lifecycle of the facility (e.g. construction, operation, decommissioning)
Remote	The consequence has occurred once or twice in the industry

4.5.5 Determination of Significance of Effects

The significance of effects is a combination of the environmental value (or sensitivity) of a receptor or resource and the magnitude of the project impact value (change). In other words, it is this product of the impact acting on the receptor that produces an environmental effect. Table 3-6 shows the criterion used for determining the significance of environmental effects. Definitions of each significance categories are provided below.

Table 4-4 Criteria for Determining Significance of Effects

		Magnitude of impact (degree of change)				
		No change	**Negligible**	**Minor**	**Moderate**	**Major**
Sensitivity of Receptor	**Very High**	Neutral	Minor	Moderate or Major	Major	Major
	High	Neutral	Minor	Minor or moderate	Moderate or Major	Major
	Medium	Neutral	Negligible or minor	Minor	Moderate	Moderate or Major
	Low	Neutral	Negligible or minor	Negligible or minor	Minor	Minor or moderate
	Very Low	Neutral	Negligible	Negligible or minor	Minor	Minor

Table 4-5 Definition of Significance of Effects

Significance Category	Criteria
Major	Only adverse effects are assigned this level of importance as they represent key factors in the decision-making process. Effects are associated with sites and features of national or regional importance. Effects exceed statutory limits. Mitigation measures are unlikely to remove such effects.
Moderate or Major	Important considerations at a local scale but, if adverse, are potential concerns to the project and may become key factors in the decision-making process. Mitigation measures and detailed design work are unlikely to remove all of the effects upon the affected communities or interests.
Moderate	These effects, if adverse, while important at a local scale, are not likely to be key decision-making issues. Nevertheless, the cumulative effect of such issues may lead to an increase in the overall effects on a particular area or on a particular resource. They represent issues where effects will be experienced but mitigation measures and detailed design work may ameliorate or enhance some of the consequences upon affected communities or interests. Some residual effects will still arise.
Minor	Local issue unlikely to be of importance in the decision-making process. Effects do not exceed statutory limits. Nevertheless, they are of relevance in enhancing the subsequent design of the project and consideration of mitigation or compensation measures.
Neutral or Negligible	No effect or effect that is beneath the level of perception, within normal bounds of variation or within the margin of forecasting error. No mitigation is required.

The significance of the effect is determined by comparison, wherever possible with company, locally, nationally or internationally accepted standards. If no standards are available then it is necessary to develop project specific limits, based on guidance or best practice as necessary. Such standards or limits are referred to as the **Significance Threshold**. If the size and type of effect is greater that the significance threshold, then this is termed a **Significant Effect**. Potential significant effects need to be avoided and are therefore prioritised by identifying mitigation measures to reduce the effect to an acceptable level. Significant effects are considered 'Major' or 'Moderate'.

Note: All predicted impacts with a beneficial impact have been colour coded green.

4.5.6 Mitigation Measures

This ESIA includes mitigation subsequent to the findings of the assessments undertaken.

4.5.7 Residual Impacts

Following assessment of the additional mitigation measures, the projects residual impacts have been considered. The significance of such impacts is based upon the same criteria used to determine the impact significance prior to mitigation.

4.5.8 Consideration of Cumulative Impacts

Cumulative impacts occur when project impacts combine with other existing (and reasonably anticipated future impacts resulting in successive, incremental and/or combined effects on the environment and/or society. The assessment of cumulative impacts has been included to applicable disciples, specifically for noise and marine discharges.

Additionally, a section for planned projects (potential future impacts) has been included to this ESIA.

4.5.9 Project Stakeholder Analysis and Consultations

Statutory requirements for stakeholder engagement, ESIA consultation or disclosure have not been established in Oman, and are not recognised as a necessity in the EIA process.

In regard to the lender requirements, all of the IFC Performance Standards include requirements for an amount of stakeholder engagement (either in the ESIA, or as part of the future ESMS) and therefore the project will require a level of engagement. In particular, IFC Performance Standard 1 on "Social and Environmental Assessment and Management Systems" describes the stakeholder engagement requirements in more depth. It states the following:

"Stakeholder engagement is the basis for building strong, constructive, and responsive relationships that are essential for the successful management of a project's environmental and social impacts. Stakeholder engagement is an on-going process that may involve, in varying degrees, the following elements:

- Stakeholder analysis and planning;
- Disclosure and dissemination of information;
- Consultation and participation;
- Grievance mechanism; and
- On-going reporting to Affected Communities.

The nature, frequency, and level of effort of stakeholder engagement may vary considerably and will be commensurate with the project's risks and adverse impacts, and the project's phase of development."

ESIA Consultation

Stakeholder engagement is considered a key aspect of all projects and should be undertaken at the ESIA stage in order to notify, gain views and enable a better understanding of the dynamics of the local environment.

With respect to Oman, a culturally relevant consultation process has been developed by 5 Capitals, based largely on experiences from Salalah & Dhofar, as well as input from other local projects who have advised on the most appropriate consultation techniques.

Potential stakeholders of relevance to the project have been identified below.

Stakeholder Identification

Table 4-6 Potentially Impacted Stakeholders

Potentially Impacted Stakeholders	Description	Consultation Rationale
Salalah IWPP	A gas-fired power and water plant situated adjacent to the western boundary of the proposed project area.	The proposed project will be a direct neighbour of the Salalah IWPP and may require items of common management, such as co-ordination for emergency planning. The proposed projects land was previously used as the construction laydown area for the Salalah IWPP. The Salalah IWPP is a key facility locally and may have had valuable interactions with other stakeholders, for which information sharing may be relevant.
Scout Camp	The nearest semi-residential area to the project. The camp is a temporary residential area used for approximately 2 weeks in a year, with Omani youths staying at the premises.	Notification of the project, gaining feedback regarding any concerns. Raising awareness that a project ESIA is being undertaken and that there will be a project grievance mechanism developed and implemented during construction and operations.
Worker Accommodation	A worker's accommodation area for workers of the nearby highway construction project.	
Local Populations (use of land for camels)	Several small shelters understood to belong to local people are in use as temporary refuge for camels. The shelters are present on a seasonal basis adjacent to the access road to the existing Salalah IWPP.	There is potential that the camel herders have used the project land as a throughway to the east, the project may partly disrupt an access corridor. Therefore, to understand any access needs and safety concerns related to construction, or operations.

Table 4-7 Other Stakeholder Groups

Stakeholder Group	Description	Consultation Rationale
Wilayat of Mirbat	The local government at the project location.	To gain information on known uses of project land (informal uses), particularly with regard to the use of nearby land for camel shelters and the grazing of camels on local land.
Ministry of Heritage and Culture (MOHC)	The governmental body in the Sultanate of Oman responsible for promoting and preserving Omani heritage and culture.	To request data in regard to known archaeology at the site and the potential risk of encountering archaeological artefacts within the Project footprint.

Record of Consultation

Table 4-8 Record of Consultations

Potentially Impacted Stakeholders	Form of Consultation	Date & Location	Consultation Notes
Salalah IWPP	Meeting with HR & Admin Manager (responsible for CSR and public relations) and HSE Manager	17/12/2017 at Sembcorp Salalah IWPP administration building.	Salalah IWPP participate in a CSR programme with the Wilayat of Mirbat, the activities from which are decided between a committee made up of 2 members of Salalah IWPP and 2 members of the Wilayat of Mirbat. The activities are based on a Memorandum of Understanding between the project and the Wilayat, for which a set amount of funds are set aside by the project. The CSR activities are undertaken on projects which provide benefits for communities rather than individuals, and include items such as renovations of schools, provision of disabled access etc. Besides the CSR activities, there is no formal consultation being undertaken by the project with local stakeholders. A record of external communications is kept and occasionally this includes requests form the local government to suggest candidates for employment. Salalah IWPP does not operate an established grievance mechanism for external complaints, although it was noted that community complaints with respect to the project have always

			been directed via the Wilayat. The project has received few external communications during operations, however, during construction grievances in regard to waste disposal practices in the adjacent wadi were raised via the Wilayat. The Salalah IWPP's HR Plan has a preference for local recruitment (depending on capability), and is linked to clearly defined positions. Note: With specific regard to the project development, the Salalah IWPP staff did not note any concern or issues with the Salalah IWP, but did appreciate that Emergency Planning & Preparedness activities would need to be aligned/co-ordinated in the future. An item of note was the issues the Salalah IWPP has faced with corrosion, and the staff were keen to suggest that such instances are taken into consideration for the Salalah IWP.
Scout Camp	Discussion with Scout Camp staff member.	10/07/2017 at Scout Camp Buildings.	The Scout Camp belongs to the Scout and Girl Guides of Oman, on land owned by the government. The area is used for approximately 2 weeks during the Khareef season.
Worker Accommodation (Galfar Co.)	Telephone conversation with Galfar Co. Project Manager	18/12/2017 via telephone.	The highway project was scheduled to be complete by the end of March 2018, however, several small delays are expected to elongate the project until June 2018. The present manpower of approximately 500 people are accommodated at the Galfar camp, although this is expected to reduce in number to approximately 50 people after June 2018, with the remainder staying for other projects elsewhere locally. Following the completion of the highway project, the camp is expected to be reduced in size and items of it demobilised.
Local Populations (use of land for camels)	During the ESIA Consultation activities in December 2017, local people, camels and/or herders were not present in the local project area. It is understood from the consultation with Salalah Sembcorp IWPP personnel (and informal discussions with other local people) that the use of camels in this area is a seasonal activity, with presence only during the Khareef season. The land that they occupy belongs to the Omani government and is approximately 2.25km to the west of the proposed Salalah IWP site.		
Ministry of Heritage and Culture (MOHC)	Meeting with Ministry Manager and	17/12/2017 at the Ministry of Heritage and	Given the past land uses at the project site (i.e. use as a laydown area for Salalah IWPP) the Ministry indicated that it was unlikely there

	Technical Specialist.	Culture offices in Salalah.	would be any specific or known artefacts in this area. However, the Ministry did request an official letter to be sent by the project sponsors in this regard to request information on the presence or absence of such features. *Note: Following the meeting, a letter (in Arabic) was prepared and issued to the Ministry. At present this is awaiting a response. The consultation letter is presented in Appendix K.*
Wilayat of Mirbat	Consultation with the Wilayat of Mirbat was not conducted at this time. The WIlayat has been referenced in this section to highlight their presence as a potential project stakeholder to be adopted into the future Stakeholder Engagement Plan (SEP), for construction and operational phases of the project respectively.		

5 AIR QUALITY

5.1 Introduction

This chapter describes the potential impacts and effects that may occur as a result of the projects construction and operational activities and identifies the measures that will be undertaken and implemented in order to mitigate these impacts. The assessment of impacts has been measured against Omani regulation and IFC guidelines.

Since SWRO plants do not generate any air pollutants during their operations, only the construction related effects air quality have been scoped in for further assessment to this ESIA; please refer to 'Outcome from Scoping Exercise' (below).

The areas assessed in this section are:

- The project footprint;
- Associated facilities (e.g. access road);
- Any construction working areas (e.g. temporary laydown areas);
- Other areas that may be impacted by construction effects to air quality (e.g. dispersion of particulates);

This chapter includes the following:

- Outcome of the scoping exercise;
- Applicable ambient air quality standards;
- Baseline conditions related to air quality;
- Identification of air quality impacts receptors;
- Identification of potential impacts relating to the construction and operational phases;
- Assessment of potential impacts significance (including cumulative impacts);
- Identification of appropriate mitigation & management measures (construction and operational phases);
- Assessment of residual impacts following the application of mitigation & management measures; and
- Identification of appropriate monitoring measures.

Although construction and operational impacts of air quality have been scoped out from further assessment in the is ESIA, the mitigation and management measures section incorporates best practice measures to reduce the effects of transportation emissions.

5.2 Scoping Outcomes

Air quality impacts associated with the construction and operational phases of this project have been considered at the scoping stage and have either been scoped in or out for detailed assessment within this ESIA. Potential project impacts and justification of why these have been scoped in or out are detailed in the following table; in line with the MECA approved scoping report.

Table 5-1 Air Quality Impacts Scoping Decision

Potential Impact	Scoped In/Out of ESIA	Justification
Construction		
Dust Generation	**Scoped Out**	In accordance with screening guidance of the UK's Institute of Air Quality Management (IAQM) for construction dust, the need for detailed assessment relating to dust impacts will normally be required where: • There is a 'human receptor' within 350m of the boundary of the site, or within 50m of a route used by construction vehicles on public roads (up to 500m from the site entrance). • There is an 'ecological receptor' within 50m of the boundary of the site, or within 50m of a route used by construction vehicles on public roads (up to 500m from the site entrance). With respect to the screening criteria above, the project is not within 350m of a human receptor (i.e. residential or recreational area), or within 50m of an ecological sensitivity. The camel shelters along the paved access road are also over 500m away from the project site. It is therefore considered that impacts relating to construction dust can be scoped out of further assessment. No sensitive receptors are located within 500m of the project site. According to the UK-IAQM, 'where the need for a more detailed assessment is screened out, it can be concluded that the level of risk is "negligible", and any effects will not be significant.
Gaseous Emissions	**Scoped Out**	Emissions are not expected to result in noticeable cumulative impacts to the local air shed, which is already affected by major emission sources from the Salalah IWPP.
VOC's	**Scoped Out**	The potential for VOC impacts is expected to be minimal and expected to be negligible at off-site receptors, and as such is scoped out. This is primarily due to the limited potential for diffuse source VOC's from the site.
Odour	**Scoped Out**	The potential for odour impacts is expected to be minimal and expected to be negligible at off-site receptors, and as such is scoped out.
Operation		
Vehicle Gaseous Emissions	**Scoped Out**	Emission from vehicle movements are not expected to result in noticeable cumulative impacts to the local air shed, which is already affected by major emission sources from the Salalah IWPP.

5.3 Standards and regulatory requirements

With regards to ambient air quality standards, MECA currently implements the USEPA's National Ambient Air Quality Standards (NAAQS) as an indicative guideline.

Financial institutions will require adherence to the World Health Organisation Ambient Air Quality requirements, as detailed in the IFC General EHS Guidelines.

The following tables detail these standards.

Table 5-2 USEPA NAAQS

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide		Primary	8-hour	9ppm	Not to be exceeded more than once per year
			1-hour	35ppm	
Lead		Primary and secondary	Rolling 3-month average	0.15 µg/m^3	Not to be exceeded
Ozone		Primary and secondary	8-hour	0.075 ppm	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Nitrogen Dioxide		Primary	1-hour	100ppb	98th percentile, average over 3 years
		Primary and secondary	Annual	53ppb	Annual Mean
Particulates	**PM$_{2.5}$**	Primary and secondary	Annual	15µg/m^3	Annual Mean, averaged over 3 years
			24-hour	35µg/m^3	98th percentile, average over 3 years
	PM$_{10}$	Primary and secondary	24-hour	150µg/m^3	Not to be exceeded more than once per year on average over 3 years
Sulphur Dioxide		Primary	1-hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		Secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

(Primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings).

MECA is in the process of developing Omani Ambient Air Quality Standards (AAQ). Although these have not yet been declared, the provisional standards are shown in the following table.

Table 5-3 Proposed MECA Ambient Air Quality Standards

Parameter	Averaging Period	Standard Limits (µg/m³)
NO_2	24 Hr average	112
SO_2	24 Hr average	125
CO	8 Hr average	6000
H_2S	24 Hr average	40
O_3	8 Hr average	120
HCNM	3 Hr average	160
PM_{10}	24 Hr average	125

Table 5-4 WHO Ambient Air Quality Standards (ref: IFC General EHS Guidelines) (µg/m³ unless otherwise specified)

Parameter	WHO Ambient Air Quality Standards	
	24 hour	Annual
PM_{10}	150 (Interim target 1)	70 (Interim target 1)
	100 (Interim target 2)	50 (Interim target 2)
	75 (Interim target 3)	30 (Interim target 3)
	50 (guideline)	20 (guideline)
$PM_{2.5}$	75 (Interim target 1)	35 (Interim target 1)
	50 (Interim target 2)	25 (Interim target 2)
	37.5 (Interim target 3)	15 (Interim target 3)
	25 (guideline)	10 (guideline)
NO_2	200 (1 hour)	40
SO_2	125 (Interim target 1)	500 (10-minute guideline)
	50 (Interim target 2)	
	20 (guideline)	
O_3	160 (interim target 1) (8-hour daily maximum)	
	100 (8 hour daily maximum guideline)	

5.4 Observations and Baseline Conditions

The main purpose of the baseline characterisation process is to identify existing air quality conditions, key sources of emissions and environmental & social sensitive receptors that may potentially be affected by the projects construction or operation; with respect to air quality. The environmental baseline is then used as the basis for the assessment of any future impacts over the identified sensitive receptors.

In accordance with the approved scoping study (ref. scoping outcomes above and scoping report presented in Appendix A), the air quality baseline has been collected through desktop information and observations made on-site. There have been no specific monitoring activities undertaken, as justified in the scoping exercise for this project.

Existing Air Pollution Sources

The Salalah IWPP is located adjacent to the western boundary of the proposed project area. This is a gas fired power plant with a total gross capacity of 490 MW and is anticipated to have the most significant impact on ambient air quality locally, particularly for concentrations of NO_2 and CO; due to the combustion of natural gas. Fuel is combusted at the IWPP for power generation with emissions directed through several stack structures located at the IWPP site.

Vehicle movements on local roads are a source of mobile emissions. The primary local roads in the project area include Highway 49 located approximately 1km north of the project site and the existing hardstanding access road that links the Salalah IWPP to Highway 49.

Figure 5-1 Local Roads (Project site shown in yellow)

Satellite Image Source: Google Earth

Highway 49 provides a key link through the southern section of Dhofar Governorate linking Salalah with areas including Taqah, Mirbat, Sadah and to Hasik. In proximity to the project site, Highway 49 runs parallel to the coastline at the foot of the hillslopes to the north. The highway has a low vehicle flow and resulting emissions are expected to the low. In accordance with the UK's DMRB Guidance for assessing air quality impacts from roads, it is typical that vehicle emissions will sufficiently mix to background concentrations within 200m of the road edge. As such, direct impacts from highway 49 are not expected to be noticeable at the project site.

The existing access road is not a through-road and traffic is only associated with the Salalah IWPP, temporary labour camp for the existing highway project, or the infrequently used Scout

Camp. It is not anticipated that this road currently has any discernible impact on the existing air quality condition in the local area.

5.4.1 Sensitive Receptors

The site visits undertaken in 2016 and 2017 and the review of satellite imagery have revealed few sensitive receptors in proximity of the project, or within range of the potential construction or operational impacts. For instance, there are no permanent residences within 1km of the project site, with the nearest isolated communities approximately 2km from the project and the nearest urban area of Taqah, approximately 8km to the west of the project site.

Several small shelters utilised as temporary refuge for camels and their herders have been identified along the existing access road to the Salalah IWPP.

A scout camp, 1.1km west of the site, was identified during the site visit on July 10, 2017. It is understood from camp staff that the camp is used as temporary residences for 2 weeks per year; for overnight visits.

A worker accommodation area has been established approximately 1.3km northwest of the project site. The accommodation houses for workers for the nearby highway construction project.

Figure 5-2 Potential Air Quality Receptor Locations

Satellite Image Source: Google Earth

Table 5-5 Potential Air Quality Receptors

Receptor	Receptor Type	Justification
Salalah IWPP	**industrial**	The IWPP is an industrial facility located adjacent to the project site. As an industrial facility and as an emitter of air pollutants from fuel combustion it is of low vulnerability to changes in ambient air quality.
Camel Shelters	**Agricultural / Temporary Residence**	Camel shelters are understood to belong to the Jebali people and have been observed in a cluster adjacent to the existing hardstanding access road that links the highway to the project site. At their nearest location, these shelters are over 2km from the site and 1.5km from the proposed access road construction. People employed by the Jebali people to tend the camels are present in these areas and have shelters for sleeping. It is recognised that these receptors are not permanent features and are subject to movement depending on the season and availability of grazing fodder for the camels.
Scout Camp	**Temporary Residence**	A Scout camp is located approximately 1km from the project site with the camp entrance being located on the existing hardstanding access road. The gates of the Scout Camp are adjacent to the existing access road and approximately 600m from the proposed project site access road construction area (associated project facility). During the site visit undertaken on 10th July 2017 camp staff informed the Consultants that the camp is only inhabited for approximately 2 weeks per year by the Scouts.
Worker Accommodation	**Temporary Residence**	The temporary worker accommodation is in place to accommodate workers for the construction of the Highway upgrades to the north of the project site. The site is temporary facility with accommodation blocks and a materials and vehicle laydown area. It is understood that this area will be decommissioned once the highway project is completed.

5.5 Potential Impacts

5.5.1 Construction

Dust Generation (within 350m of project construction works)

Site Preparation

According to the UK's IAQM Guidance on the assessment of dust from demolition and construction, when there is a human receptor within 350m of the construction works there may be potential for impacts relating to dust dispersion and settlement. In the instance of this project, far field dust impacts from construction works are therefore not considered applicable, due to the projects distance to identified receptors. For instance, the project site is over 1km from the temporary accommodation area (for highway workers) and over 900m from the Scout Camp (also over 600m from the access road works).

The magnitude of dust impacts from construction works will largely be based on the direction of the wind and the proximity of sensitive receptors to the wind direction. The wind direction in the project area tends to vary and could therefore disperse site generated dust in any direction.

Impacts related to construction dust may only be discernable at the Salalah IWPP receptor due to close proximity to the site and access road construction. Dust impacts will be temporary and are discernable at this industrial receptor.

Dust & particulate emissions due to Equipment use and movement of trucks and material transportation

Besides vehicle movements on unpaved (or dusty) surfaces, dust due to the movement of trucks and material transportation should only occur where mitigation measures are not effectively implemented at the site, or by contractors bringing materials to the site (i.e. the sheeting/containment of truck and barge loads, wheel washing).

Uncontained and/or un-sheeted trucks may be subject to losses of material where the containment is not effective (i.e. spills), or where wind or other air turbulence may disturb the contents and result in dispersion of material. Such impacts have the potential to degrade local air quality in the immediate area of such movements.

In accordance with the UK's IAQM Guidance on the assessment of dust from demolition and construction, detailed assessment of vehicle movements should only be required where 'human' or 'ecological' receptors are located within 50m of the route use for construction vehicles, up to 500m from the project site entrance. In the instance of the Salalah IWP project, all human receptors (discounting the Salalah IWPP as an 'Industrial' receptor) are located at greater distances than this. It can therefore be 'concluded that the risk is negligible and the effects will not be significant'.

Gaseous Emissions from Construction Equipment & vehicles

Vehicles and equipment that operate on liquid fuel will result in the emission of gases to air due to the combustion of fossil fuels. Such vehicles and equipment are likely to include, but not be limited to the following:

- Excavators;
- Graders;
- Pavers;
- Trucks;
- Cranes;
- Temporary Generators; and
- Hand held equipment operating on liquid fuel.

Air quality impacts relating to the use of the above are small in magnitude for individual sources, however where old or poorly-maintained equipment is operated, there is potential for noticeable and/or cumulative impacts to occur.

Impacts relating to gaseous emissions, may not be discernable at the Salalah IWPP due to the existing source of emissions from this facility. At distant receptors, gaseous emissions will mix sufficiently with ambient air (within a short-range), for which emissions are not expected to be distinguishable from background concentrations. Particularly as these are over 600m from any project working areas.

Minor impacts of vehicle emissions may be discernable at receptors located adjacent to the projects access road network, which may include the existing temporary worker accommodation area and the Scout camp. Such impacts are however expected to be minimal as there is an existing set back of 50m from the road to these receptors' buildings. Further, the volume of vehicle traffic is not expected to be exceptionally high (i.e. comparable to typical road or highway flows).

Volatile Organic Compound (VOC) Emissions

Small quantities of fuels, paints, solvents and other volatile substances are likely to be required during the construction phase. These materials will be stored in secure areas within the construction laydown area. If not adequately contained, such substances have the potential to result in the dispersion of volatile emissions to the immediate air shed. Given that the storage of such volatile substances will be in small volumes, any potential impacts will be limited to the immediate surrounding area. Impacts may occur to areas immediately outside of the site, where inappropriate storage or use of substances is in close proximity to the construction site boundaries. In the instance of this project, such minimal impacts may only occur at the Salalah IWPP, which as an industrial receptor is less sensitive to changes in air quality.

Other receptors are located at greater distances by which point VOC emissions are not expected to be discernible.

Odour

There is the potential for release of associated odour to the immediate surrounding areas associated with inappropriate containment and coverage associated with wastewater holding/septic tanks. Any such impacts are likely to be temporary and limited to the immediate surrounding area.

Such impacts may only occur at the Salalah IWPP, which as an industrial receptor is less sensitive to changes in air quality. Other receptors are located at greater distances by which point odour is not expected to be discernible.

Impacts to construction workforce

There is potential that the construction workforce for the project may be impacted by the impacts stated above (as a result of construction) and as a result of existing air emission sources, such as the Salalah IWPP. The Salalah IWPP combusts natural gas, resulting in the emission and subsequent dispersion of exhaust gases, notably NO_2 and CO, which can potentially result in adverse health effects.

The risks from site generated air emissions (i.e. dust and vehicle/equipment emissions) can be managed via a robust CESMP and associated air quality management plan.

Risks from the Salalah IWPP cannot be mitigated by the project, however the risk to the workforce is considered to be low. The primary factor relating to emissions from the Salalah IWPP is the buoyancy of the emissions plume. As a CCGT project the hot exhaust gases will result in a buoyant plume from the IWPP stacks, which are expected disperse at a higher altitude than the project working area (i.e. ground level). The effects of wind would further result in the emissions plume coming to ground away from the projects working area. It is therefore unlikely that emissions from the Salalah IWPP will be distinguishable form the background at the location of the Salalah IWP site. This low risk is not further considered in the potential impacts section, but monitoring recommendations are included herein, as a precautionary approach to protect the workforce.

Table 5-6 Potential Air Quality Impact Significance - Construction

Potential Impact	Potential Impact Magnitude	Receptor	Receptor Sensitivity	Potential Impact Significance
Dust Generation (within 350m distance of project)	Minor Negative	Salalah IWPP	Very Low	**Minor**
Gaseous Emissions	Negligible Negative	Salalah IWPP	Very Low	**Negligible**
		Scout Camp	Medium	**Negligible or Minor**
		Worker Accommodation	High	**Minor**
VOC's	Negligible Negative	Salalah IWPP	Very Low	**Negligible**
Odour	Negligible Negative	Salalah IWPP	Very Low	**Negligible**

5.5.2 Operation

As the proposed projects power demand will be generated and supplied externally, there are no fuel combustion requirements or any other associated air emissions directly from the project.

The facility will result in a small additional number of commuter vehicles and delivery/removal vehicles along the road network to the IWP, however such additions will unlikely be discernible and may relate up to a small number of 30 vehicles trips per hour at peak times.

Likewise, with the construction impacts outlined above, the adjacent Salalah IWPP may have a risk of emissions exposure to the projects operational workforce, however, as a low risk this is not further considered in this impacts assessment, although a recommendation for monitoring of ambient air quality is included to the monitoring measures below.

Table 5-7 Potential Air Quality Impact Significance - Operation

Potential Impact	Potential Impact Magnitude	Receptor	Receptor Sensitivity	Potential Impact Significance
Vehicle - Gaseous Emissions	Negligible Negative	Salalah IWPP	Very Low	**Negligible**
		Scout Camp	Medium	**Negligible or Minor**
		Worker Accommodation	High	**Minor**

5.6 Mitigation & Management Measures

Although the projects potential construction and operational impacts related to air quality have been scoped out of detailed assessment, the ESIA includes mitigation and management measures to reduce the potential for any associated effects relating to air quality. These measures will be included into the CESMP/OESMP and construction/operational phase ESMS for effective management and implementation on-site.

5.6.1 Construction

Table 5-8 Air quality – Mitigation Measures Proposed for Construction Phase

Impact / Source	Mitigation Measure
Dust due to site preparation	Any land grading, excavations and moving of uncovered waste/materials should be undertaken during periods of low winds (e.g. <15 km/h is recommended as a threshold when a review of works is conducted).
	Material stockpiles higher than 5 metres will be avoided where possible, with a dust control method (e.g. dust suppression sprays or cover) being utilised on any piles during periods where the wind speeds exceed 15km/h).
	Where sand and other dusty materials are transported to the site, trucks will not be overloaded and will be appropriately covered / sheeted to avoid loses en-route.
	Dusty material stockpiles (i.e. any fine sands and powders) are to be located away from the site boundaries and be contained to avoid dispersion during storage or use.

Impact / Source	Mitigation Measure
	Dust generating activities such as stone cutting and grinding are to be undertaken away from the site boundaries and/or should be effectively controlled to avoid dust dispersion.
	Powdery materials (e.g. cements) will be stored and transported in sealed containers to avoid dust dispersion.
Gaseous and Particulate Emissions from Vehicles	Construction roads in the site will be designated with signage for directions and speed limits placed all along the roads.
	The provision of a wheel cleaning facilities to ensure all vehicles leaving the site are in a satisfactory state of cleanliness to avoid material (e.g. soil) deposition on external roads. Dry wheel cleaning is recommended, unless seawater or adequately treated water can be reused.
	A visual assessment of dust emissions will be undertaken on a daily basis and actions taken to reduce emissions, where they are identified as excessive.
	Deliveries of equipment/plant to the site will be efficiently managed to reduce the number of trips.
	Exhaust fumes and particulates emitted from trucks and vehicles will be minimised by assuring the use of good condition vehicles (e.g. compliant to national mobile emission/vehicle emission requirements).
	Vehicles entering the site for the first time will be inspected for their worthiness and where necessary will not be permitted to enter the site.
	Lorries and trucks engines will be turned off while waiting on site to minimise gaseous emissions. Air-conditioned or heated shelters should be provided for drivers in designated waiting, loading and unloading areas.
VOC Emissions	Hazardous materials stored and used on site with potential gas emissions (e.g. Volatile Organic Compounds) will be located in well-ventilated, but secure low-risk areas, away from major transport routes.
	Fires and material burning will not be allowed on the Project site.
Odours	Adequate and sufficient sanitary facilities for site workers must be provided. These facilities shall be regularly maintained to avoid odour dispersion.

5.6.2 Operation

Table 5-9 Air quality – Mitigation Measures during the Operational Phase

Impact / Source	Mitigation Measure
Vehicular movements associated with operation and maintenance.	Planned inspection and maintenance of project vehicles and mobile equipment shall be undertaken annually to ensure worthiness and compliance to the required national emission limits for vehicles and mobile equipment.
	The project shall encourage a car pooling, or lift sharing programme to reduce vehicle trips by commuting staff.

5.7

5.8 Residual Impacts

5.8.1 Construction

Table 5-10 Air Quality – Residual Impacts – Construction Phase

Potential Impact	Receptor	Potential Impact Significance	Mitigation	Residual Impact
Dust Generation (within 350m distance of project)	Salalah IWPP	Minor	✓	**Negligible**
Gaseous Emissions	Salalah IWPP	Negligible	✓	**Negligible**
	Scout Camp	Negligible or Minor	✓	**Negligible**
	Worker Accommodation	Minor	✓	**Negligible**
VOC's	Salalah IWPP	Negligible	✓	**Negligible**
Odour	Salalah IWPP	Negligible	✓	**Negligible**

5.8.2 Operation

Table 5-11 Air Quality – Residual Impacts – Operation Phase

Potential Impact	Receptor	Potential Impact Significance	Mitigation	Residual Impact
Vehicle - Gaseous Emissions	Salalah IWPP	Negligible	✓	**Negligible**
	Scout Camp	Negligible or Minor	✓	**Negligible**
	Worker Accommodation	Minor	✓	**Negligible**

5.9 Monitoring

Air quality monitoring will be undertaken during both the construction and operational phases of the project by the EPC Contractor and the O&M Company respectively. The minimum expected requirements for the monitoring are outlined in the table below. The final monitoring methodology with specific monitoring details (i.e. locations, frequencies, durations, parameters etc.) will be developed in the specific 'Environmental Monitoring Plan'.

Table 5-12 Minimum Monitoring Requirements: Air Quality

Monitoring	Parameters	Frequency & Duration	Locations	Standards
Construction				
Dust Generation & Dispersion	Dust	Daily (visual observations). To be monitored quantitatively (at receptors) if generation is considered to be excessive or complaints are received.	Access Road, Construction site and laydown area generation. Dispersion to external receptors from point of generation.	Applicable or adopted Omani ambient air quality standards. & WHO Ambient Air Quality standards.
Engine Emissions Monitoring	Vehicle emissions (or other emission control check)	Prior to use of equipment on site and annually.	All non-road vehicles and engines	National Mobile Source Emission Standards
Ambient Air Quality	NO_2 & CO	Monthly (if compliant for all months (over 3 months) suggest to reduce/end.	Project site (away from engine sources)	National Ambient Air Quality standards & WHO standards
Operation				
Engine Emissions Monitoring	Vehicle emissions (or other emission control check)	Annually	All road and non-road vehicles and engines	National vehicle standards and Mobile Source Emission Standards
Ambient Air Quality	NO_2 & CO	Based on the outcomes of the construction monitoring this should be taileoured appropriately.	Project site (away from engine sources)	National Ambient Air Quality standards & WHO standards

6 NOISE AND VIBRATION

6.1 Introduction

This chapter describes the potential noise and vibration impacts that may occur as a result of the projects construction and operational activities, and identifies the measures that will be undertaken and implemented in order to mitigate these impacts. The assessment of impacts has been measured against Omani regulations and IFC guidelines.

The study area assessed in this section is delineated as follows:

- The project footprint;
- Associated facilities (e.g. access road);
- Construction working areas;
- Areas that may be impacted by secondary construction effects of noise & vibration (e.g. access road surroundings and receptors off-site);

This section includes the following:

- Applicable ambient noise standards & guidelines;
- Baseline overview of noise & vibration and outcomes of the baseline noise survey;
- Identification of noise & vibration receptors;
- Identification of potential impacts relating to the projects construction and operation;
- Assessment of significance of potential impacts (including any cumulative impacts);
- Environmental mitigation & management measures (Construction and Operational phases);
- Assessment of residual impacts following the application of mitigation & management measures; and
- Monitoring measures.

6.2 Scoping Outcomes

Preliminary noise and vibration impacts associated with the construction and operational phases of the project have been assessed in the scoping exercise in order to scope in or out a detailed assessment in the ESIA. A list of the potential impacts as well as a justification of why they have been scoped in or out for further assessment in the ESIA is detailed in the following table; as is consistent with the approved project scoping report.

Table 6-1 Noise & Vibration Impacts Scoped In or Out

Potential Impact	Scoped In/Out of ESIA	Justification
Construction		
Construction Site Noise	**Scoped Out**	As an industrial facility, the adjacent IWPP is less sensitive to noise impacts, and is unlikely to have any discernible effects on staff engaged in power plant activities. Construction noise may not be discernible above the operational noise from the IWPP facility, which is the primary anthropogenic noise source locally.
Construction Access Road Noise	**Scoped In**	The increase in vehicle traffic due to the construction phase may be noticeable along the public access road located adjacent to the camel shelters. Additional vehicle movements along the site access road may result in discernible noise impacts at the camel shelters.
Vibration	**Scoped Out**	Vibration impacts are expected to be negligible and will not impact more sensitive receptors such as the camel shelters.
Operation		
Operational Noise	**Scoped Out**	Operational noise will be minimal and largely attenuated by the SWRO housing and pump housing. Impacts will unlikely be discernible above the noise from the adjacent IWPP.
Vibration	**Scoped Out**	Impacts related to vibration are not expected.

6.3 Standards and Regulatory Requirements

Omani Noise Standards

Omani regulations for noise are applicable for both the workplace and ambient noise levels. The ambient noise levels are provided in M.D. 79/94 and the applicable limits of noise generated from industrial facilities, which includes desalination plants, is provided in the following table.

Table 6-2 Limits of noise generated by industrial sources

Type of District	Leq, dB(A)		
	Day Time 7am-6pm Workdays	Evening Time 6pm- 11pm Workdays	Night Time 11pm – 7am Workdays and holidays
Rural residential and recreational	45	40	35
Sub-urban residential	50	45	40
Urban residential	55	50	45
Urban residential with some workshops or business city hub	60	55	50
Industrial and commercial	70	70	70

Ministerial Decree 80/1994, describes the measures taken to control noise pollution in the working environment. The requirements specify that:

- Employees should not be exposed to noise levels exceeding 85 dB(A);
- If work place noises exceed 85 dB(A), then the employer should provide the workers with suitable personal hearing protection devices;
- The attenuation devices should minimise the noise levels to 80dB(A) or lower; and
- Machines must be designed and constructed in such a way that risks resulting from elevated noise are reduced to the lowest level possible using state-of-the-art technology and available means particularly at noise source.

Lender Requirements

The IFC General EHS Guidelines require that the project is in compliance with the WHO noise standards, though these relate to noise received at receptor locations rather than the project boundary.

Table 6-3 WHO Noise Standards

Receptor	One Hour LAeq (dBA)	
	Daytime 07:00 – 22:00	Night time 22:00 – 07:00
Residential, Institutional, Educational	55	45
Industrial, Commercial	70	70

Noise impacts should not exceed the levels presented above, or result in a maximum increase in background levels of 3 dB at the nearest sensitive receptor location off-site.

Furthermore, the following requirements have also been specified in the IFC EHS noise guidelines:

- No employee should be exposed to a noise level greater than 85 dB (A) for duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB (A), the peak sound level reaches 140 dB(C), or the average maximum sound level reaches 110 dB (A). Hearing protective devices provided should be capable of reducing sound level at the ear to at least 85 dB (A).
- For every 3 dB(A) increase in sound levels, the allowed exposure period or duration should be reduced by 50%.
- Where feasible, use of acoustic insulating materials isolations of the noise source and other engineering controls should be investigated and implemented prior to the issuance of hearing protection devices as the final control mechanism.
- Medical hearing checks on workers exposed to high noise levels should be performed periodically.

6.4 Observations and Baseline Conditions

6.4.1 Existing noise sources

Salalah IWPP is located adjacent to the western boundary of the proposed project area. This is a gas fired power plant with a total gross capacity of 490 MW and is a significant source of anthropogenic noise locally. The noise from the Salalah IWPP resembles a continuous humming noise with occasional noises from on-site activities (e.g. tannoy address system, and blowing of steam). The lower frequencies of the noise are more apparent at greater distance from the IWPP, with very low volume humming discernable up to 2km distance from the IWPP.

Site visits were made during the Khareef season (constant drizzle and rough seas) and experienced high levels noise from the coastline, where waves of moderate to high energy levels were breaking on the beach. Coastline noise. Noise form the coastline is the dominant noise at the clifftop above the beach, but becomes less discernible with distance away from the cliff line in land.

6.4.2 Sensitive Receptors

The site visits undertaken in 2016 and 2017, and the review of satellite imagery have revealed few sensitive receptors in proximity to the project, or within range of the potential construction or operational impacts. For instance, there are no permanent residences within 1km of the

project site, with the nearest isolated communities approximately 2km from the project and the nearest urban area of Taqah, approximately 8km to the west of the project site.

Potential sensitive receptors were identified adjacent to the project site during the assessment of the project. The receptors, as well as a justification of the site and map are listed below.

Table 6-4 Potential Noise and Vibration Receptors

Receptor	Receptor Type	Justification
Salalah IWPP	**industrial**	The IWPP is an industrial facility that is located adjacent to the project site. As an industrial facility and the primary source of anthropogenic noise in the local area, it is of low vulnerability to changes in noise condition.
Camel Shelters	**Agricultural / Temporary Residence**	Camel shelters are understood to belong to the Jebali people and have been observed in a cluster adjacent to the existing hardstanding access road that links the highway to the project site. At their nearest location, these shelters are over 2km from the site and 1.5km from the proposed access road construction. People employed by the Jebali people to tend the camels are present in these areas and have shelters for sleeping. It is recognised that these receptors are not permanent features and are subject to movement depending on the season and availability of grazing fodder for the camels.
Scout Camp	**Temporary Residence**	A Scout camp is located approximately 1km from the project site with the camp entrance being located on the existing hardstanding access road. The gates of the Scout Camp are adjacent to the existing access road and approximately 600m from the proposed project site access road construction area (associated project facility). During the site visit undertaken on 10th July 2017 camp staff informed the Consultants that the camp is only inhabited for approximately 2 weeks per year by the Scouts.
Worker Accommodation	**Temporary Residence**	The temporary worker accommodation is in place to accommodate workers for the construction of the Highway upgrades to the north of the project site. The site is temporary facility with accommodation blocks and a materials and vehicle laydown area. It is understood that this area will be decommissioned once the highway project is completed.

Figure 6-1 Potential Noise and Vibration Receptor Locations

Satellite Image Source: Google Earth

6.4.3 Baseline Noise Monitoring

In order to determine a representative baseline for existing noise levels at the Camel Shelters, temporary scout camp and temporary worker accommodation along the existing public access road, a noise monitoring survey was undertaken with a noise meter compliant with Class 1 specification, as set out in BS EN 60804:2001 (calibration certificate presented in Appendix F).

Five (5) locations (as seen in Figure 6-2)were chosen for the noise monitoring survey. Three (3) sites were located on the north, south and east borders of the project site. Two (2) locations were located adjacent to the public access road to represent noise that could affect the worker accommodation, scout camp and camel shelters.

The survey monitored ambient noise levels for 20-minute periods to provide measurements of Leq(A) readings for daytime periods. As night time construction works are not expected, night-time noise surveys are excluded.

20-minute periods are considered representative to ensure that a baseline can be achieved from primary noise sources, the vehicle movements along the public access road and the Sempcorp IWPP. The assessment was made by considering the existing baseline condition in

combination with the potential additional construction phase noise impacts from vehicular sources.

Figure 6-2 - Noise Monitoring Locations

Table 6-5 Coordinates of Noise Monitoring Locations

ID	Co-Ordinates		Location Observations	Photo
	N	E		
N-1	17°02'09"	54°29'45"	At the centre of the eastern boundary of the proposed IWP. Note: no immediate receptors to the east.	

ID	Co-Ordinates		Location Observations	Photo
	N	E		
N-2	17°02'19"	54°29'43"	At the northern boundary of the proposed IWP, in the area that the proposed access road will meet the site.	
N-3	17°02'04"	54°29'42"	In the southern portion of the site, on the cliff top.	
N-4	17°02'29"	54°29'02"	Adjacent to the existing hardstanding access road to Salalah IWPP, on the boundary of the Scout camp.	
N-5	17°02'30"	54°28'23"	Adjacent to the existing hardstanding access road to Salalah IWPP, adjacent to the nearest camel shelters.	

The observations during the noise monitoring assessment are listed in the table below.

Table 6-6 Noise Monitoring Observations

ID	Date & Time	Measured Noise Level			Field Observation
		Leq dB(A)	Lmax dB(A)	Lpeak dB(C)	
N-1	10/07/2017 10:45	52.1	55.3	82.4	Wind: 1.2m/s Average, Westerly The primary noise at this location is from the IWPP cooling fans and gas turbines, resembling a constant humming noise. Wave breaking at the shoreline are also discernible on a continuous rumbling basis. A small generator at a communications mast (approx. 100m) was also discernible to a lesser extent.
N-2	10/07/2017 11:00	51.7	55.8	83.0	Wind: 0.5m/s Average, Westerly The IWPP is producing the only constantly discernible noise at this location. Key noise sources are the fans and turbines. A beeping high-pitched siren was apparent during times of the survey, as was a sound similar to steam release (all from the IWPP).
N-3	10/07/2017 11:35	61.6	64.9	88.5	Wind: Calm Noise from the shoreline is predominant at this location and the IWPP was not discernible. Shoreline noise related to medium – large sized waves continually crashing, creating an on-going thunder like sound.
N-4	10/07/2017 13:15	49.1	66.0	82.3	Wind: 3m/s Average, Westerly Background humming from the IWPP is the primary continuous noise source at this location. Noise from shoreline waves was barely discernible. Passing vehicles on the access road to the IWPP were clearly discernible for short durations during the vehicle passing (a total of 5 vehicles passed in 15-minutes at this location). Minor construction work with hand tools was discernible at the adjacent Scout camp.
N-5	10/07/2017 13:35	47.6	60.6	89.0	Wind: 2.5m/s Average, Westerly Background humming from the IWPP (approximately 1.7km east) is barely discernible at this location, whereas distant road noise from Highway 49 (approximately 850m north) can be heard as vehicles pass. The primary 'loud' noise source at this location is the passing vehicles on the access road (40m to the north), particularly HGV's travelling to the highway construction worker camp and laydown area.

The baseline noise assessment identified the noisiest location to be on the cliff top above the shoreline (N-3), where the only discernible noise was as a result of waves crashing on the beach.

Discounting the noise from N-3, the remaining noise levels from the centre and northern section of the proposed project area (i.e. locations N-1 & N-2) were monitored as 52.1 & 51.7dB(A) respectively, which were primarily affected by noise from the existing IWPP.

Monitoring locations N-4 and N-5 (located adjacent to the existing IWPP access road at the Scout Camp and Camel herder locations) have slightly lower noise levels, due to a greater separation form the IWPP. The highest magnitude noises at these locations are as a result of passing vehicles. The monitored noise levels exceed the WHO night time noise limits for Residential, Institutional, Educational (set at 45dB(A)). Depending on the Omani classification of these receptors, the baseline noise levels may already exceed the required standards for rural residential areas during all times of the day, unless the industrial noise standards are applicable.

6.4.4 Baseline Vibration

In terms of a baseline, no noticeable vibrations were encountered at any time during the preliminary site visits. Equally, the power and water generation facilities in the local area, are not significant vibration sources, as their key components do not comprise laterally or vertically moving mechanisms, or impact interactions with surfaces.

6.5 Potential Impacts

6.5.1 Construction

Construction Site Noise

Construction activities will likely result in temporary and short duration increases in the noise and vibration levels emanating from the project site, construction access road and the laydown areas.

Noise will be generated by construction and propagated to the surrounding areas via a range of processes. Pertinent construction activities at the project site in relation to noise are likely to include earthworks, movement of vehicles, compaction works and piling (limited piling will be required with shoring purposes, not foundation purposes, around the Pump Station which will enable a safe and dry excavation).

The accumulation of noise from the above sources can also introduce potential cumulative impacts when generated in tandem. All of these impacts may have a negative effect on the amenity at nearby receptors.

As noise levels dissipate with distance, the effects from the construction site on receptors such as the Scout Camp and existing worker accommodation area (both over 600m from any works) are unlikely to be discernible; particularly over the existing noise source of the Salalah IWPP and noise from the shoreline. In addition, noise generated from the main project

construction site will likely be further attenuated by the screening effects of the Salalah IWPP which is located in between the project site and these receptors.

Construction Access Road Noise

Impacts relating to construction access road noise were specifically scoped in for detailed assessment at the ESIA stage to assess the impacts of vehicle noise on the Camel shelters, existing worker accommodation areas and the Scout Camp.

In order to undertake a further impact assessment with regards to construction access road noise, a basic noise model has been undertaken in accordance with calculations guided by the UK's Calculation for Road Traffic Noise (CRTN) guidelines. The noise model operates with a number of inputs relating to the expected traffic flows and uses calculations to correct the received noise level at a receptor. The further assessment of construction access road related noise has assumed/included the following:

- Daily traffic flow of 400 vehicles on the construction access road.
- 60% of vehicles will be HGV's.
- Vehicle speeds will be an average of 40kph.
- Receptors (Camel Shelters, Scout Camp and Worker Accommodation Area) are set back 50m from the road edge; as observed during site visits.
- There is no absorbent ground (i.e. vegetation) between the construction access road and the receptors.
- There is no noise barrier or other form of attenuation intersecting the link and the receptor (e.g. noise fence, wall etc.)

The calculation inputs and resulting adjustments from the noise model are provided in the tables below.

Table 6-7 Construction Access Road Noise Calculation – Data Inputs

Link	Data Input								
Reference	AADT	18hr Flow	HGV (%)	Velocity (kph)	Distance to Receptor	Barrier	Gradient	Height of receptor	I - Absorbent Ground
Existing Access Road to Salalah IWP	400	380	60	40	50	Illuminated	0	1.5	0

Table 6-8 Construction Access Road Noise Calculation – Noise Corrections

Link	Corrections (dB)				
Reference	HGV & Velocity	Gradient	Distance Attenuation	Barrier Attenuation	Absorbent Ground
Existing Access Road to Salalah IWP	-0.5	0.0	-6.0	0	0

Table 6-9 Construction Access Road Noise Calculation – Adjusted Noise Impacts

Link/Receptor	Day Time Noise	Day Time Noise	Night Time Noise
Reference	LA10 18hr db(A)	LA10 16hr db(A)	LA10 8hr db(A)
Existing Access Road to Salalah IWP	48.4	46.4	45.8

Based on the above calculations, the resulting daytime average noise level from access road vehicles is expected to be approximately 48dB(A) at the identified receptors. Night time works are not expected, and any night time project related vehicle movement are expected to be minimal.

When considered as a cumulative impact with the monitored baseline, the combination of noise levels has the resulting potential impact.

Table 6-10 Construction Access Road Noise Calculation – Cumulative Impacts

Receptor	Baseline Noise	Potential Impact	Potential Cumulative Impact (Baseline + Impact)	Potential Change from Baseline
Reference	Monitored Baseline	LA10 18hr db(A)	db(A)	db(A)
Scout Camp	49.1	48.4	51.8	**2.7**
Existing Worker Accommodation Area	49.1	48.4	51.8	**2.7**
Camel Shelters	47.6	48.4	51	**2.4**

The assessment results presented above predict that potential noise impacts will be less than a 3dB(A) change from the existing baseline conditions. When considering short term road noise impacts the UK Design Manual for Roads and Bridges (DMRB) Volume 11, Section 3, Part 7, HD213/11 states that long term impacts (i.e. over 1 year of construction) of a change between 0.1 – 2.9dB(A) magnitude is 'Negligible'.

Vibration

Certain construction processes, particularly those involved with site preparation and civil works, e.g. breaking, piling, vibratory rollers etc. have the potential to create vibration within the vicinity of the works.

As vibrations dissipate rapidly (due to losses of energy radiating 360 degrees from their source) the vibration impacts at the project construction site will likely be negligible, and may only have a minimal impact at the Salalah IWPP. These impacts are not expected to be discernible at other receptors.

Table 6-11 Potential Noise and Vibration Impact Significance – Construction

Potential Impact	Potential Impact Magnitude	Receptor	Receptor Sensitivity	Potential Impact Significance
Construction Site Noise	Minor Negative	Salalah IWPP	Very Low	**Negligible or Minor**
Construction Access Road Noise	Negligible Negative	Camel Shelters	High	**Minor**
		Existing Worker Accommodation	High	**Minor**
		Scout Camp	Medium	**Negligible or Minor**
Vibration	Minor Negative	Salalah IWPP	Very Low	**Negligible or Minor**

6.5.2 Operation

Noise

The operation of SWRO plants are not considered noisy processes. Some items of equipment do cause some noise such as seawater pumps and RO trains (to a lesser extent), however, these will be housed within buildings/rooms which further provide a good level of attenuation. Given the limited potential for noise impacts, particularly when considered either separately or in combination with the existing noise source of the Salalah IWPP, discernible impacts at any receptors are not expected.

Vibration

Vibration impacts are not expected as a result of the projects operation.

6.6 Mitigation & Management Measures

6.6.1 Construction

Table 6-12 Noise – Mitigation Measures during Construction

Impact	Mitigation Measure
Construction Noise and Vibration	Work will at all times be undertaken in such a manner as to keep any disturbance from noise and vibration to a minimum.
	Activities emitting the highest noise levels will be undertaken during daylight hours between Sunday and Thursday.
	Where possible, the highest noise emitting activities should be undertaken in a central site area and away from sensitive receptors. For example, fabrication of materials before moving to other areas.
	All operatives will be trained/informed (e.g. in tool box talks) ton how to reduce noise levels from construction activities.
	Mechanically powered (e.g. diesel engine vehicles and compression equipment) and pneumatic plant will be equipped with effective silencers, or other abatement equipment, when necessary (i.e. noise monitoring reputedly shows exceedances associated to diesel engine vehicles or compression equipment).
	Electrically powered plant will be preferred, where practicable, to mechanically powered alternatives.
	Where feasible, bored piling techniques will be preferred to impact piling.
	Delivery vehicles will be prohibited from waiting outside the site with their engines running. The movement of heavy vehicles during the night will be avoided wherever practical.
	All construction plant will be maintained and operated according to the manufacturers recommendations, in such a manner to avoid causing excessive noise.
	Items of plant on site operating intermittently will be shut down in the intervening periods between use.
	Where appropriate, noise barriers /attenuation to be employed (e.g. for generators) to ensure that the maximum noise level at 1m distance from a single source will not exceed 85dB(A).
	Where noise levels exceed 85dB(A) noise protection devices will be provided to personnel on-site.

6.6.2 Operation

Table 6-13 Noise –Mitigation Measures for Operation

Impact	Mitigation Measure
Operational Noise	Where practicable, all noise generating equipment shall be sited away from sensitive receptors adjacent to site.
	Deliveries and removals of waste are to be undertaken during daylight hours where possible.

6.7 Residual Impacts

6.7.1 Construction

Table 6-14 Noise – Residual Impacts – Construction Phase

Potential Impact	Receptor	Potential Impact Significance	Mitigation	Residual Impact
Construction Site Noise	Salalah IWPP	Negligible or Minor	✓	**Negligible**
Construction Access Road Noise	Camel Shelters	Minor	✓	**Minor**
	Existing Worker Accommodation	Minor	✓	**Minor**
	Scout Camp	Negligible or Minor	✓	**Negligible or Minor**
Vibration	Salalah IWPP	Negligible or Minor	✓	**Negligible**

6.7.2 Operation

As above, discernible operational impacts relating to noise and vibration are not expected.

6.8 Monitoring

Noise monitoring will be undertaken on a periodic basis during both the construction and Operational phases of the project by the EPC Contractor and the O&M Company respectively. The minimum expected requirements for the noise monitoring are outlined in the table below. The final monitoring methodology with specific monitoring details (i.e. locations, frequencies, durations, parameters etc.) will be developed in the specific 'Environmental Monitoring Plan'.

Table 6-15 Minimum Monitoring Requirements: Noise

Monitoring	Parameters	Frequency & Duration	Locations	Standards
Construction				
Day time Noise	Leq(A)	Weekly for 5-minute periods at each location	Project boundary locations (north, east, south & west)	Omani Noise standards & WHO Noise Standards
Night Time Noise*				
Operation				
Noise (Day & Night)	Leq(A)	Monthly for 5-minute periods at each location	Project boundary locations (north, east, south & west)	Omani Noise standards & WHO Noise Standards

* Night time noise works are not expected. However, if works are required, this shall be undertaken as a minimum monitoring requirement.

7 TERRESTRIAL ECOLOGY

7.1 Introduction

This chapter describes the potential impacts and effects that may occur as a result of the projects construction and operational activities and identifies the measures that will be undertaken and implemented in order to mitigate these impacts. The assessment of impacts has been measured against applicable Omani regulations and IFC standards.

The study area assessed in this section is delineated as follows:

- The projects footprint;
- Construction working areas;
- The projects access road and construction access road.

This section includes the following:

- Applicable ecological regulations and best practice guidelines;
- Terrestrial ecology baseline;
- Identification of any specific terrestrial ecology receptors;
- Identification of potential impacts relating to the projects construction and operation;
- Potential Impact Assessment and assessment of significance (including any cumulative impacts);
- Environmental mitigation & management measures (Construction and Operational phases);
- Assessment of residual impacts following the application of mitigation & management measures; and
- Minimum monitoring measures.

7.2 Outcome of Scoping Report

Impacts associated with the construction and operational phases of this project have been assessed to be scoped in or out of detailed assessment within this ESIA, as referenced in the approved scoping report. A list of the potential impacts as well as a justification of why these have been scoped in or out of detail assessment are detailed in the following table.

Table 7-1 Ecological Impacts Scoped In or Out

Potential Impact	Scoped In/Out of ESIA	Justification
Construction		
Habitat Loss	**Scoped In**	Impacts are expected to be very minor as the site habitats are common for the local area. The project site location will also not result in the severance of habitats. However, without undertaking a baseline assessment of flora species in the project footprint, it is not appropriate to scope this impact out at this stage.
Disturbance of Fauna	**Scoped In**	The preliminary site visit and baseline observations did not identify faunal species of importance. Impacts (if any to fauna) are not expected to be of significance. However, without undertaking a baseline review of potential faunal species, it is not appropriate to scope this impact out at this stage.
Operation		
All operational impacts to terrestrial ecology have been scoped out as there are not expected to be any further impacts of significance during the operational phase.		

7.3 Standards and Regulatory Requirements

7.3.1 Omani Requirements

RD 6/2003: Law on Nature Reserves and Wildlife Conservation established requirements for the protection of designated nature reserves with in the sultanate of Oman and identifies a list of species that are protected against killing, hunting or smuggling (no evidence suggesting the presence of any species were noted during the initial site visit).

7.3.2 Lender Requirements

IFC Performance Standard 6 requires the consideration of relevant threats to biodiversity and ecosystem services, especially focusing on habitat loss, degradation and fragmentation, invasive alien species, overexploitation, hydrological changes, nutrient loading, and pollution. Performance Standard 6 outlines that impacts on biodiversity and ecosystem services should be avoided where possible. When avoidance of impacts is not possible, measures to minimise impacts and restore biodiversity and ecosystem services should be implemented.

7.4 Observations and Baseline Conditions

7.4.1 Designated & Sensitive Areas

The project footprint is not located in any designated ecological areas, such as Omani nature reserves, RAMSAR sites, Important Bird Areas.

Khawr Rawi – Nature Reserve

The nearest sites designated for nature conservation value in Dhofar Governorate is located approximately 5 km west of the project site. This site is Khawr Rawi Nature Reserve, it was established in 1997, with an area of 8.2 km^2. The Reserve is located on the Salalah Coastline at approximately 2.5km long and up to 400m wide. The intertidal habitat provides an important area for birds and fish.

It is the largest reserve in Dhofar Governorate and is considered very popular amongst tourists. The nature reserve also houses some historical sites. It has gained special recognition and has been included in the World Heritage List as part of the 'Land of Frankincense'; primarily for the port at Khor Rawi (Samharam – Archaeological park).

Plate 7-1 Photograph of Khawr Rawi Nature Reserve (July 2017)

Wadi Darbat

Wadi Darbat approximately 9km to the north-west of the project site has a rich ecology and is an Important Bird Area.

Plate 7-2 Photographs of Wadi Darbat (July 2017)


Important Bird Areas (IBAs)

Although the project footprint is not within an Important Bird Area (IBA), there are three IBAs in close proximity to the project including:

- Khawr Rouri (6km to the west of the site)
  - *The most important khawr in Dhofar for wintering and passage waterbirds, with a greater diversity of species and larger numbers of birds present than at other khawrs.*
- Wadi Darbat (4km to the north of the site – closest location of IBA designation)
  - *A rich assemblage of breeding species of wetland, woodland and cliffs, including many Afrotropical species.*
- Khawr Hassan (10km to the west of the site)
  - *Large roosts of non-breeding seabirds occur on the barrier beach in summer. At least 193 species occur, including a wide variety of waterbirds and breeding Afrotropical species.*

The location of the project site does not include habitat consistent with those found at the nearby IBAs. As such, it is not expected that bird species similar to those at the IBAs will be present on-site. Furthermore, the same is expected for migratory bird species, which are also not expected to be transient at the project location.

Figure 7-1 Important Bird Areas(IBAs) Locations (Project site in red)

7.4.2 Habitats

The proposed project site is predominately an open cliff top plain with little vegetation due to the previous use of the land as a construction laydown area. The project will include seawater intake and outfall pipelines that will be routed down the cliff face and there will also be some interaction with beach prior to being buried underground and directed out to sea. The project access road is located in the same habitat type as the main project site area on the cliff top. To the north of the project site and away from any working areas is a large wadi.

Figure 7-2 Habitat Overview

Figure 7-3 Habitat Overview – On-Site

Habitat	Photograph
Beach An intertidal area of loose unconsolidated sand. The rear of the beach area has areas of rocky outcrops, close to the cliff and there are areas of vegetation. (Some project works are required at the beach level to bury intake and outfall pipelines)	

Habitat	Photograph
Cliff A rocky slope rising form the beach to a clifftop plateau (plain). The cliff is primarily rocky with some sandy soils and a spread of low-lying vegetation. (Intake & Outfall pipelines are to be routed up/down the cliff face)	
Clifftop Plain The clifftop plain or plateau has been graded due to previous use as a construction laydown areas and there are few if any remains of flora. The soils are mixed & unconsolidated with small rocks and gravels. (Primary land area for main project facilities)	

The little vegetation on site is dominated by small pioneer shrub species and grasses. Uprooted palm trees were seen during the site visit in Summer 2016, nearby camels were grazing on them. Passerine birds were also seen foraging amongst the root systems.

The wadi habitat is not within the site footprint nor is it in the footprint of the construction access road and construction working areas, however it is located immediately adjacent to the construction access road.

Figure 7-4 Habitat Overview – Off-Site

Habitat	Photograph
Wadi (Not in the projects footprint or construction working area, but to the immediate north of the project's access road)	

7.4.3 Flora and Fauna

The following flora and fauna observations were made during a Phase 1 Habitat survey between July 11-12, 2017. All the observations of flora are actual siting's. These have been compiled into an inventory and presented herein, with reference to any flora afforded national protection or associated with any international conservation status (IUCN).

Evidence of fauna or potential fauna in the projects footprint and working areas (beach, cliff and clifftop plain) was also collected to establish the presence for any sensitive habitats. All baseline records of flora and fauna are based on incidental siting's.

The fauna on site identified during the summer 2016 and 2017 site visits include:

Beach Observations

The beach habitat is predominantly free of any flora however, a number of ghost crabs were identified to be foraging and burrowing along the shoreline. Remains of shellfish and crustaceans were scattered amongst the beach sands.

Table 7-2 Observed Beach Flora

Name	Images	Observations	Conservation Significance
Pennisetum divisum		Sporadic and located on elevate sandy areas prior to the cliff	None
Grass indet.		Located in clusters in proximity to rocky outcrops in the sand prior to the cliff	Unknown
Perennial indet.		Sporadic and located on elevate sandy areas prior to the cliff	Unknown

Table 7-3 Observed Beach Fauna

Name	Images	Observations	Conservation Significance
Ocypodinae (Ghost Crab)	  ref: File Photo	Occasional (various crab burrows in beach habitat)	None

Cliff

Table 7-4 Observed Cliff Flora

Name	Images	Observations	Conservation Significance
Perennial indet.		Sparse	Unknown

Name	Images	Observations	Conservation Significance
Annual indet.		Sporadic flowering species observed at the base of the cliff.	Unknown
Heliotropium pterocarpum.		Sporadic species observed at the base of the cliff.	None
Perennial indet.		One observation at the base of the cliff.	Unknown

Little fauna was observed in the cliff face, however an incidental siting of a scorpion as recorded during the site visit undertaken in Summer 2016.

Table 7-5 Observed Cliff Fauna

Name	Images	Observations	Conservation Significance
Leiurus Quinquestriatus (Deathstalker Scorpion)		Sparse	None

Clifftop Plain

The clifftop plain is largely void of vegetation, besides isolated examples of common low-lying local vegetation species presented below.

Table 7-6 Observed Clifftop Plain Flora

Name	Site Image	Observations	Conservation Significance
Grass indet.		Sporadic (seen around site area)	None – common species in the region.
Tribulus Omanense (Zahra)		Sporadic	None – common species in the region.

Name	Site Image	Observations	Conservation Significance
Calotropis procera(Sodoms apple milkweed)		Sparse (one or two instances on-site)	None – common species in the region.

As with flora, there were few observations of fauna on the clifftop plain at the project site. The amount of rock and available refugia left from the rehabilitation of the previous laydown area does present suitable habitat for reptiles.

During the site visit in 2017 a lizard or agama species was observed on-site. Siting of individual species were infrequent, but reptiles were using the rocky areas of the site for refuge.

Table 7-7 Identified Clifftop Plain Fauna

Name	Image	Observations	Conservation Significance
Agama		Seen on project site and in the wadi	None

Wadi

To the north of the project area, in close proximity to the proposed access road the landscape slopes to a deep and wide Wadi channel. During the site visits, the Wadi was dry but substrates suggest that there is the potential for vegetation to cover a substantial area of the wadi.

The wadi is expected to be wet for periods of the year, and an amount of vegetation cover is apparent, which is more substantial relative to areas outside the Wadi. During the time of the site visit in 2016, the area was being grazed by camels and 2 Tristrams starlings (*Onychognathus tristramii*) were identified following the course of the wadi.

No coastal or wading birds were identified during the site visits.

During the site visit on July 10, 2017, several piles of excavated material as well as some construction waste was identified in the wadi. A Stationary crusher (for the nearby highway construction project) was also seen in the wadi.

Plate 7-3 Rubble Waste in Wadi

Table 7-8 Identified Fauna – In Adjacent Wadi

Name	Image	Observations	Conservation Significance
Onychognathus tristramii (Tristram's starlings)	 ref. File Photo	Sparse (was seen on project site during the initial site visit prior to full clearance of temporary facilities)	None – common pioneer species to the region.

7.4.4 Sensitive Receptors

Potential sensitive receptors were identified adjacent to the project site during the assessment of the project. The receptors, as well as a justification of the site and map are listed below.

Table 7-9 Sensitivity of Receptors - Ecology

Receptor	Sensitivity	Justification
Site Flora	**Very Low**	Common flora species were identified on site, none of which have been identified to have any conservation status. The primary construction areas of the site are void of flora.
Site Fauna	**Low**	Fauna on site was limited to lizard/agama species and an observation of a scorpion. Ghost crabs and their burrows (on the beach) were identified.

7.5 Potential Impacts

7.5.1 Construction

Habitat Loss/Disturbance

Site preparation activities will include the removal of any remaining vegetation in the project footprint, followed by grading for foundations, excavations for below ground infrastructures, and trenching and backfilling for cables and pipelines.

Impacts to flora will be minimal in the main portion of the site (clifftop plain) due to the lack of vegetation. There are no widespread areas of flora cover in any areas of the site, and as such the impacts to flora will be limited given that the identified species are common.

Disturbance of Fauna

Impacts to site fauna may be of a higher significance than that of flora due to the presence of suitable refugia reptiles in the main clifftop site area, and the identification of crab species on the beach. It is expected however that only a small section of beach will be affected, and only for a temporary period during construction. There may however be permanent impacts to the rear of the beach to install and bury the intake and outfall pipelines as these may protrude above ground at these locations.

Construction impacts are likely to drive any fauna away from the site to other similar habitat (i.e. to the east).

Table 7-10 Potential Construction Impacts - Ecology

Impact	Magnitude	Justification
Habitat Loss	**Minor**	Habitat Loss will be permanent, however there will be little measurable change with respect to the abundance of available similar habitat to the east of the project and to the west of the existing Salalah IWPP.
Disturbance of Fauna	**Minor**	Construction activities are likely to result in disturbance, or would trigger a flight response from fauna within the project area. Given ample availability of refuge and foraging areas around the site, this is unlikely to have any discernible impact upon local terrestrial ecology, or result in carrying capacity impacts to other neighbouring habitats.

Table 7-11 Significance of Construction Impacts - Ecology

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Loss of Fora and Fauna	Minor	Site Flora	Very Low	**Negligible or Minor**
	Minor	Site Fauna	Low	**Negligible or Minor**

7.5.2 Operation

Due to the likely paving and hard standing construction over the majority of the proposed site, it is anticipated that impacts during the operational phase to any on site vegetation will be minimal. No further assessment of operational impacts has been made.

As such, the only activities that could negatively impact the ecology of the site would be through indirect project activities, relating to poor management practices of any designated landscaped areas; or to the fauna species inhabiting/using these areas.

7.6 Mitigation & Management Measures

7.6.1 Construction

Table 7-12 Mitigation Measures during the Construction Phase - Terrestrial Ecology

Impact	Mitigation
Habitat Loss	The project shall ensure that no encroachment to the nearby, adjacent land will occur.
	All construction vehicles shall adhere to clearly defined transportation routes. Transport routes should be identified and training provided to emphasise the need to adhere to the designated routes in order to protect the existing vegetation and reduce encroachment on adjacent land, and reduce dust fall across the site.
	Hazardous materials used during the construction stage should be adequately managed, in order to minimise the potential risk of spillage and therefore potential contamination to the ecosystem.
	Transportation within and to and from the site should be minimised through efficient transport management in order to minimise the risk of running animals over.
	Machinery should be maintained on a regular basis to ensure smooth efficient running to control emissions and prevent contamination events as a result of faulty equipment etc.
Disturbance of Fauna	Prior to shoreline works, the contactors shall make efforts to ensure that crabs are not within their burrows and are not harmed during the works. This may include excavated material which may contain crab burrows to be spread thinly and left overnight for crabs to escape.
	The grading/levelling works at the commencement of construction shall endeavour to begin from the west and work eastwards. This will allow any fauna to flee/vacate the project site to the open land to the north of the project, which is of similar habitat.

7.6.2 Operation

Table 7-13 Terrestrial Ecology Mitigation & Management Measures – Operation Phase

Impact/ Source	Mitigation & Management Measures
Exposure of habitats to chemical additives and hazardous materials	Landscaping on site should incorporate indigenous halophytic and xerophytic plant species to minimise irrigation requirements and avoid the need for fertilisers/pesticides. Intentional replanting of vegetation would enhance the biodiversity of the site.
	Appropriate storage of hazardous materials, should be designed in accordance with the management measures stated in the soils & geology section of this ESIA, to prevent spillages to any site based habitats.
Attraction of pests	Implement an integrated pest management scheme instead of using large scale application of pesticides. A plan to manage pests should be prepared to outline specific mitigation and management measures.

7.7 Residual Impacts

7.7.1 Construction

Table 7-14 Terrestrial Ecology – Residual Impacts – Construction Phase

Potential Impact	Receptor	Potential Impact Significance	Mitigation	Residual Impact
Habitat Destruction	Flora	Negligible or Minor	✓	**Negligible**
Disturbance of Fauna	Fauna	Negligible or Minor	✓	**Negligible**

7.8 Monitoring

Terrestrial ecology monitoring will be undertaken during the construction phase of the project by the EPC Contractor. The minimum expected requirements for the monitoring are outlined in the table below. The final monitoring methodology with specific monitoring details (i.e. locations, frequencies, durations, parameters etc.) will be developed in the specific 'Environmental Monitoring Plan'.

Table 7-15 Minimum Monitoring Requirements: Terrestrial Ecology

Monitoring	Parameters	Frequency & Duration	Locations	Standards
Construction				
Fauna	Crab & Reptiles	Daily visual observations of live fauna and burrow locations by workers at the commencement of working activities, and general observations throughout the day – to inform evacuation of specific burrows	In all working area requiring land grading or earthworks.	Applicable regulation includes IFC PS6.

8 GEOLOGY, SOILS AND GROUNDWATER

8.1 Introduction

This chapter describes the potential impacts and effects that may occur as a result of the projects construction and operational activities and identifies the measures that will be undertaken and implemented in order to mitigate these impacts.

The study area assessed in this section is delineated as follows:

- The projects footprint;
- Construction working areas;
- The projects access road.

This section includes the following:

- Applicable soil and groundwater standards and best practice guidelines;
- Baseline overview of soil, geology and groundwater and outcomes of soil baseline analysis;
- Identification of soil & groundwater receptors;
- Identification of potential impacts relating to the projects construction and operation;
- Potential Impact Assessment;
- Mitigation & management measures (Construction and Operational phases); and
- Assessment of residual impacts following the application of mitigation & management measures.

8.2 Outcome of Scoping Report

Impacts associated with the construction and operational phases of this project have been assessed to be scoped in or out of detailed assessment within this ESIA, as referenced in the approved scoping report. A list of the potential impacts as well as a justification of why these have been scoped in or out of detail assessment are detailed in the following table.

Table 8-1 Soil, Geology & Groundwater Impacts for detailed assessment in the ESIA

Potential Impact	Scoped In/Out of ESIA	Justification
Construction		
Cross Contamination of Historic Contamination	**Scoped In**	Due to the historic land use of the site as a construction laydown areas the Initial Conceptual Model has identified a 'Moderate' risk of encountering contamination on site. Due to the requirement for excavations and land grading on-site during construction, there are potential risks of cross-contamination of potentially contaminated soils.
Spill and Leaks Associated with Construction	**Scoped Out**	Hazardous materials, fuels and chemicals will be on-site during the construction phase and there is a risk of direct contamination if not handled or stored correctly. Such risks will be managed through the implementation of a CESMP.
Operation		
Spill and Leaks Associated with Operation	**Scoped Out**	Small quantities of hazardous materials, fuels and chemicals will be on-site during the operations phase and there is a risk of direct contamination if not handled or stored correctly. Such risks will be managed through the implementation of a OESMP.

8.3 Standards and Regulatory Requirements

8.3.1 Omani Requirements

Several legal instruments in the Sultanate of Oman are in place to control the handling and management of potential dangerous substances. These include:

- RD No. 46/1995: Issuing the Law of Handling and Use of Chemicals;
- MD 140/93 Regulations for Chemical Materials Registration and Related Permits;
- MD No. 248/1997: Regulation for the Registration of Chemical Substances and the Relevant Permits.

In addition, RD No. 114/2001: Law for the Conservation of Environment and Prevention of Pollution establishes strict prohibition against the release of environmental pollutants.

8.3.2 Lender Requirements

Financial institutions will require adherence to IFC Performance Standard 3 which aims to prevent pollution and requires that in the instance of historical pollution it is necessary to determine project responsibility for associated mitigation measures.

Omani standards do not exist for soil or groundwater quality. As such, the use of the Dutch standards is common practice for the analysis of soils and groundwater, and these are viewed as international best practice. Where contaminants are found to exceed 'action' levels, this is

considered to be a case of soil contamination, which is dangerous to the health of humans and the natural environment. Such a level of contamination should prompt a need for remediation, appropriate treatment and disposal.

Table 8-2 Dutch Soil and Groundwater Standards – For Heavy Metals

Contaminant	Dutch Soil (mg/kg dry weight)		Dutch Groundwater (µg/l)	
	optimum	action	optimum	action
Arsenic	29	55	10	60
Barium	200	625	50	625
Cadmium	0.8	12	0.4	6
Chromium (total)	100	380	1	30
Cobalt	20	240	20	100
Copper	36	190	15	75
Lead	85	530	15	75
Nickel	35	210	15	75
Mercury	0.3	10	0.05	0.3
Zinc	140	720	65	800
Benzene	0.05	2	0.2	30

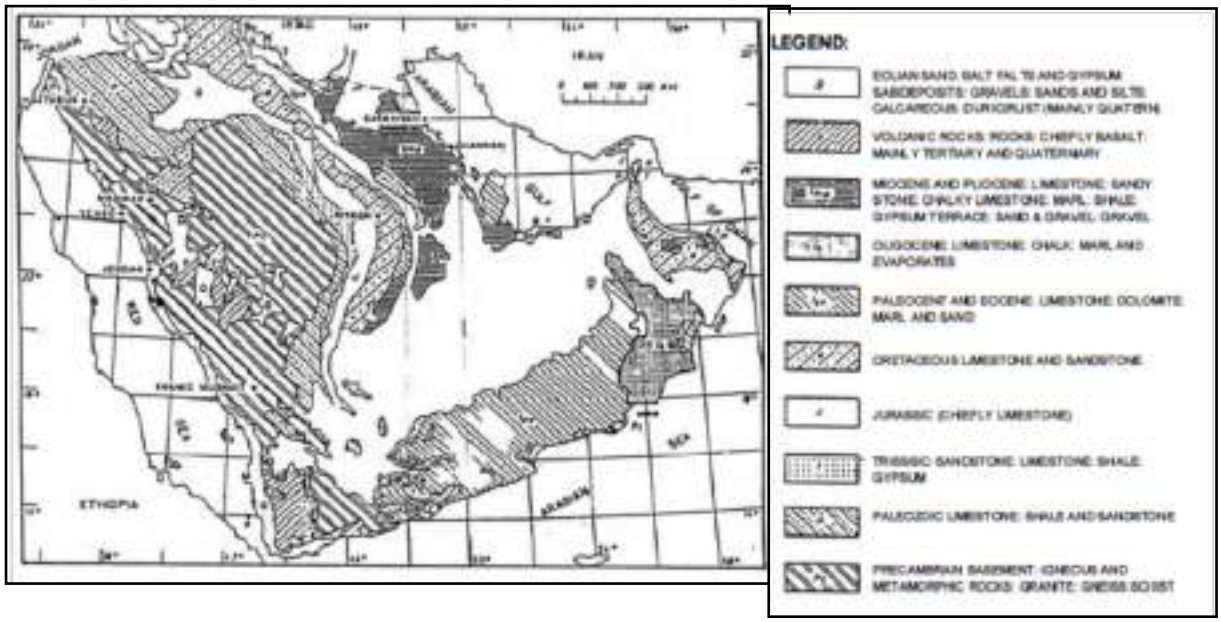
8.4 Observations and Baseline Conditions

8.4.1 Geology

Regional Context

Figure 8-1 Map of the Arabian Peninsula and Arabian Plate

Figure 8-2 Geological Map of Arabia



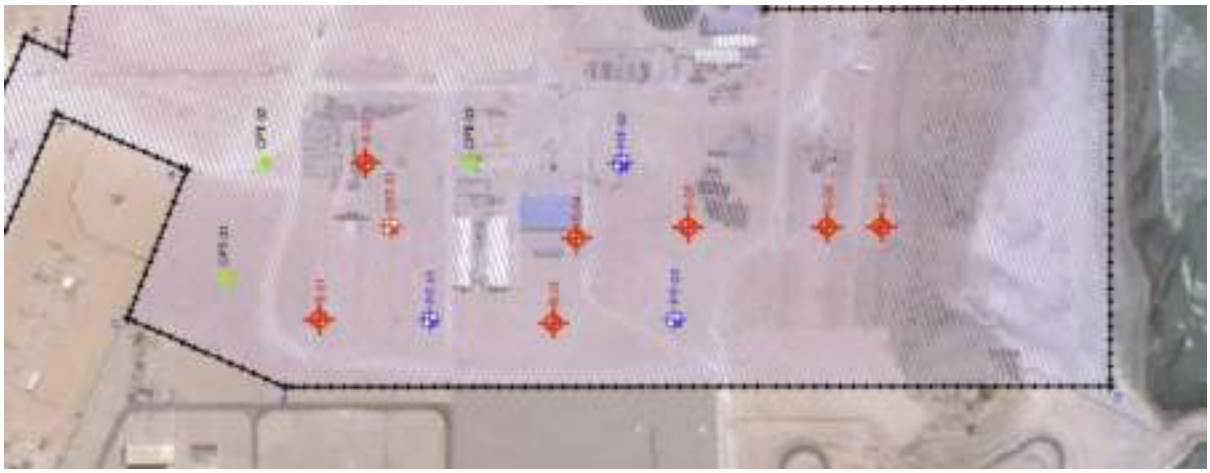
Site Geology

Existing geotechnical information gathered for the Salalah IWPP and supplied with the RFP identifies that the underlying geology consists of a highly fractured limestone from 0.40-0.80m to 2.10-3.00m, a moderately weathered and moderately fractured limestone from 0.40-0.80m to 20.00-30.00 and a moderately weathered, moderately fractured calcareous sandstone from 8.30-18.50m to 21.80-20.50m.

8.4.2 Groundwater

A geotechnical study undertaken on behalf of the project proponent (OPWP), and issued with the project RfP, reported groundwater in one of its deep boreholes (borehole #7) at a depth of 35m. Borehole number 7 is the closest borehole to the Arabian Sea, as presented in the figure below.

Figure 8-3 Geotechnical boreholes (OPWP RfP study – January 2016)



Groundwater quality is expected to be consistent with the quality of sea water, due to the proximity to the shoreline (i.e. with elevated concentrations of chloride, sodium and sulphate).

8.4.3 Soil

The soil baseline has been collected through desktop literature review and a series of site visits undertaken by experienced consultants.

Historical Site Use

Historic satellite imagery from August 2011 (sourced from Google Earth) identifies that the majority of the project area has previously been used as a site construction compound.

Table 8-3 Historical Land Use at Site

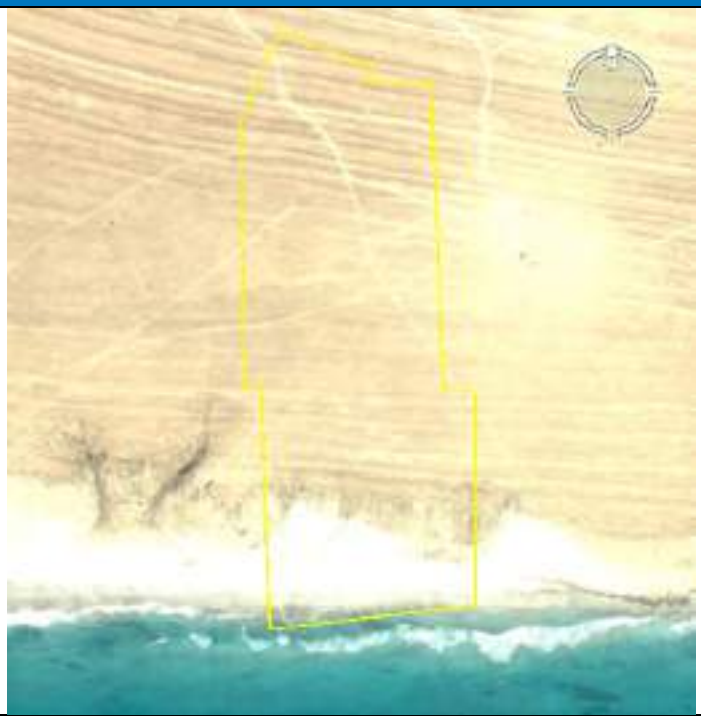
Image Date	Satellite Image	Observations
28/11/2003		Prior to the development of the Salalah IWPP, the project site and surrounding area was undeveloped with only a few tracks discernible form the satellite image.

Image Date	Satellite Image	Observations
08/12/2011		The development of the Salalah IWPP utilised the main project land area (on the cliff top plain) as a construction laydown area. As identified from the satellite imagery, this area was primarily used as a storage area for materials, and as a staging area to enable works. An administration area is also visible to the immediate east of the project site and rubble waste appears to have been stored in the northern portions of the site.
27/03/2013		Following the completion of the main construction phase at the Salalah IWPP, a large portion of the laydown area was demobilised. The administration area to the east of the project remained in place and was likely used throughout the warranty period of the project by the EPC Contractor. The land at the site remained in a similar condition until 2016 as can be seen in other available historic satellite images.

Image Date	Satellite Image	Observations
16/10/2016		The remainder of the project site was rehabilitated during 2016. During the site visit undertaken in 2016 there was visible evidence of the rehabilitation works being undertaken, including instances of minor hydrocarbon spillages and other waste & material interactions with soils. As of 2017, the site was free of remaining construction facilities, materials and visible waste.

Soil Condition

The soils within the project area are unconsolidated, with a mix of cobbles, sandy silt and boulders. The soil surface presents little evidence of any organic material and appears to be free draining.

During the site visit in 2016, the Salalah IWPP construction laydown areas was in the process of being demobilised and remediated. During the follow up site visit on 10th July 2017 it was observed that the site was fully demobilised, but that site soils appear to have been largely mixed and graded. The majority of site soils included mixed stoned and gravels of varying sizes.

Further it was identified that the previous Salalah IWPP laydown areas may have introduced some spills and leaks to soils; potentially associated with the storage of fuels and oils. Examples of potential minor and isolated spills have been highlighted in the figure below.

Figure 8-4 – Potential Leaks and Spills on Site

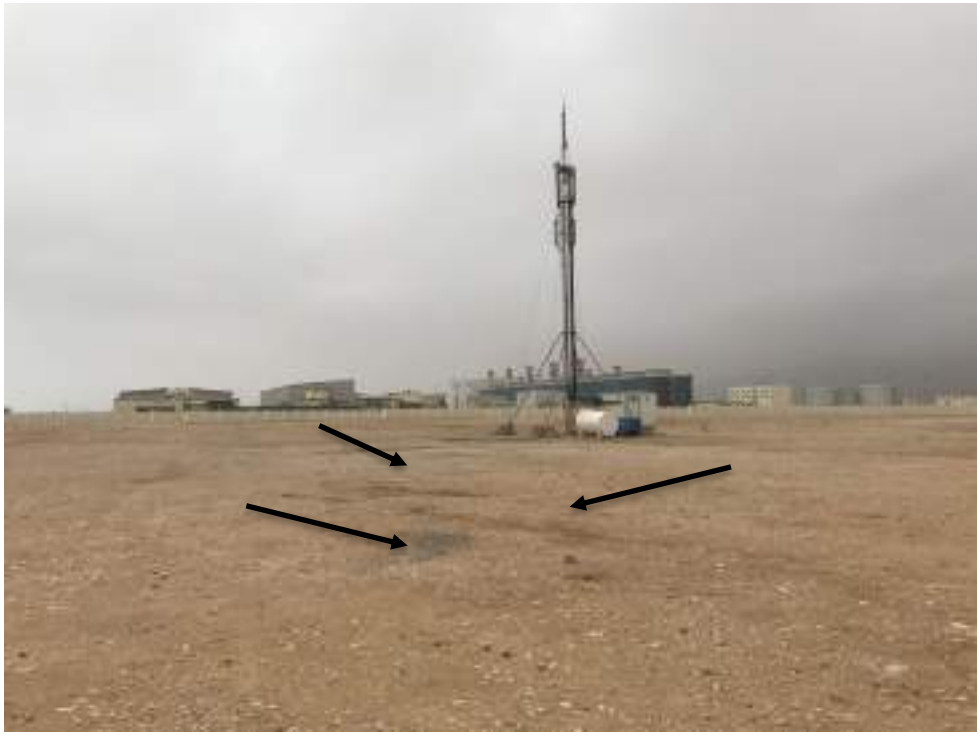


Figure 8-5 Typical Surface Soil Conditions

8.4.4 Initial Conceptual Model and Preliminary Risk Assessment

Based upon the observations from the site visit in 2016 and the historical satellite observations the following initial conceptual model was developed during the scoping stage to determine the level of risk of contamination that may exist at the project site.

The Contaminated Land Risk Assessment methodology used for this assessment was based on CIRIA C552 (2001) Contaminated Land Risk Assessment – A Guide to Good Practice, in order to quantify potential risk via risk estimation and risk evaluation, which was adopted at the Phase I stage; to support the scoping process. This process determines an overall risk category which can be used to identify likely actions for the site, as have been incorporated to the methodology of this ESIA. This methodology uses qualitative descriptors and therefore is a qualitative approach (ref. Appendix E for the CIRIA good practice guidelines).

Table 8-4 Source – Pathway – Receptor Model

Potential Source	Potential Receptor	Potential Transport Pathways
Historic Contaminants from IWP construction laydown area (i.e. oils & greases, hydrocarbons and heavy metals)	Soil	Direct contamination to surface and top-soils.
	Groundwater	Leaching through high porosity soils
Fuel & chemical storage (at adjacent IWPP)	Groundwater	Leaching through high porosity soils and transfer via groundwater movement

Table 8-5 Source – Pathway – Receptor Analysis

Potential Source	Potential Receptor	Potential Transport Pathways	Likelihood of Source – Receptor Linkage	Potential Consequence of Source to Receptor Linkage	Risk Classification
Historic Contaminants from IWPP construction laydown area (i.e. oils & greases, hydrocarbons and heavy metals)	Soil	Direct contamination to surface and top-soils.	Likely	Mild	**Moderate Risk**
	Groundwater	Leaching through high porosity soils	Low Likelihood	Mild	**Low Risk**
Fuel & chemical storage (at adjacent power and water plants)	Groundwater	Leaching through high porosity soils and transfer via groundwater movement	Low Likelihood	Mild	**Low Risk**

8.4.5 Further Soil Investigation

Following the outcome of 'Moderate Risk' for potential soil contamination from the initial conceptual model and preliminary risk assessment, it was determined appropriate to undertake a further soil investigation as part of the ESIA.

In order to determine a baseline representative for soil condition, a survey was undertaken on 11-12 July 2017. The further soil investigation was based upon a Phase 2 land contamination assessment and involved collecting surface soil samples from potential high-risk soil areas on-site to confirm instances of potential contamination. High risk areas were identified during the site visit in July 2017, as areas that may have been exposed to potential pollutants.

For the main project site, four (4) soil sampling locations were identified, whilst two (2) samples were taken along the expected access road routing. The location of the sampling sites can be seen in the figure below.

Figure 8-6 Soil Sampling Locations

A topsoil sample was collected from each sampling location up to a depth of 10cm (after scraping away the immediate surface layer). The purpose of sampling in the topsoil was based on the likely influence of historic above ground features (i.e. construction laydown area) with the immediate surface layer of soil.

Soil samples were collected in glass containers prepared by the laboratory and stored on ice. The samples were sent for analysis at a MECA accredited laboratory (Lonestar Laboratories) where they were analysed for concentrations of Oils & Greases, speciated TPH and a suite of heavy metals.

Table 8-6 Soil Sampling Coordinates and Observations

ID	Location Observations	Monitoring Observations / Notes	Photo
S-1	Sample taken from 0.02 – 0.08m depth within compacted site soils (central areas of proposed site), close to a telecommunications tower, and generator.	Soil appears to have been mixed, graded and compacted. The area was a previous construction laydown area for the Salalah IWPP. The soil contains stones of various sized and soil colour is not consistent in the immediate area of the sample. The immediate topsoil appears to be slightly stained, but there is no immediate olfactory evidence (although fuel from the storage tank is discernible), and underlying soils do not appear to have the same staining.	
S-2	Sample taken from 0.02 – 0.1m depth within compacted track soils, in the extreme north of the proposed IWP site.	The soil has been compacted as a track and there are vehicle tracks, as well as camel footprints. The upper topsoil has a softer layer of orange/brown soil (approximately 1cm), beneath this layer is a mixed soil with lots of stones of various sizes.	

ID	Location Observations	Monitoring Observations / Notes	Photo
S-3	Sample taken from 0.05 – 0.1m depth within compacted site soils (southern area above cliff on proposed site).	Soil appears to have been mixed, graded and compacted. The area was a previous construction laydown area for the Salalah IWPP. The upper soil layer (1cm) is stained orange and is consolidated (by what appears to have been previous collected water), whilst the underlying soil contains stones of various size and is unconsolidated. There is no discernible olfactory evidence, and underlying soils do not appear to have the same staining.	
S-4	Sample taken from 0.02 – 0.08m depth within loose upper soil from the proposed project site area.	This area appears to have previously been beneath a temporary cabin during the Salalah IWPP construction. Although compacted, there is a loose upper soil layer (up to 3cm depth), with mixed soils beneath containing stones of varying sizes. The colour of the soil varies with depth and the colour of the surrounding area is not consistent, however there was no discernible olfactory evidence.	
S-5	Sample taken from the expected routing of the proposed site access road (currently a compacted track). The sample was taken at a depth of (0.01 – 0.03m)	The existing compacted track is used by vehicles to access the proposed project site. The soils are very hard (although unconsolidated) with many stones of what appears to be a mixed nature. No visual or olfactory evidence was noted at this location.	

ID	Location Observations	Monitoring Observations / Notes	Photo
S-6	Sample taken from the expected routing of the proposed site access road (currently a compacted track). The sample was taken at a depth of (0.02 – 0.08m)	The existing compacted track is used by vehicles to access the proposed project site. The soils are very hard (although unconsolidated) with many stones of what appears to be a mixed nature. No visual or olfactory evidence was noted at this location. Immediately adjacent to this sampling location is stored mixed soils of what appears to be a similar nature to the soil.	

The soil analysis results are presented below with comparison shown to the Dutch Soil Standards (where applicable). Full analysis results are presented in Appendix G.

Table 8-2 Baseline Soil Chemistry

Contaminant (mg/kg)	S-1	S-2	S-3	S-4	S-5	S-6	Dutch Soil (mg/kg dry weight)	
							optimum	action
Arsenic	2.33	3.00	2.18	2.34	2.41	2.90	29	55
Barium	24.5	49.5	56.5	37.3	48.5	58.1	200	625
Cadmium	<0.2	0.29	0.27	<0.2	0.39	0.47	0.8	12
Chromium	32.8	26.3	44.5	35.9	22.3	32.4	100	380
Cobalt	6.52	4.55	10.6	8.48	3.57	5.15	20	240
Copper	<1.0	3.00	3.91	2.05	1.83	2.25	36	190
Lead	<1.0	1.07	4.64	3.12	1.55	2.53	85	530
Manganese	194	116	312	257	96.8	165	-	-
Mercury	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.3	10
Nickel	33.4	25.5	54.3	43.9	18.4	27.6	35	210
Oil & Grease	<10	<10	<10	<10	<10	<10	-	-
Selenium	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	-	-
Zinc	20.0	22.7	59.7	25.2	19.3	31.7	140	720
Total Petroleum Hydrocarbons								
n-Octane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Nonane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Decane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Undecane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Dodecane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Tridecane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Tetradecane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Pentadecane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Hexadecane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Heptadecane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-

Contaminant (mg/kg)	S-1	S-2	S-3	S-4	S-5	S-6	Dutch Soil (mg/kg dry weight)	
							optimum	action
Pristane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Octadecane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
Phytane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Nonadecane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Elcosane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Heneiconsane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Docosane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Tricosane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Tetrasane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Pentacosane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Hexacosane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Heptacosane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Octacosane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Nonacosane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Triacontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Hentriacontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Dotriacontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Tritriacontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Tetratriacontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Pentatriacontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Hexatriacontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Heptatriacontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Octatriacontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Nonatriacontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-
n-Tetracontane	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	-	-

The results of the soil analysis presented above indicate that there is no soil contamination detected in any of the samples for any of the parameters analysed. All heavy metal concentrations are within the Dutch 'Action' standards, whilst all results (except for S-3 & S-4 concentrations of Nickel) are within the Dutch 'Optimum' guidelines values.

In regard to total petroleum hydrocarbons, all analysis results are below detectable levels.

8.4.6 Sensitive Receptors

Table 8-7 Soil and Groundwater - Receptor Sensitivity

Receptor	Sensitivity	Justification
Soil Quality	**Medium**	Detectable concentrations of heavy metals are present in site soils but are expected to be characteristic of the baseline soil condition locally. All analysis results are below Dutch Standard values for contamination. Potential hotspots of contaminants may exist, but these are not likely to have unduly impacted the wider quality of soils.
Groundwater Quality	**Low**	The location of the project site and its proximity to the sea is likely to have an influence on the characteristic of groundwater. The expected depth of groundwater from the cliff top plain is not likely

		to have had existing effects from the Salalah IWPP construction activities, as per the initial conceptual model.

8.5 Potential Impacts

8.5.1 Conceptual Model and Risk Assessment

The following conceptual model supersedes the preliminary conceptual model developed at the scoping stage (presented above). The potential risks to soil contamination have now been informed by the outcomes of the baseline soil sampling regime.

Table 8-8 Source – Pathway – Receptor Model

Potential Source	Potential Receptor	Potential Transport Pathways
Historic Contaminants from IWP construction laydown area (i.e. oils & greases, hydrocarbons and heavy metals)	Soil	Direct contamination to surface and top-soils.
	Groundwater	Leaching through high porosity soils
Fuel & chemical storage (at adjacent IWPP)	Groundwater	Leaching through high porosity soils and transfer via groundwater movement

Table 8-9 Source – Pathway – Receptor Analysis

Potential Source	Potential Receptor	Potential Transport Pathways	Likelihood of Source – Receptor Linkage	Potential Consequence of linkage	Risk Classification
Historic Contaminants from IWPP construction laydown area (i.e. oils & greases, hydrocarbons and heavy metals)	Soil	Direct contamination to surface and top-soils.	Low Likelihood	Minor	**Very Low Risk**
	Groundwater	Leaching through high porosity soils	Low Likelihood	Minor	**Very Low Risk**
Fuel & chemical storage (at adjacent power and water plants)	Groundwater	Leaching through high porosity soils and transfer via groundwater movement	Low Likelihood	Mild	**Low Risk**

8.5.2 Construction

Cross Contamination of Historic Contamination

Given the historic use of the site as a construction compound, there is an inherent risk of encountering contaminated materials during excavations and earthworks. This could result in the cross-contamination of materials and potential direct exposure of site staff to hazardous substances.

As has been identified from the soil baseline assessment, there are no identified exceedances of analysed parameters. Further, the conceptual model has identified a very low risk of soil contamination to be present in site soils. In spite of this, it is still possible for isolated hotspots of contamination to exist on the site due to the historic use of the site as a construction laydown area for the Salalah IWPP. Such instances could potentially result in cross-contamination of sites soils. Any potential impacts are expected to remain on-site.

Spill and Leaks Associated with Construction

Storage and usage of fuels, chemicals and sanitary provision during the construction phase will introduce risks associated with spills and leaks to ground. Such instances may potentially result from poor storage, handling, transfer or containment of such materials. Direct exposure to soil would likely be the primary impacts, however, given the free draining nature of the soils and the geology at the site, groundwater at depth may potentially be vulnerable to contamination events.

Such risks will be managed through the implementation of a CESMP, however, instances of contamination may only be localised and limited to the site or construction laydown.

Table 8-10 Potential Soil, Geology & Groundwater Impact Significance - Construction

Potential Impact	Impact Magnitude	Receptor	Receptor Sensitivity	Impact Significance
Cross contamination of soils	Minor Negative	Soil	Medium	**Minor**
Spill and Leaks Associated with Operation	Minor Negative	Soil	Medium	**Minor**
	Negligible Negative	Groundwater	Low	**Negligible or Minor**

8.5.3 Operational Phase

Spill and Leaks Associated with Operation

Storage and usage of any hazardous materials (e.g. operational chemicals) and sanitary provisions (e.g. containment and forwarding of sewerage facilities) during the operational phase may introduce risks associated with spills and leaks to ground. Such instances may

potentially result from poor storage, handling, transfer or containment of such materials. Direct exposure to soil would likely be the primary impacts, however, given the free draining nature of the soils and the geology at the site, groundwater at depth may potentially be vulnerable to contamination events.

Table 8-11 Potential Soil, Geology & Groundwater Impact Significance - Operation

Potential Impact	Impact Magnitude	Receptor	Receptor Sensitivity	Impact Significance
Spill and Leaks Associated with Operation	Negligible Negative	Soil	Medium	**Negligible or Minor**
	Negligible Negative	Groundwater	Low	**Negligible or Minor**

8.6 Mitigation & Management Measures

8.6.1 Construction

Table 8-12 Soil, Geology & Groundwater – Mitigation Measures during Construction

Impact	Mitigation Measure
Spillage/ Leakage	All permanent or temporary hazardous materials/fuel/chemical storage areas must have a roof and a leak tight bunding sufficient to contain 110% of the total stored volume, in the event of a spill or leakage.
	A 'Spill Prevention and 'Spill Response Plan' will be established. The plan will outline methods for the prevention of incidents, response and remediation of any contamination. Where appropriate for applicable risks, this should be consistent with the sites 'Emergency Preparedness and Response Plan'.
	The clean-up of any spillage or leakage will be made by spill absorbents, available at all fuel, hazardous material and hazardous waste storage locations on the site (i.e. spill kits). Absorbents and other clean up material/provision will be contained within accessible and clearly marked spillage kits. Training on spillage response will be provided to site personnel, and will be covered in tool box talks. All contaminated clean-up material will be disposed of as hazardous waste.
	Refuelling of mobile equipment and fuel tanks (e.g. located in laydown areas) will only be conducted in designated areas following specified procedures for re-fuelling, and not at the working locations to minimise potential spillages.
Cross contamination of soils	Implementation of good housekeeping practices during construction activities including procedures and requirements for proper handling, storage, and transport of hazardous materials and waste.
	If contaminated soils are observed during construction activity, the identified contaminated soil should be excavated separately, and stored, handled and disposed in accordance with the waste management plan, to avoid instances of cross-contamination. Contaminated aggregate wastes or excavation material will be disposed through licensed waste contractors at licensed facilities.
	Washing of equipment, machinery and vehicles will only be permitted in designated areas, with impermeable surfaces and dedicated drainage systems that lead to separate treatment facilities and/or lined evaporation ponds. The

Impact	Mitigation Measure
	use of evaporation ponds will require the removal of sludge residues as solid hazardous waste by a licensed waste contractor.
Storage and waste management	All hazardous materials or waste being temporarily used or otherwise stored outside of its designated storage areas should be kept in well-equipped, leak-tight containers with drip protection to avoid leaks to the ground.
	Where possible, the quantity of chemicals and fuels stored on-site will be kept to a minimum practical level. Infrequently used chemicals should be ordered in suitable quantities only when required.
	Excavated materials will be kept in the stockpiles for as short a time as possible.
	No hazardous materials will be stockpiled.
	Training will be provided relating to the management, transportation and handling of hazardous materials and wastes – in accordance with procedures developed to guide the on-site management of such activities.

8.6.2 Operation

Table 8-13 Soil, Geology & Groundwater – Mitigation Measures during Operation

Impact	Mitigation Measure
Spillage/ Leakage	All chemical/hazardous material and liquid storage tanks will be afforded impermeable bunded protection. Bunds will contain 110% of the maximum volumetric tank capacity.
	All drainage systems within bunded areas will be separated and will be directed to a contained sump.
	Leakage monitoring systems will be installed on key tanks (e.g. large chemical tanks) in order to determine leaks at an early stage.
	Spill kits and clean up materials will be well located and visible in key areas of the site (e.g. chemical stores and close to any fuel storage areas). Larger provisions for spill clean-up and control should be available in the event of significant spills.
Storage and Waste Management	Effective waste management controls will be implemented through a site-specific waste management plan. The Waste Management Plan will include measures to limit instances of contamination to soils and groundwater.
	Hazardous waste storage areas will be well constructed with impermeable bunded protection to soils, separate drainage system and a rain shelter to avoid any potential instance of runoff, or leakage of runoff.

8.7 Residual Impacts

8.7.1 Construction

Table 8-14 Soil, Geology & Groundwater – Residual Impacts – Construction Phase

Potential Impact	Receptor	Potential impact Significance	Mitigation	Impact Significance
Cross contamination of soils	Soil	Minor	✓	**Negligible or Minor**
Spill and Leaks Associated with Construction	Soil	Minor	✓	**Negligible or Minor**
	Groundwater	Negligible or Minor	✓	**Negligible or Minor**

8.7.2 Operation

Table 8-15 Soil, Geology & Groundwater – Residual Impacts – Operational Phase

Potential Impact	Receptor	Potential impact Significance	Mitigation	Impact Significance
Spill and Leaks Associated with Operation	Soil	Negligible or Minor	✓	**Neutral**
	Groundwater	Negligible or Minor	✓	**Neutral**

8.8 Monitoring

Soil monitoring will be undertaken during the construction and operational phase of the project by the EPC Contractor and O&M Company respectively. The minimum expected requirements for the monitoring are outlined in the table below. The final monitoring methodology with specific monitoring details (i.e. locations, frequencies, durations, parameters etc.) will be developed in the specific 'Environmental Monitoring Plan'.

In the event that groundwater dewatering is required for any works, it will be appropriate to ensure that effluent is compliant with the applicable discharge standards stated in Table 9-2, particularly for suspended solids, but also turbidity. Minimum monitoring requirements have also been included to the table below.

Table 8-16 Minimum Monitoring Requirements: Soil & Groundwater

Monitoring	Parameters	Frequency & Duration	Locations	Standards
Construction & Operation				
Soil Quality	Hydrocarbons and other potential hazardous or chemical	Daily (Visual inspections). Event based sampling (if	Construction site, laydown areas (including sub-contractor areas) and	If laboratory analysis is required for event based sampling: The

	pollution sources.	required to confirm contamination in the event of a spillage)	temporary access road	Dutch Soil Guidelines (Intervention values)
Groundwater Quality	TSS, Turbidity	Weekly (if dewatering is required)	Prior to discharge following any settlement pond/tanks	Omani discharge standards

9 MARINE ENVIRONMENT

9.1 Introduction

The assessment provided in this section refers to the impacts upon the marine environment (i.e. marine flora, marine fauna and ambient water quality) as a result of the proposed projects construction and operational phases, as well as cumulative impacts with respect to the effects of other local projects.

The study area assessed in this section is delineated as follows:

- The projects marine footprint;
- Any marine construction working areas;
- Areas that may be impacted by secondary construction effects (e.g. settlement of sediments and water quality degradation);
- The area of the scientifically established brine mixing zone.

This section includes the following:

- Applicable ambient water quality standards & guidelines;
- Baseline overview of the marine environment, referenced from an existing marine survey;
- Identification of marine receptors;
- Identification of potential impacts relating to the projects construction;
- Identification of potential impacts relating to the projects operation;
- Brine dispersion predictive modelling (operational activities);
- Potential Impact Assessment (including any cumulative impacts);
- Marine Environment mitigation & management measures (Construction and Operational phases); and
- Assessment of residual impacts following the application of mitigation & management measures.

9.2 Outcome of Scoping Report

The Scoping Study assessed the following impacts in regards to the Marine Environment. Potential impacts were scoped in and scoped out of detailed assessment in the ESIA. The Impacts as well as the justification of why they were included (or not included) in the ESIA are detailed in the table below.

Table 9-1 Marine Environment Impacts for further Assessment at the ESIA

Potential Impact	Scoped In/Out of ESIA	Justification
Construction		
Dredging of Seabed / Installation of Intake and Outfall	**Scoped In**	Marine habitats may be sensitive to such activities, and may result in the loss of any benthic fauna as well as any seagrass that may be present.
Disturbance of Marine Fauna	**Scoped In**	It is generally expected that fish will avoid the working area during construction due to noise and a slight reduction in ambient water quality. However, the potential impact will be scoped in.
Degradation of Water Quality	**Scoped In**	Impacts to ambient water quality from marine works could potentially be significant. Any impacts will be managed through a CESMP which will include measures to limit this temporary impact.
Operation		
Entrainment of fauna to intake	**Scoped Out**	Impacts upon fish are expected to be minimal as the intake velocity will be optimised to reduce such effects. The ESIA will not further assess the impacts upon marine fauna, but will provide mitigation measures to reduce the impacts.
Increased Salinity	**Scoped In**	It is necessary to determine the extent of the brine mixing zone to ensure that it can meet the necessary standards and to ensure that the size of the mixing zone can be reduced as far as practically possible in accordance with the IFC EHS Guidelines.
Discharge of Treated Wastewater Effluents	**Scoped In**	Given that the project will be designed to comply with the applicable Omani and IFC EHS discharge standards, it is expected that compliance will be achieved, however, further assessment is required to determine any potential impacts upon marine habitats.

Note: Deviation from Scoping & ESIA ToR

Following the completion of the scoping report, 5 Capitals were informed that diving off the coast of the project to undertake a marine survey was prohibited during the Khareef Season and would not be permitted. Furthermore, it was apparent from the site visits undertaken during the Khareef season that the intensity of the waves and coastal action at this time of year would have made such a survey extremely difficult to undertaken (even in benign conditions) due to the turbidity and expected lack of visibility.

In order to progress the ESIA, it has been necessary to reference existing information to inform the baseline marine condition. A marine survey was undertaken for the project on behalf of the project proponent 'OPWP' prior to the bidding stage, which was supplied to the bidders. The report, 'Environmental Survey for Salalah IWP', prepared by Al Safa Environmental &

Technical Services (commissioned by Masirah International on behalf of OPWP), is presented in Appendix H.

The use of this survey is considered to be representative of the baseline in 2017 due to the lack of/minimal changes in environmental factors in this period, as well as consistent anthropogenic influences in the local area, which primarily relate to the operation of the Salalah IWPP.

The 'Environmental Survey for Salalah IWP', prepared by Al Safa Environmental & Technical Services (commissioned by Masirah International on behalf of OPWP) report has been used to establish baseline conditions on which the assessment of potential impacts on marine flora and fauna has been undertaken (as presented in Appendix H). The ambient water quality data from this survey collected on behalf of Masirah International in July and August 2016 has been used to establish baseline ambient water quality conditions (laboratory analysis results as presented in Appendix I).

9.3 Standards and Regulatory Requirements

9.3.1 Omani Requirements

MD 159/ 2005: Regulations for the Discharge of Liquid Effluents to the Marine Environment establishes the requirement for a permit for any discharge to the marine environment and established strict thresholds for specific chemical parameters intended for discharge.

The regulation describes the following measures that should be implemented and achieved in order to obtain a permit to discharge:

- The discharge pipe should be set a depth of not less than 1 meter from the lowest tide line.
- The discharge should not be in contact with corals and seaweeds.
- It is prohibited to destroy any seabed marine life with a 300 meters radius from the discharge outlet in the initial mitigation area.
- A mixing zone of 300m radius from the point of discharge should be established, and within the mixing zone the following should not be exceeded:
  - Change of 1 °C on weekly average;
  - Reduction of Dissolved Oxygen (DO) of more than 10%, weekly average;
  - Increase or decrease in rate of salinity by more than 2ppt; and
  - Change in pH by more than 0.2 units.

The quality of discharged effluent should be within the limits specified in the following table.

Table 9-2: Discharge of Effluent to the Marine Environment – Maximum Limit

Parameter	unit	Maximum limit (MECA)
Temperature	°C	<10 change
BOD_5	mg/l	20
Oxygen chemical deficiency	mg/l	200
Suspended Solid	mg/l	30
Aluminium	mg/l	5
Arsenic	mg/l	0.1
Barium	mg/l	2
Beryllium	mg/l	0.3
Boron	mg/l	1
Cadmium (Cd)	mg/l	0.01
Chromium (Cr)	mg/l	0.05
Cobalt	mg/l	0.05
Copper (Cu)	mg/l	0.2
Cyanide (CN)	mg/l	0.1
Fluoride	mg/l	2
Iron (Fe)	mg/l	1.5
Lead (Pb)	mg/l	0.08
Lithium	mg/l	0.07
Mercury (Hg)	mg/l	0.001
Molybdenum	mg/l	0.05
Nickel (Ni)	mg/l	0.1
Ammonia nitrogen	mg/l	1.0
Nitrate	mg/l	15
Nitrogen (Kjeldahl)	mg/l	5
Total Nitrogen	mg/l	15
Grease and oil	mg/l	15
Phenols	mg/l	0.002
Phosphorus	mg/l	2
Selenium (Se)	mg/l	0.02
Silver (As)	mg/l	0.01
Sulphur	mg/l	0.1
Chlorine total	mg/l	0.4
Vanadium	mg/l	0.1
Zinc	mg/l	1
Number of colon faeces bacillus (per litre)		1
Number of tapeworm eggs (per litre)		<1
Organic Halogen	mg/l	<0.001
Pesticides and by products	mg/l	<0.001
Organic silicon components	mg/l	<0.001
Organic copper components	mg/l	<0.001
Organic tin components	mg/l	0.00002

9.3.2 Lender Requirements

IFC Performance Standard 6 requires the consideration of relevant threats to biodiversity and ecosystem services, especially focusing on habitat loss, degradation, hydrological changes, nutrient loading, and pollution. The standard requires that where possible impacts on

biodiversity and ecosystem services should be avoided. When avoidance of impacts is not possible, measures to minimise impacts and restore biodiversity and ecosystem services should be implemented.

With regards to the biodiversity on and affected by the site, the Performance Standard 6 defines three main divisions of habitat and requires the following assurances by the project:

Modified Habitat *"The client should minimise impacts on such biodiversity and implement mitigation measures as appropriate".*

Natural Habitat *"The client will not significantly convert or degrade natural habitats, unless all of the following are demonstrated:*

- *No other viable alternatives within the region exist for development of the project on modified habitat;*
- *Consultation has established the views of stakeholders, including Affected Communities, with respect to the extent of conversion and degradation; and*
- *Any conversion or degradation is mitigated according to the mitigation hierarchy.*

In areas of natural habitat, mitigation measures will be designed to achieve no net loss of biodiversity where feasible. Appropriate actions include:

- *Avoiding impacts on biodiversity through the identification and protection of set-asides*
- *Implementing measures to minimize habitat fragmentation, such as biological corridors;*
- *Restoring habitats during operation and/or after operations; and* Implementing biodiversity offsets."

Critical Habitat *"The client will not implement any project activities unless all of the following are demonstrated:*

- *No other viable alternatives within the region exist for development of the project on modified or natural habitats that are not critical;*
- *The project does not lead to measurable adverse impacts on those biodiversity values for which the critical habitat was designated, and on the ecological processes supporting those biodiversity values*
- *The project does not lead to a net reduction in the global and/or national/regional population of any Critically Endangered or Endangered species over a reasonable period of time; and*
- *A robust, appropriately designed, and long-term biodiversity monitoring and evaluation program is integrated into the client's management program. "*

The IFC's Performance Standard 3: 'Resource Efficiency and Pollution Prevention', is also applicable and notes that the project should consider "…a number of factors, including the finite assimilative capacity of the environment, existing and future land use, existing ambient conditions, the project's proximity to ecologically sensitive or protected areas, and the potential for cumulative impacts".

9.4 Observations and Baseline Conditions

Marine Ecology Survey

As stated above, the following marine ecology baseline has been referenced from 'Environmental Survey for Salalah IWP', prepared by Al Safa Environmental & Technical Services (commissioned by Masirah International on behalf of OPWP), as presented in Appendix H.

The Al Safa report, indicates that previous algal and marine surveys have been conducted in the project area, with algal surveys at the mouth of Khor Rawri (2000), an algal survey close to Taqah (1983) and a previous marine survey for the Salalah IWPP EIA in 2008.

During the EIA survey in 2008 for the Salalah IWPP, the surveyors took subtidal observations for periods of 20 to 30 minutes at each location, by using open-circuit SCUBA techniques. Standard transect methodologies were also employed to identify and mark various communities represented within the survey area.

Table 9-3 Faunal Species from 2008 EIA Survey for Salalah IWPP

Genus	Species	IUCN Status
Moray Eels Muraenidae	*Gymnothorax sp.*	U
Groupers and Sea Basses Serranidae	**Epaulet Grouper** *Epinephelus stoliczkae*	U
Cardinalfishes Apogonidae	**Persian Cardinalfish** *Cheilodipterus persicus*	U
	Indian Ocean Cardinalfish *Cheilodipterus novemstriatus*	U
	Golden Cardinalfish *Apogon aureus*	U
Snappers Lutjanidae	*Lutjanus sp.*	U
Sweetlips & Grunts Haemulidae	*Pomadasys sp.*	U
Breams Nemipteridae	**Dotted Bream** *Scolopsis ghanam*	U
	Seabream *Rhabdosargus sp*	U
Mullets Mugilidae	*Mugil spp*	U
Goatfishes Mullidae	*Mulloidichthys sp.*	U
	Yellowfin Goatfish *Mulloidichthys vanicolensis*	U
	Pearly Goatfish *Parupeneus margo*	U
	Long barbel Goatfish *Parupeneus macronemus*	
Damselfish Pomacentridae	**Indo-Pacific Sergeant** *Abudefduf vaigensis*	U
	Neopomacentrus sp.	U
	Damselfish sp.	U
Wrasses Labridae	**Black-and-Blue Cleaner Wrasse** *Labroides dimidiatus*	LC
	Moon Wrasse *Thalassoma lunare*	LC
Parrotfishes Family Scaridae	*Scarus sp.*	
Butterflyfishes Chaetodontidae	**Black spotted butterfly fish** *Chaetodon nigropunctatus*	
	Longfin Bannerfish *Heniochus acuminatus*	
Surgeon fishes Acanthuridae	*Acanthurus sp.*	
Triggerfishes Balistidae	**Largescale triggerfish** *Canthidermis macrolepis*	U
	Triggerfish sp.	U
Porcupine Fish Diodontidae	**Porcupinefish** *Diodon hystrix*	U

During the 2008 survey, it is identified that no species of endangered or near threatened conservation status were observed. Species of Wrasses were the only species with an IUCN classification, and are listed as 'Least Concern'.

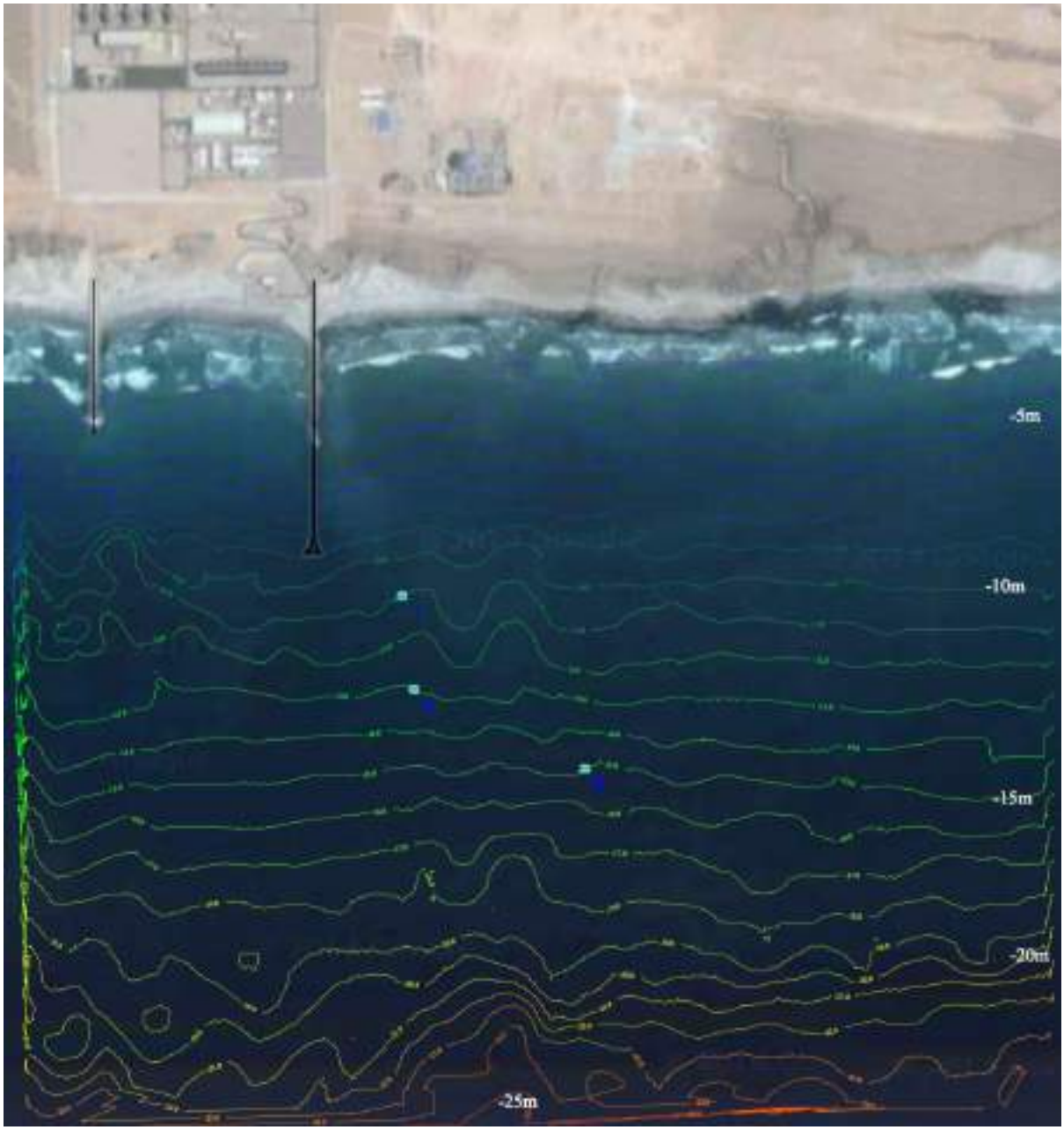
The marine survey undertaken by Al Safa Environmental included three survey points referenced below.

Note: At the time of the survey these locations were being considered as proposed intake options. Hence the later references as such.

Table 9-4 Marine Survey Locations

ID	Co-Ordinates		Approximate Depth
1	233348.34 m E	1884330.69 m N	11m
2	233375.00 m E	1884158.00 m N	13m
3	233722.00 m E	1883998.00 m N	15m

Figure 9-1 Marine Survey Locations



Source: Al Safa Environmental & Technical Services (2016), Environmental Survey for Salalah IWP

The Al Safa report indicated that videos and photographs were taken from four spot dives and six line transects. *'The four spot dives were of 'Objects' located on the seafloor as identified by the bathymetric survey and requested by OPWP as requiring further examination for information from bathymetric survey regarding each 'object'. These four objects may be a coral reef, shipwreck, rock outcrop or some other object and may have some ecological importance, and it was necessary to carry out ground truthing of these sites to determine their significance.'*

Table 9-5 'Object' Survey Locations

ID	Co-Ordinates		Approximate Depth
Object 1	232390 E	1883776 N	18m
Object 2	233891 E	1883648 N	19m
Object 3	232738 E	1883906 N	16m
Object 4	232718 E	1883989 N	14m

In addition to the spot dives, dive transects were made, from Location ID 1 to ID 2, to ID3, as well as from ID 1 to the shore. Videos are understood to have been taken of these transects. The total length of the transects was approximately 1011m. Lengths of individual sections were 463m from ID 1 to the shore, 172m from ID 1 to ID 2 and 376m from ID 3 to ID 2. Each transect was divided into two.

The following extracted tables present the Al Safa results in regard to marine fauna observed during the transects and spot dives. The Al Safa report indicates the following definitions for species density:

- L - Low Density (2 or less)
- M - Medium Density (2 -10 species encountered)
- H - High Density >10 species encountered.

Note: the density as above relates to the number of a particular species of fish and corals encountered at the stated location/along the stated transect.

Marine Fauna

Table 9-6 Marine Fauna Encountered During Al Safa Survey (March 2016)

Genus	Species	Object 1	Object 2	Object 3	Object 4	Intake 3 to Intake 2	Intake 2 to Intake 1	Intake 1 to Shore
	Unidentified ray1	L						
Rays	Unidentified ray2			L				
Dasyatidae	Unidentified ray3							L
	Striped eel catfish *Plotosus lineatus*					L		
Eel Catfishes Plotosidae	Darkfin eel catfish *Plotosus limbatus*		L					L
Sardines Clupeidae	Indian oil sardine *Sardinella longiceps*					H		
Groupers Serranidae	Epaulet Grouper *Epinephelus stoliczkae*							L
	Persian Cardinalfish *Cheilodipterus persicus*		H					H
Cardinalfishes, Apogonidae	Golden cardinalfish *Apogon aureus*		L					
	Blackbanded Cardinalfish *Apogon cookii*							M
	Dhofar Cardinalfish *Apogon dhofar*		H			M		M
Grunts, Haemulidae	Bronzestriped Grunt *Pomadasys kaakan*							M
	Dotted Bream *Scolopsis ghanam*		L					M
	Whitecheek monocle bream *Scolopsis vosmeri*		H					
	Black-streaked monocle bream *Scolopsis taeniata*		M					
Breams, Nemipteridae	Onespot Porgy *Diplodus sargus kotschyi*							L

Genus	Species	Object 1	Object 2	Object 3	Object 4	Intake 3 to Intake 2	Intake 2 to Intake 1	Intake 1 to Shore
Emperors Lethrinidae	Blackspot Emperor *Lethrinus harak*		L					L
Goatfishes, Mullidae	Rosy Goatfish *Parupeneus rubescens*							H
	Indo-Pacific Sergeant *Abudefduf vaigiensis*							M
Damselfish, Pomacentridae	Miry's Damselfish *Neopomacentrus miryae*		H					H
	Sheila's Damselfish *Chrysiptera sheila*							L
Wrasses, Labridae	Black-and-Blue Cleaner Wrasse *Labroides dimidiatus*		M					
	Blackbar Coris *Coris nigromaculata*							M
Parrotfishes, Scaridae	Bridled parrotfish *Scarus frenatus*							L
Sandperches Pinguipedidae	Smallscale sandperch *Parapercis robinsoni*		M					L
Butterflyfishes, Chaetodontidae	Vagabond Butterflyfish *Chaetodon vagabundus*							L
Triggerfishes, Balistidae	Bridled Triggerfish *Sufflamen frenatus*					L		L
Filefishes Monacanthidae	Scrawled filefish *Aluterus scriptus*					L		
Puffers, Tetraodontidae	Spiny Puffer *Diodon holocanthus*							L
Mullets, Mugilidae	Fringelip mullet *Crenimugil crenilabis*					H		
TOTAL		**1**	**11**	**1**	**0**	**6**	**0**	**20**

Source: Al Safa Environmental & Technical Services (2016), Environmental Survey for Salalah IWP

According to the Al Safa report, a total of 29 faunal species were recorded within the Project Area during the survey. Noteworthy fish included the Blackspot Emperor *Lethrinus harak*, found

close to the shore at the transect from ID 1 to shore (13 mins), which is understood to be rare in Oman, though has a distribution from Red Sea to Natal. The Sheila's Damselfish *Chrysiptera Sheila* is understood to be a common resident of tidepools and exposed rock shoreline, typically less than 3m in depth, but is primarily encountered from the Arabian Sea coast of Oman to Muscat in the Gulf of Oman, so is endemic to Oman. It was identified in a location close to the Blackspot Emperor.

The Al Safa report indicates that diversity varied greatly across the sites, according to habitat-types found at the site or transect. The most important habitat was the artificial reef found near ID 2; diversity here was low but fish numbers were high per unit area.

As an additional point, turtles, and specifically turtle nesting beaches are not expected in the immediate project location due to the partly rocky coastline and observed wave power. Turtles in Oman are more common approximately 1000km to the north at Ras Al Had and Masirah Island.

Corals

The Al Safa report states that, *'As with fish, corals varied greatly between survey sites and this was also due to the habitats encountered. The most important coral habitats were found at Object 2 and ID 1 to shore.'*

Table 9-7 Coral Encountered During Al Safa Survey (March 2016)

Species	Photo No.	Object 1	Object 2	Object 3	Object 4	Intake 3 to Intake 2	Intake 2 to Intake 1	Intake 1 to shore
Stylophora danae	(7896/7897), 7910, 7911, 7912, 7915,		L					
Favites pentagona	7912,		L					
Favia	7898, 7914,		L					
Leptastrea	7908, 7909,		L/M					L
Paramontastrea			L/M					L
Plesiastrea	7907, 7908,		L/M					
Pseudosiderastrea	7898, 7902, 7908, 7909, 7910, 7915,		L/M					L
Montipora cf. danae	1 to shore 1 6/31							L
Turbinaria (massiortina)	(7888/7889)							L
Goniopora	7898, 7902, 7915,		L/M					
Siderastreidae						M	L	L
TOTAL		0	8	0	0	1	1	8

Benthic Epifauna

There was a low diversity of benthic epifauna. In contrast to fish and coral, the sandy habitats were more diverse than the rock/algae habitats. None of the benthic epifaunal species observed were of rare or threatened classification.

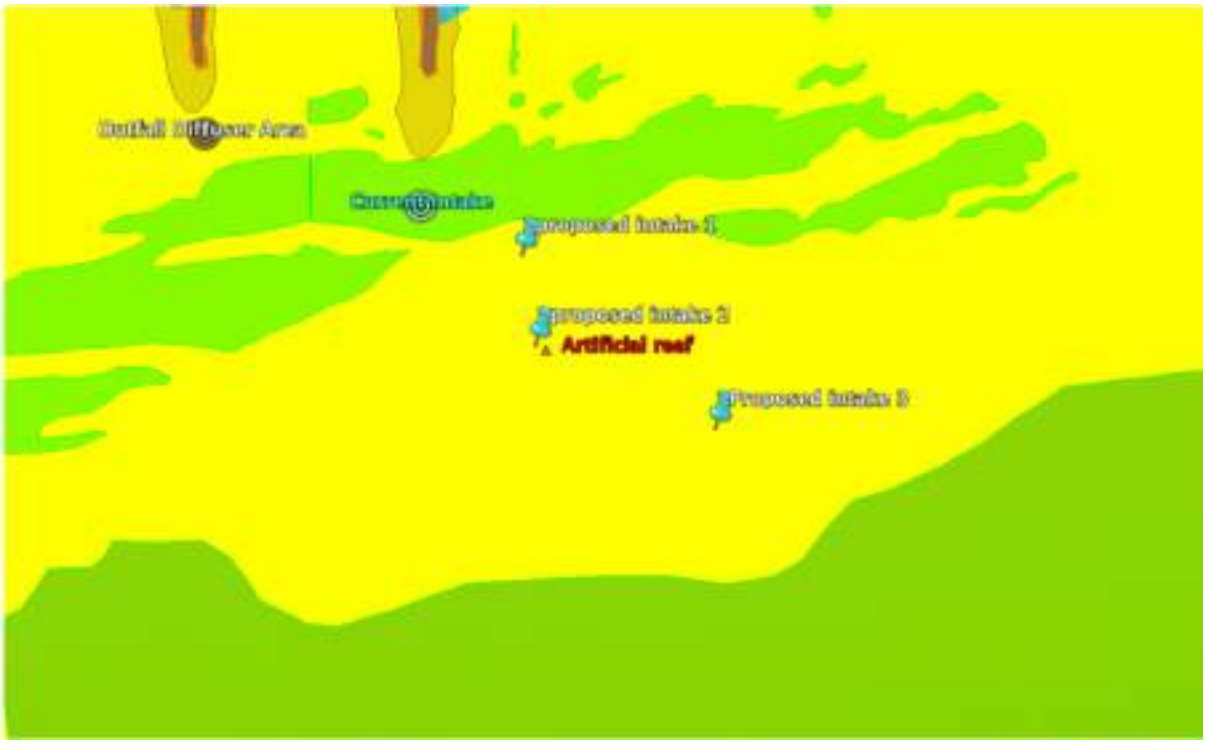
Table 9-8 Benthic Epifauna Encountered During Al Safa Survey (March 2016)

Species	Object 1	Object 2	Object 3	Object 4	Intake 3 to Intake 2	Intake 2 to Intake 1	Intake 1 to shore
Ceriantbidae				L			
Polychaeta					M	M	L
Ophiotobranchia					L		
Holothuria atra					L		
Asteronotus cepitosus						L	
	0	0	0	1	3	2	1

Habitats

The Al Safa report identifies 8 habitat-types within the survey area, as mapped on the figure below based on satellite imagery, bathymetric map and ground truthing through spot dives and video transects.

It is considered that these habitat types are not likely to have changed since the 2016 survey.



Key

No.		
1		Sandy sea bed
2		Rocky areas with algal mats and coral
3		Disturbed ground
4		Sandy beach exposed at low tide -eulittoral zone, often turbid due to wave action
5		Land never covered by sea (supralittoral, terrestrial)
6		Boulders exposed at low tide
7	Δ	Wrecks or other man-made objects
8		Deep rocky areas with algal mats and coral

The difference between some habitat-types is dramatic and is evident between the sandy sea bed habitat to the rocky area with algal mats. Several of the submerged objects provide equal changes in habitat.

As referenced above, the best habitat for fish was considered in the Al Safa report to be the artificial reef (habitat 7) due to the abundance of fish present. The next best habitat was the shallow rocky area with algae and sand (habitat 2) followed by the deep rocky area with algae and sand (habitat 8). For corals, the deeper rocky areas provided better habitat than the shallower rocky areas, but it is also noted that no corals were present in any of the other habitats, except for occasional sea pens (soft coral) in the sandy areas.

Ambient Water Quality

Ambient water quality in the project area has relatively few influences, however one primary source of discharge is the Salalah IWPP, located adjacent to the proposed project. As an IWPP, the facility intakes water for desalination and cooling water purposes, it subsequently discharges a mixture of warm water, brine and likely other trace elements (e.g. such as residual chlorine from dosing and water treatment processes) via an outfall to the Indian Ocean. The Salalah IWPP will have an existing influence on ambient water quality locally, within its mixing zone. At present, there are no other industrial facilities with discharges to the ocean in proximity to the project location. There are also no other known discharges, besides various natural outlets from runoff water.

As part of the marine survey works samples of ambient water were collected on behalf of Masirah International in July and August 2016. The samples were analysed by Lonestar Laboratory in Muscat (ref. Appendix I for full laboratory certificates). Note: specific sampling locations, or sampling depths were not reported in the referenced report.

A summary of key parameter is presented below as per the laboratory results in the table below.

Table 9-9 Ambient Water Quality Analysis

Parameter	Unit	July 2016	August 2016
Arsenic	mg/l	<0.01	<0.01
Barium	mg/l	<0.1	<0.1
Biochemical Oxygen Demand	mg/l	<2	<2
Boron	mg/l	4.54	4.39
Chlorides	mg/l	20207	19398
Total Kjedahl Nitrogen	mg/l	<0.6	<0.6
Cadmium	mg/l	<0.003	<0.003
Chemical Oxygen Demand	mg/l	<5	<5
Cobalt	mg/l	<0.03	<0.03
Copper	mg/l	<0.02	<0.02
Cyanide	mg/l	<0.0001	<0.0001
Mercury	mg/l	<0.001	<0.001
Molybdenum	mg/l	<0.01	<0.01
Nickel	mg/l	<0.02	<0.02
Nitrite	mg/l	0.033	0.012
Tin	mg/l	<0.01	<0.01
Total Iron	mg/l	<0.02	<0.02
Total Manganese	mg/l	<0.02	<0.02
Total Aluminium	mg/l	<0.03	<0.03
Salinity	ppt	36.51	35.04
Selenium	mg/l	<0.01	<0.01
Sulphate	mg/l	2710	2702
TDS	mg/l	37800	35850
TSS	mg/l	3	3
Oil & Grease	mg/l	<5	<5
Sodium	mg/l	10950	11430
Turbidity	NTU	0.7	5.6
Zinc	mg/l	<0.1	<0.1
TOC	mg/l	1.9	1.7
TPH	mg/l	<0.01	<0.01
Enumeration of Phytoplankton	Number/litre	4800	880

It is understood that there are no applicable ambient water quality standards in Oman. However, when considering the values specified (where available) by the Omani discharge water standards (MD 159/2005) in addition to other ambient standards for more sensitive marine environments (PME, 2012 Red Sea and ANZECC, 2000) in addition to water quality recorded in-situ from the Arabian Sea (Bhadja *et al.* 2012) these are considered in the typical ranges expected for ocean water quality and would in fact comply with other ambient standards for more sensitive marine environments throughout the GCC.

The August record for Turbidity and TDS recorded in July and August is considered slightly elevated. The time of sampling would have coincided with the 'Khareef' where the rough ocean waters naturally result in increased turbidity and TDS due to increased wave action and sediment suspension. Chloride levels may appear high due to the proximity of the sample location to the location of the outfall pipe. Hypochlorites are used as part of the desalination process and known to breakdown rapidly to background levels once mixing with the surrounding seawater.

9.4.1 Sensitive Receptors

Table 9-10 Sensitive Receptors - Marine Environment

Receptor	Sensitivity	Justification
Benthic Habitats	**Medium**	The majority of benthic habitat in the project footprint and immediate surrounding area is sandy sea bed with few sensitivities. There are areas of rocks with algal mats and some corals closer to the shoreline and at a deeper depth. These habitats were not identified to include high density corals, with limited sightings of corals along the transects, and a higher diversity at 'Object 2' an artificial object in the sea at this location. Benthic epifauna was also in low density. Some of the corals identified are endemic to the region and therefore are of regional importance. Given the proximity of the adjacent Salalah IWPP, its marine structures, cooling water and brine discharges and the presence of man-made objects, the habitat is considered to be 'Modified', although it is recognised that some of the low/medium density corals, may be of importance.
Marine Fauna	**Medium**	The Sheilas Damselfish a species of fish endemic to Oman was identified during the survey, as was the Blackspot Emperor which is understood to be rare in Oman. In addition, Wrasse fish species (IUCN Least Concern) were identified, however no IUCN species of greater conservation concern were identified. Such species may be of medium to high regional importance.
Ambient Water Quality	**Low**	Ambient water quality is not significantly impacted and the ambient data shows a spare carrying capacity.

9.5 Potential Impacts

9.5.1 Construction

Dredging

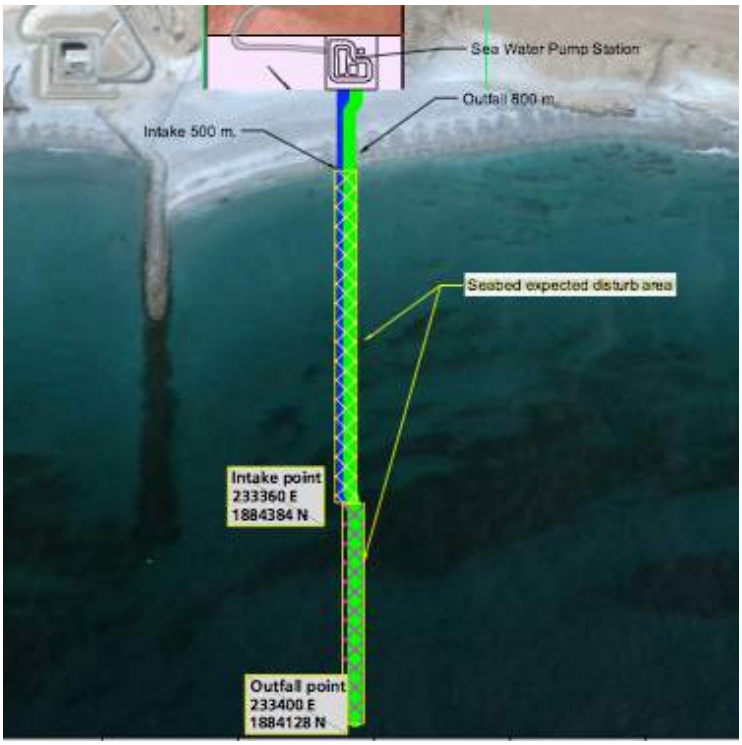
Dredging will be required in order to lay the intake and outfall pipelines. The dredging activities will create a common trench to lay the entire intake pipeline and approximately 5/8th of the outfall pipeline. These will be constructed in a common trench to reduce construction activities and associated impacts upon the marine environment. The outfall pipeline will extend a further 300m into the ocean from the intake; this will ensure that suitable space is allowed for brine

dispersion to avoid recirculation. In addition, this will ensure that the location of the outfall will be located in an area of sandy seabed (close to Survey ID 2 – as per the baseline survey data), away from corals and algal mats as required by Omani regulation.

The width of the common trench for Intake and Outfall pipelines will be 19.20 meters and for the Outfall section its end has a width of 14.00 meters. In both trenches, it is necessary to consider an oversized of about 4-5 meters in plant by possible displacement of the dredging system.

In total, there may be disturbance of up to an approximate 25m (width) for the common intake and outfall trench and 19m for the remaining portion of the outfall pipeline trench, as per the figure below.

Figure 9-2 Proposed Dredging Area for Intake & Outfall Pipe Installation



Within the dredged footprint, the removal of benthic communities would result with a permanent negative impact to the diversity and density of the benthic infauna.

In accordance with the baseline habitat survey and mapping provided, the proposed dredge area primarily comprises sandy seabed and an area of rocky outcrops with some corals and algal mats. The location of the rocky outcrops vs. sandy seabed is visible on the satellite image above, as also corresponding with the marine survey baseline data. The alignment of the corridor appears to avoid a large portion of the main rocky outcrop, however, there will be a small element of separation.

The figure below has been generated using Google Earth to illustrate the location of the proposed intake and outfall heads, as well as the dredging corridor (in blue). In addition, the areas of rocky outcrops with some corals and algal mats have been highlighted (in brown).

Figure 9-3 Benthic Habitat as Determined by Habitat Mapping (presented above)

The approximate dredging footprint for the project (including 5m width for excess dredging) is expected to total an area of approximately 18,200m^2.

Out of this area and based on the calculations from Google Earth, the dredging corridor will impact approximately 5,150m^2 of shallow rocky outcrop areas, which contain low density and low diversity corals, with some algal mats. The remaining footprint will be sandy seabed which has relatively low benthic importance as a habitat, as identified form the baseline surveys.

it is expected that recovery rates will vary once marine construction activities have ceased. Typically, the adjacent sandy subtidal habitats will return to a benthic ecosystem similar to that

which existed prior to dredging activities, as an amount of the dredged material will be used for backfilling purposes. In rocky areas, these habitats will only recover where rocky substrate is provided. The regrowth rate will be slower, but where local rock is deposited, these areas will likely provide suitable habitat for coral re-growth with the potential for no net loss, or a possible net gain in this habitat over time.

The impacts to the benthic habitats are expected to be minor in magnitude as there will be some measurable change in the attributes, but not adversely affecting integrity, and will only be limited to the corridor of the works. Further the impacts are not considered to be permanent, as there is the potential for re-growth of marine flora and return of habitats to similar types once the installation of the pipelines is complete.

Disturbance of Marine Fauna

Marine works will result in a temporary disturbance to marine fauna (i.e. fish species), which are expected to vacate the area of works. This may include a loss of foraging and refuge opportunities for fish in this area.

Impacts relating to benthic epifauna are expected to be minimal due to the low diversity and sensitivity identified during the baseline. Impacts are expected to be reversible once the seabed is restored following dredging works.

Degradation of Water Quality

Sediments released by the dredging activity will negatively impact the water quality in the area. Sands and sediments greater than 0.063mm3 will fall out of suspension relatively quickly and close to the dredging locations. Very fine sands and silts may remain suspended for longer periods, and would consequently settle further from the activity location. Therefore, plumes of fine suspended sediment would be expected to form in the direction of the localised currents and will result with a temporary localised increase in turbidity.

Further, impacts from nutrient mobilisation may also occur as organic material in the seabed is disturbed. Such impacts could feasibly increase algal growth, however due to the largely sandy and rocky seabed the amount of organic material is expected to be minimal.

Increased turbidity of ambient sea water will temporarily decrease light penetration through the water column and may result in a reduction in photosynthetic activity of marine flora (e.g. coral). This could have impacts on production and growth. However, over time turbidity levels will return to background levels once marine construction activities have ceased and when the current velocities have reduced thereby facilitating the settlement of suspended sediments. In contrast, where sediments do settle, this may also starve flora of light and will restrict the gaseous exchange required to sustain floral life (particularly corals).

Table 9-11 Marine Environment Impact Significance - Construction

Potential Impact	Potential Impact Magnitude	Receptor	Receptor Sensitivity	Potential Impact Significance
Dredging Activities and Disturbance of Benthic Habitat	Minor Negative	Benthic Habitats	Medium	**Minor**
Disturbance of Marine Fauna	Minor Negative	Marine Fauna	Medium	**Minor**
Degradation of Water Quality	Minor Negative	Ambient Water Quality	Low	**Negligible or Minor**

9.5.2 Operation

The main impacts on the marine environment from the operation of the project are linked to the following operational elements:

- Intake of the seawater resulting with fish entrainment; and
- Discharge of brine water.

Entrainment to Intake

Seawater drawn by the intake system contains a variety of aquatic organisms. Those organisms that are small enough to pass through the debris screens in the intake will be drawn into the SWRO plant. This process, called entrainment, may affect phytoplankton, zooplankton, planktonic larval stages of benthic organisms such as shellfish (i.e., meroplankton), and fish eggs and larvae (ichthyoplankton). Because of large numbers and short regeneration times of phytoplankton and zooplankton, impacts of entrainment on these organisms are considered to be of little consequence. As such entrainment impacts to phytoplankton and zooplankton are considered to be negligible.

Aquatic organisms that are drawn into the intake and are too large to pass through the debris screens may be impinged against the screens. Mortality of fish that are impinged is high as impinged organisms are ultimately suffocated against the screen mesh or are abraded. Impingement can affect fish and invertebrates (crabs, shrimp, jellyfish, etc.) that come in close proximity to the intake. Impingement occurs when the intake through-screen velocity is too high for species, such as crab or fish, to move away and are retained against the screens.

Brine Discharge

The water contaminant of particular concern with regards to the operation of the SWRO is salinity. The Omani standards allows for a change in salinity of up to 2ppt from background within a 300m radius of the outfall. Impacts relating to brine discharge will likely include:

- Hyper-saline water affects the osmoregulation capability of marine organisms, which consequently may cause acute toxicity due to an excess, or deficiency of specific ions.

- Hyper-saline water is denser that background seawater, resulting in some stratification of the water column, with the denser water settling at lower depth.
- Hyper-saline water also reduces the entropic ability of water consequently thermal dissipation rates are decreased.

The overall effect of this hyper-saline seawater at depth is a locally stressed environment, which will limit the ability of organisms to survive and consequently degrade the marine habitat. A degraded marine environment at depth will have secondary effects on the upper levels of the marine environment as the support structure of the food chain is compromised.

The salinity tolerance of corals is linked to the normal background levels. Therefore, salinity-induced stressors may decrease coral diversity by die off (i.e. bleaching and disease) of sensitive species and reduced recruitment success of corals. The long- term indirect effects will result in degradation of the reef system and reduced diversity of fish, flora, crustaceans and other benthic organisms.

The following table indicates the discharge limits that the project is required to comply to as set by the Project Proponent, OPWP.

Table 9-12 Project Outfall Water Quality Guarantees

Parameters		Raw Water Intake	Brine	Maximum Limit
pH max	-	8.5	9	9
pH min	-	7.5	6	6
Temperature above ambient temperature	K	18-32	18-33	<10°C above ambient temp
Biochemical Oxygen Demand (BOD) (5d@20degrees centigrade)	mg/l	1.9	4.45	<20.0
Chemical oxygen demand (COD)	mg/l	5	11.71	<200.0
Total Suspended Solids*	mg/l	10	23.42	<30.0
Aluminium (as Al)	mg/l	0.02	0.05	<5.0
Arsenic (as As)	mg/l	0.01	0.02	<0.100
Barium (as Ba)	mg/l	0.06	0.14	<2.0
Beryllium (as Be)	mg/l	<0.300	<0.300	<0.300
Cadmium (as Cd)	mg/l	0.003	0.01	<0.010
Chromium (as Cr)	mg/l	<0.050	<0.050	<0.050
Cobalt (as Co)	mg/l	0.03	0.07	<0.050
Copper (as Cu)	mg/l	0.02	0.05	<0.200
Cyanide (total as CN)	mg/l	0.001	0.00	<0.100
Iron (as Fe)	mg/l	0.02	0.05	<1.5
Lead (as Pb)	mg/l	0.01	0.02	<0.08
Mercury (as Hg)	mg/l	<0.001	<0.001	<0.001
Molybdenum (as Mo)	mg/l	0.01	0.02	<0.05

Parameters		Raw Water Intake	Brine	Maximum Limit
Nickel (as Ni)	mg/l	0.02	0.05	<0.100
Nitrogen: Ammoniacal (as N)	mg/l	0.01	0.02	<1.0
Nitrogen: Nitrate (as N)	mg/l	3.8	8.90	<15.0
Nitrogen: Organic (Kjeldahl) (as N)	mg/l	0.6	1.41	<5.0
Total-Nitrogen	mg/l	5	11.71	<15.0
Oil & Grease	mg/l	5	11.71	<15.0
Phenols (total)	mg/l	<0.002	<0.002	<0.002
Phosphorus (total as P)	mg/l	<2.0	<2.0	<2.0
Selenium (as Se)	mg/l	0.01	0.02	<0.020
Silver (as Ag)	mg/l	<0.010	<0.010	<0.010
Sulphide (total as S)	mg/l	0.01	0.02	<0.100
Total chlorine (as Cl_2)	mg/l	0.15	0.35	<0.4
Vanadium (as V)	mg/l	<0.100	<0.100	<0.100
Zinc (as Zn)	mg/l	0.1	0.23	<1.0
Faecal Coliform Bacteria (per litre)	per litre	1	2.34	<1,000

Brine modelling Results and Assessment

WKC Environment Consultancy (WKC) were contracted by 5 Capitals to conduct hydrodynamic modelling and a brine plume assessment for the proposed project under operational conditions.

The brine modelling study has included the assessment of brine plumes for the existing (Salalah IWPP) and proposed outfalls (Salalah IWP), based on one existing, and two future design scenarios. The future Salalah IWP and existing IWPP outfalls are located approximately 750m and 170m perpendicularly south of the shoreline respectively, with the IWPP outfall at the end of a man-made rock groyne. The IWPP and IWP facilities are located within Salalah Bay and are approximately 50 km ENE of the Port of Salalah.

The discharges from the proposed development have been simulated using sophisticated atmospheric and ocean models:

- Analysis of European Centre for Medium Range Weather Forecast (ECMWF) data to obtain wind and atmospheric pressure fields over the Project area;
- Analysis and incorporation of the Oregon State University (OSU) Barotropic Tidal Inversion Model for tidal prediction and model boundaries;
- Simulation of tidal and wind driven ocean currents using the GEMMS 3D Coastal Ocean Model (GCOM3D) which predicts the variation horizontally and vertically of the currents in the Project area;

- Simulation of near-field brine plume behaviour using the United States Environmental Protection Agency (US EPA) approved Cornell Mixing Zone Model (CORMIX), which simulates the 'jet-like' dispersion of the discharge; and,
- Simulation of far-field brine plume behaviour using the GEMMS 3D Plume Dispersion Model (PLUME3D), which simulates the 'plume-like' dispersion of the discharge.

Requirements

Applicable Omani regulation requires a water quality objective of a change in salinity of less than 2 parts per thousand (ppt) at the edge of the regulatory mixing zone (RMZ); of 300 metres, is suitable for brine discharges into the marine environment. The model was therefore set up to establish compliance with this requirement in the first instance.

Methodology

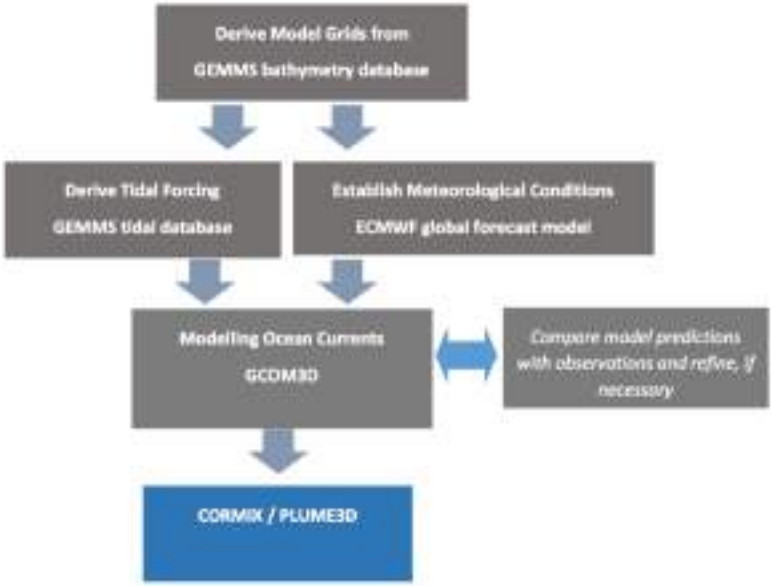
Note: Full details of the modelling methodology can be found in the full modelling report presented in Appendix J. A summary of the methodology is presented herein.

The hydrodynamic model is used to generate ocean tide and 3D current data, a pre-requisite to the subsequent plume modelling. The results of this hydrodynamic modelling have been used to 'drive' the plume and coastal processes assessments.

The assessment was broken down into the following components to enable a full and comprehensive assessment to be carried out:

- Hydrodynamic Modelling;
  - 3D Hydrodynamic Modelling (GCOM3D);
- Brine Plume Assessment;
  - Near-Field Plume Dispersion Assessment (CORMIX);
  - Far-Field 3D Plume Dispersion Assessment (PLUME3D);

Figure 9-4 Modelling flow Chart



The model was set up by WKC and included the primary location points for the existing and future intake and outfalls.

Figure 9-5 Station Locations

The model used representative, tidal and meteorological data for input conditions. Full details of the input conditions are included to the full report as per the ESIA Appendices.

Model Scenarios

The Salalah IWP brine outfall consists of a multiport diffuser, covering a length of 20 m, approximately 800 m from the shoreline. The diffuser has 5 risers, each with two ports at an angle of 45° and pointing in opposite directions. These risers are spaced 5 metres apart and point into/out of the typical ambient current which flows perpendicularly across the diffuser line and parallel to the shoreline. Each of the ten (10) diffuser ports has a diameter of 0.4 m. The flowrate of

brine through this outfall is being increased from 11,680 m^3/hr to 12,270 m^3/hr (represented in the modelling as Scenarios 2 and 3 respectively).

An additional existing outfall (known as the IWPP outfall) is located closer to the shoreline at the end of a man- made rock groyne and is included in the modelling assessment. The IWPP outfall consists of a single outfall pipe, approximately 1.8 m below the surface which is orientated vertically upwards. The outfall has a diameter of 1.29 m and has a flowrate of approximately 6,000 m^3 of brine per hour. This outfall is represented in isolation for Scenario 1 (existing conditions) and is not expected to change during the development of the IWP outfall.

In summation, the following scenarios and outfalls were selected for assessment within this study:

1. Existing Conditions (Baseline);
    a. IWPP Outfall – 6,000 m3/hr.
2. Nominal Future Conditions;
    a. IWPP Outfall – 6,000 m3/hr; and,
    b. IWP Outfall - 11,680 m3/hr.
3. Exigency Conditions;
    a. IWPP Outfall – 6,000 m3/hr; and,
    b. IWP Outfall – 12,270 m3/hr.

In order to capture the near-field mixing facilitated initial momentum as the brine leaves the outfalls, the plume was first simulated utilising CORMIX. The far-field modelling was conducted utilising PLUME3D, with ambient conditions driven using outputs from GCOM3D.

The 'near field' can be defined as the zone where mixing behaviour is influenced by the momentum and buoyancy (influenced by discharge design and brine characteristics) of the discharge as well as boundary interactions. CORMIX is particularly useful in determining plume behaviour in the near field based on discharge brine parameters and is therefore considered suitable for this task.

The behaviour of the brine plumes at distance (within the 'far-field') is influenced by ambient parameters such as tidal currents (and tidal reversal), and meteorological conditions.

Brine characteristics and discharge design parameters were obtained from the client where possible and schematised into the CORMIX model to simulate mixing within short distances. The output from CORMIX was then interrogated by PLUME3D to determine the point where momentum no longer influenced plume trajectory. PLUME3D takes relevant data from this point (such as plume velocity, trajectory, density, dimensions, dilution etc.) to create an input file for use within the far-field assessment.

Results

In order to generate the hydrodynamic model, GCOM3D captured a full tidal cycle and achieved steady state equilibrium, being run for one month (30 days); for the months of July 2016, and January 2017, to represent a summer and winter scenario respectively.

The hydrodynamic model identified how current velocities are relatively high, particularly during summer when strong Khareef winds create faster flowing surface currents across the bay from west to east. The influence of the tide during these periods is virtually unnoticeable beyond the immediate inshore area as the deeper waters are less affected by comparatively minor changes in sea level.

During winter, the effect of the wind is diminished and tidal influence and eddy-currents become more evident when considering prolonged periods. The general trend is however for winds and currents to flow from east to west during winter months.

The tidal water heights utilised within the assessment were simulated for the summer and winter periods using OSU and Admiralty Tide Tables in order to compare the model performance at simulating tidal variations in the area.

Figure 9-6 Differential Salinity (95th Percentile) – Scenario 2 – Nominal Conditions (Summer)

Figure 9-7 Differential Salinity (95th Percentile) – Scenario 2 – Nominal Conditions (Winter)

Figure 9-8 Differential Salinity (95th Percentile) – Scenario 3 – Exigency Conditions (Summer)

Figure 9-9 Differential Salinity (95th Percentile) – Scenario 3 – Exigency Conditions (Winter)

The model output indicates that mixing within the far-field zone occurs within a relatively short distance due to the velocity of the tidal and wind driven currents as they are forced around the outfall structure, and the fully re-stratified geometry of the brine at the end of the near-field zone (which increases the availability of ambient water for dilution purposes). A differential salinity of less than 2 ppt is anticipated to be met within less than 60 m and 220 m for the IWPP and IWP outfalls respectively, for at least 95% of the time in both summer and winter. It is therefore predicted that ambient water quality thresholds will be met within the required Omani mixing zone, minimising the outfall's potential to impact upon the surrounding marine environment and beaches.

The plume is anticipated to dilute less during the winter months, due to weaker and less sustained winds. The influence of wind direction is more pronounced however with the summer and winter plume trajectories at both outfalls showing almost complete reversal. The summer monsoon (Khareef) winds force currents (and subsequently plumes) to flow from west to east while in winter the direction is ostensibly reversed.

A minor reduction in dilution (and hence increase in salinity effected area) is anticipated to occur in winter, due to pooling effects caused by the low current speeds during these periods.

Impacts to Marine Habitats

The projects outfall is located in an area of sandy seabed located at a distance of over 220m from any rocky outcrops (based on the referenced baseline survey report) which includes habitat for algal mats and low-density corals.

In order to assess ecological impacts of the saline plume, additional figures have been prepared to show the pattern of dispersion against the underlying benthic habitat. These are presented below for modelling scenarios 2 & 3.

Figure 9-10 Differential Salinity (95th Percentile) vs Benthic Habitat – Scenario 2 – Nominal Conditions (Summer)

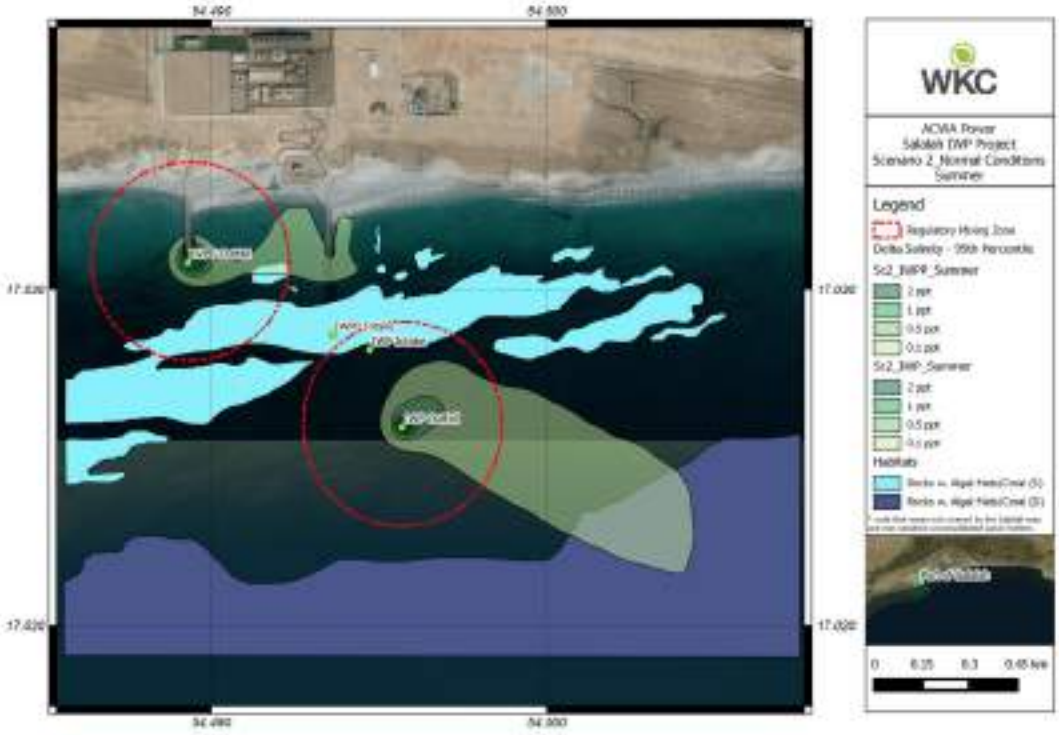


Figure 9-11 Differential Salinity (95th Percentile) vs Benthic Habitat – Scenario 2 – Nominal Conditions (Winter)

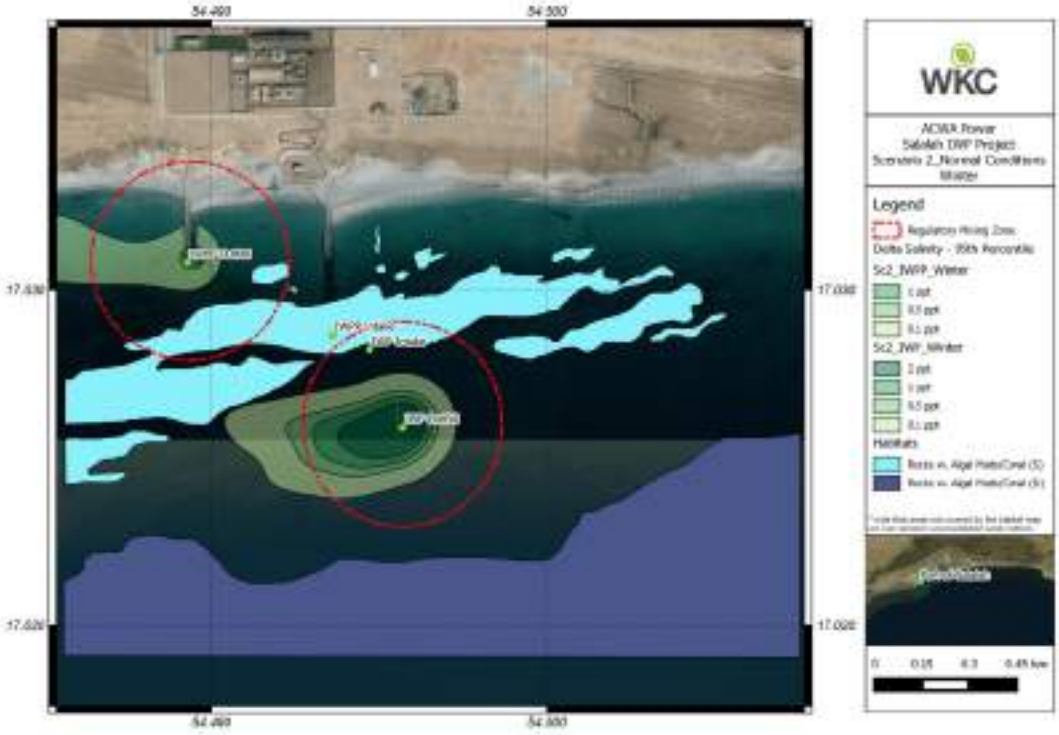


Figure 9-12 Differential Salinity (95th Percentile) vs Benthic Habitat – Scenario 3 – Exigency Conditions (Summer)

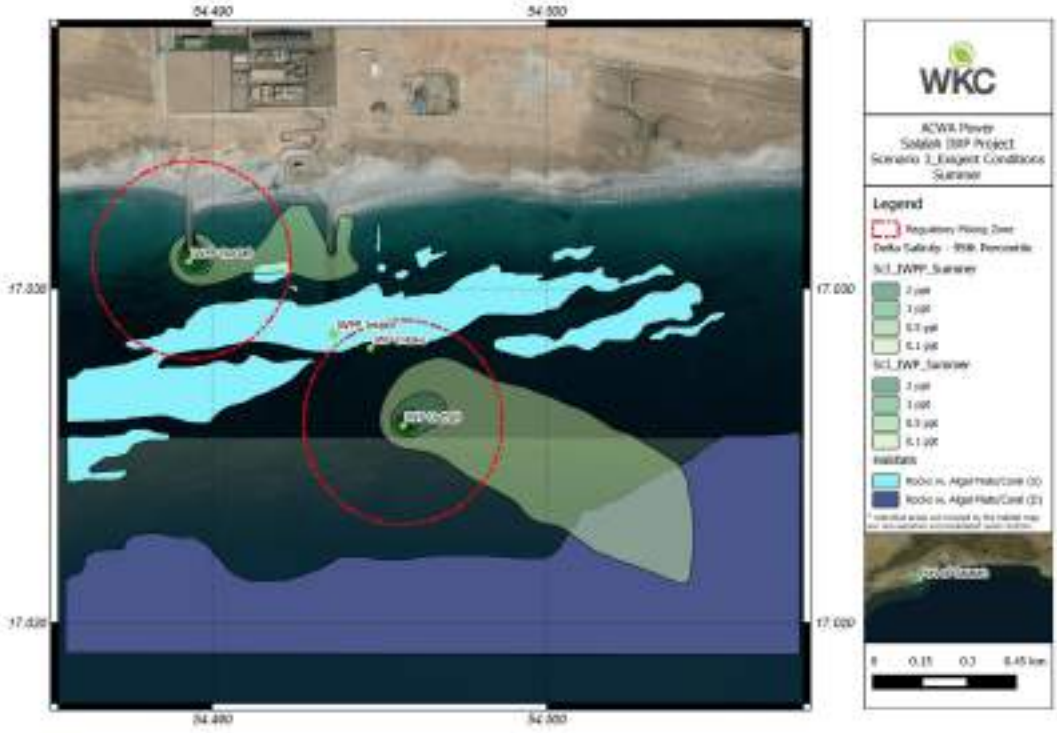
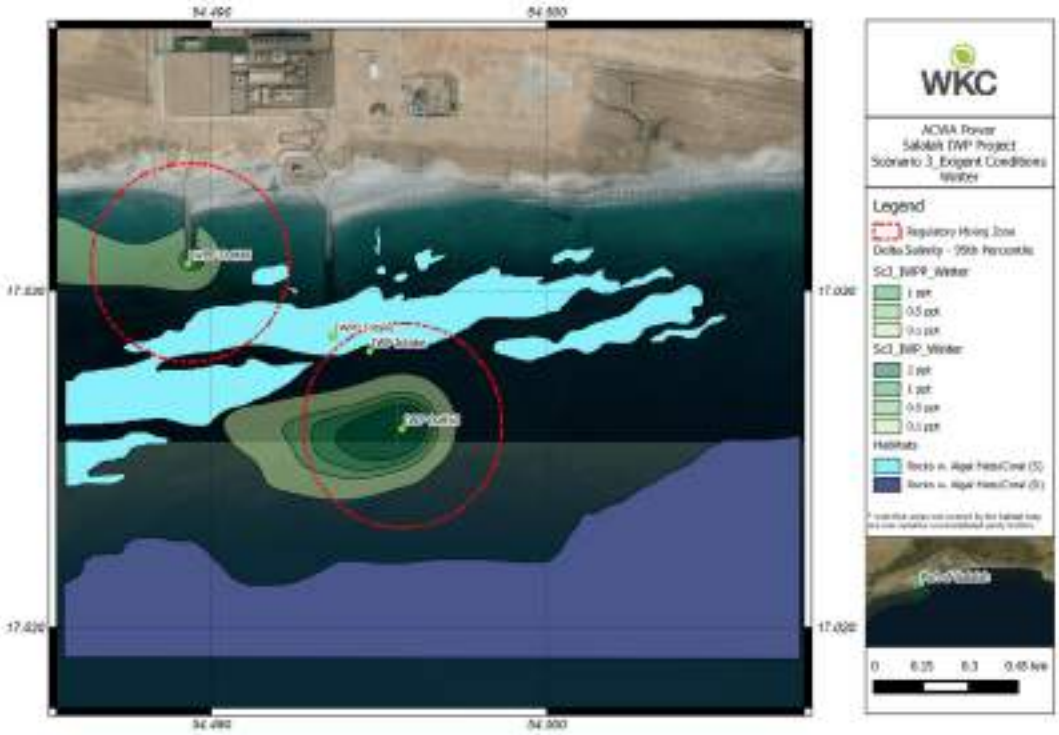


Figure 9-13 Differential Salinity (95th Percentile) vs Benthic Habitat – Scenario 3 – Exigency Conditions (Winter)



As identified by the plots presented above, there are no instances of overlap between the IWP dispersion plume and the shallow rocky habitat during any modelled scenarios.

Instances of saline plume overlap with the deeper rocky habitat up to a 0.1ppt differential salinity concentration does occur during the summer modelled scenarios for the nominal and exigency conditions. The maximum area of the IWP plume overlap during the worst-case summer exigency conditions is 93,000m^2. The impact magnitude of this overlap is however considered negligible. A paper by Donguy and Meyers (1996), published in the Deep-Sea Research journal (Vol.43 No.2, pp.117-138,1996) presents annual variations of salinity in the Indian Ocean at latitudes commensurate to Salalah (i.e. 17°N) of up to 2 ppt. The 0.1ppt potential differential in salinity overlapping with the deep rocky habitat is therefore considered to be within typical seasonal variations, and is unlikely to be a factor affecting benthic ecology at these locations.

Discharge of Treated Wastewater Effluent

Besides brine there are other effluents such as gravity filters backwash waste water, RO trains chemical cleanings waste water or flushing and eventually treated sewage water and solids wastes, such as: sea water intake solids wastes and effluent treatment dewatered sludge.

A percentage of the brine stream that passes through the backwash tank is used to backwash the gravity sand filters. The backwash waste water produced during the washing cycle drags the retained suspended solids out of the filtration media and has a high suspended solids and iron concentration. This backwash waste water is sent to the effluents treatment plant. Backwash waste water produced during the rinsing cycle will have a lower concentration of suspended solids and will be directly sent to Clarified water tank in the effluent treatment.

RO membranes required periodic cleaning with specific chemical to reduce scaling produced by seclusion of suspended inorganic particles, such as calcium carbonate, barium sulphate and iron compounds or fouling produced by the seclusion of organic, colloidal and suspended particles. After the rack chemical cleaning the exhaust solution will be neutralized into the CIP tanks, using the Transfer pumps to recycle the CIP water to the tanks while dosing sodium hydroxide or sulphuric acid into the recycling pipe. The neutralized water will be sent to the Backwash waste water basing tank into the Effluents plant by the CIP pumps.

The sanitary waste water (produced in bathrooms, locker rooms, break room, laboratory, etc.) will be treated onsite by means of a dedicated sewage treatment facility placed by the effluent treatment.

Such treated wastewater effluent discharges may result in the release of trace elements into the local ambient water quality.

Effluent Quality

The clarified water produce in the effluent treatment plant will fulfil the effluent discharge limits as defined in Ministerial Decision 159/2005, except for: Fluorides and Boron whose concentrations in the raw water are similar and higher respectively than the required ones. This is confirmed in the baseline water quality analysis where the ambient concentration of boron (fluoride not sampled during baseline) ws four time in excess of the discharge standards stated by MD159/2005. These parameters values will be over the regulation requirements due to its concentration in the raw water and the inherent nature of the reverse osmosis process that concentrate the salts dissolved in the raw water in the brine stream and reduce it in the permeate one, therefore its concentration in the brine stream is expected to be at least between twice and three times the raw water one.

Prior to the project award, OPWP were issued an in-principle NOC by MECA specifically in regard to the concentrations of boron, fluoride and lithium. This in principle NOC is presented in Appendix L of this ESIA (ref. ESIA Volume 4).

Sanitary treatment facility treated water will fulfil the effluent discharge limits as defined in Ministerial Decision 159/2005.

Table 9-13 Potential Marine Environment Impact Significance - Operation

Potential Impact	Potential Impact Magnitude	Receptor	Receptor Sensitivity	Potential Impact Significance
Entrainment to Intake	Minor Negative	Marine Fauna	Medium	**Minor**
Increased Salinity (within 300m mixing zone)	Moderate Negative	Ambient Water Quality	Low	**Minor**
Increased Salinity (at overlapping rocky habitats)	Negligible Negative	Benthic Habitats	Medium	**Negligible or Minor**
Discharge of Treated Wastewater Effluents	Negligible Negative	Ambient Water Quality	Low	**Negligible or Minor**

9.6 Mitigation & Management Measures

IFC PS6 requires that there is no net loss to this natural habitat as a result of project implementation. As such, it is necessary to follow a mitigation hierarchy, such as:

- Avoidance
  - Although there are various alternative project locations in this area of Dhofar Governorate (due to availability of coastal land), the necessity to connect to the existing power network and water distribution network requires the project to be located adjacent to the existing IWPP. The site has both access and power facilities close-by. Impacts as a result of brine dispersion will be avoided as the dispersion plots predict the saline plumes to move away from the rocky benthic areas (with some corals).
- Minimisation

- The proposed arrangement of the intake/outfall alignment in the same corridor minimises the disturbance of benthic substrate during the construction phases by having a common pipeline trench. The marine survey data also confirms that the projects intake/outfall alignments will be largely within sandy seabed and that the outfall in particular will be located in a wide area of sandy seabed.

- Restoration Measures
  - The intake and outfall structures will be buried to ensure that the potential for recolinsation of seabed habitat is possible over time, as the seabed will be restored to a modified state following construction.

- Biodiversity Offsets
  - It is possible for local rock to be laid in areas where rocky outcrops existed, to enable re-growth of any affected corals to ensure no net loss, and potentially a net gain.

9.6.1 Construction

Table 9-14 Marine Ecology and Water quality – Mitigation & Management Measures for Construction

Impact/ Source	Mitigation & Management Measures
Dredging	A Dredging Method Statement is required to be prepared prior to the commencement of dredging activities. The method statement shall define all mitigation and monitoring requirements included to this ESIA and any further mitigation and monitoring measures that may occur as a condition of the ESIA approval; from the Statutory Environmental Body in Oman, or the projects lenders.
	The dredging area and working area are to be reduced to the minimum potential area, to minimise direct impacts of the construction footprint.
	Disposal of dredge spoil from the off-shore dredger will be onto the main land and will not be side cast or disposed into the marine environment (without a valid permit from the appropriate government ministry). Consideration should be given to the re-use of the dredge spoils for the cut/fill balance for the on-shore works. Mitigation in regard to dredge spoil run off will be required to limit suspended sediment. This may require settlement ponds and silt curtain filtration systems prior to discharge. Monitoring of effluent will be required to confirm compliance with the applicable standards.
	All dredging activities will incorporate the use of silt curtains to protect adjacent waters and marine habitats from suspended sediments. Silt curtains are a type of containment barrier that shall be used during dredging activities to control suspended sediments in the water column. Silt curtains reduce water movement in the area contained by the curtain, which then allows suspended sediment within the contained area to settle out of suspension, before the water disperses more broadly;
	Silt curtains will be placed at a suitable distance from the dredging activity to prevent spread of silt as much as is practicable without introducing risk to the dredger. Laying out of silt curtains and distances to be maintained from the dredger will be identified within the dredging activities risk assessment and method statement.

Impact/ Source	Mitigation & Management Measures
	Weights will be added to the bottom of the silt curtains to prevent the screen from drifting.
	All silt curtains shall incorporate a scum boom. Any scum that develops within the fenced off area will be removed with a net or similar and stored on land within containment to dry out prior to disposal.
	Silt curtains will be left in place after dredging activities have been completed, to allow for complete settling of sediment. The curtains may only be removed once concentrations of suspended sediments within the silt curtain area are reduced to levels in compliance with the applicable standards.
	Silt curtains will be in good condition without rips/holes. Prior to each working day, the silt screens will be inspected to ensure they are in an appropriate condition and are arranged effectively to limit siltation impacts.
	Timing of the dredging activities will consider current directions, tide levels and wind/wave energy in order to maximise the efficiency of the silt screen and minimise the potential for transport of the sediment plume over long distances.
	During marine dredging works, the use of explosives to clear any areas is prohibited.
Marine Vessels	At no time is bilge or ballast water allowed to be discharged into marine waters. Bilge and ballast waters must be stored securely on board the vessel, and then discharged into a port/ marina treatment facility (in accordance with Regional Organization for the Protection of the Marine Environment (ROPME) guidelines.
	Ship deck cleaning will be controlled and no effluents will be discharged or allowed to spill into the sea.
	Discharge of untreated and unmonitored effluent shall be prohibited.
	Regular inspections shall be performed of infrastructure and equipment to ensure that leaks are prevented, identified and remedied.
	Any hazardous substances on board shall be securely stored bunds with secondary containment to prevent any leaks or spills.
	Spill kits will be provided on vessels and will be easily accessible. Sufficient quantities and distribution of the kit will take into account the size of the vessel and area where spills are most likely to occur.
General	Site drainage controls will include provisions to limit pollution to the marine environment from storm-water runoff, specifically from oily water and sediments.
	Training will be provided to staff working in the marine area in regard to spill management, as per the associated spill management plan, to prevent and control the spread of a spill in the marine environment.
	Antifouling products to be applied to the underwater structures will not consist of TBT or organic compounds. No CCA treated wood products will be used.

9.6.2 Operation

Table 9-15 Marine Ecology and Water Quality – Mitigation & Management Measures for Operation

Impact/ Source	Mitigation & Management Measures
Seawater intake. Fish Entrainment and Impingement	Provisions will be made in the design of the intake to restrict the entrainment of fish and other marine fauna. This may include the installation of bar screens or nets, or bubble curtain to prevent adult fish impingement. *The US EPA has determined that if the intake velocity is lower or equal to 0.15m/s (*also recommended by IFC*), the intake facility is deemed to have met impingement mortality performance standards. Therefore, designing intake-screening facilities to operate at or below this velocity would adequately address impingement impacts.*
Brine Discharge	Monitoring will be employed at the site to ensure compliance with the discharge limits with defined operational management procedures employed at the site in order to reliably maintain these standards
	The residual Chlorine concentration in the discharge will not exceed 0.2mg/L. And the change in salinity of the discharge water from the background seawater will not be greater than 2ppt of the background beyond the mixing zone.
Protecting Marine Fauna and Flora	Antifouling products to be applied to the underwater structures will not consist of TBT or organotin compounds. No CCA treated wood products will be used.

9.7 Residual Impacts

9.7.1 Construction

Table 9-16 Marine Ecology and Water quality – Residual Impacts – Construction Phase

Potential Impact	Receptor	Potential impact Significance	Mitigation	Impact Significance
Dredging Activities and Disturbance of Benthic Habitat	Benthic Habitats	Minor	✓	**Negligible or Minor**
Disturbance of Marine Fauna	Marine Fauna	Minor	✓	**Negligible or Minor**
Degradation of Water Quality	Ambient Water Quality	Negligible or Minor	✓	**Negligible or Minor**

9.7.2 Operation

Table 9-17 Marine Ecology and Water quality – Residual Impacts – Operational Phase

Potential Impact	Receptor	Potential impact Significance	Mitigation	Impact Significance
Entrainment to Intake	Marine Fauna	Minor	✓	**Negligible or Minor**
Increased Salinity (within 300m mixing zone)	Ambient Water Quality	Minor	✓	**Minor**
Increased Salinity (at overlapping rocky habitats)	Benthic Habitats	Medium	✓	**Negligible or Minor**
Discharge of Treated Wastewater Effluents	Ambient Water Quality	Negligible or Minor	✓	**Negligible or Minor**

9.8 Monitoring

Monitoring of impacts upon the marine environment will be undertaken during the construction and operational phase of the project by the EPC Contractor and O&M Company respectively. The minimum expected requirements for the monitoring are outlined in the table below. The final monitoring methodology with specific monitoring details (i.e. locations, frequencies, durations, parameters etc.) will be developed in the specific 'Environmental Monitoring Plan'.

9.8.1 Construction

Dredging Monitoring

During dredging activities, the turbidity of the water either side of the silt screen shall be visually inspected on a daily basis. Photographic evidence shall be collected of the visual appearance of the water at the surface and records kept of any olfactory evidence of pollution. During this inspection, in-situ turbidity reading shall be from mid-point within the water column approximately 5 metres from the silt curtain. Photographic evidence and in-situ turbidity readings shall be taken at each perimeter of the silt curtain and wherever there is suspected elevated levels of silt.

On a monthly basis, water quality samples shall be collected from a mid-point within the water column approximately 5 metres from the silt curtain. Samples shall be taken at each perimeter of the silt curtain and wherever there is suspected elevated levels of silt. Samples shall be sent for lab analysis for the following representative parameters:

- Total Dissolved Solids (TDS)
- Total Suspended Solids (TSS)
- Chromium (total)
- Lead

- pH
- Dissolved Oxygen
- Turbidity (NTU)
- Biochemical Oxygen Demand (BOD5)
- Chemical Oxygen Demand (COD)
- Total Petroleum Hydrocarbons
- Total Coliform Bacteria
- Escherichia Coli
- Nickel
- Zinc
- Cadmium
- Arsenic
- Selenium
- Copper
- Mercury

Ecological Monitoring

Representative monitoring shall be undertaken of habitats and water quality adjacent to the project area (including those of the rocky substrate with coral) to identify any potential impacts outside of the area of works. A marine ecology specialist shall be engaged to undertake this specific monitoring on a bi-annual basis during the construction phase with the first survey being undertaken in advance of any marine construction works.

It is recommended that this survey be undertaken using SCUBA techniques (i.e. transects and quadrat analysis) to include sections of the reef flat, reef crest and reef wall habitats. The survey should include the identification of species of corals, their health, fish species and include water and sediment sampling, for analysis at an independent MECA licensed laboratory.

Presence and sighting of Marine Fauna

Although considered a rare event, if any threatened or protected species are observed (e.g. turtles, dugong, whales, dolphins etc.) all marine construction activities will be required to cease in the vicinity of the sighting. Management must be contacted immediately, and no attempt to move or capture the animal will be attempted until a qualified marine biologist has reviewed the situation.

Direct impacts upon such species will however be extremely limited as the works activities will be sheltered by the presence of silt curtains.

9.8.2 Operation

Discharge Monitoring

Note: See the Waste & Wastewater chapter of this ESIA (Volume 2) for minimum monitoring requirement of operational discharges and treated wastewater effluents.

Ecological Monitoring

Representative monitoring shall be undertaken of habitats and water quality adjacent to the project area, this shall include a survey of the coral receptor area to monitor health of translocated corals. A marine ecology specialist shall be engaged to undertake this specific monitoring on an annual basis during operations with the first survey being undertaken prior to the commencement of operations.

It is recommended that this survey be undertaken using SCUBA techniques (i.e. transects and quadrat analysis) to include sections of the reef flat, reef crest and reef wall habitats. The survey should include the identification of species of corals, their health, fish species and include water and sediment sampling, for analysis at an independent MECA licensed laboratory.

10 SURFACE WATER ENVIRONMENT

10.1 Introduction

This chapter considers the baseline surface water within the boundary of the proposed project as well as the proposed access road.

The study area assessed in this section is delineated as follows:

- The projects footprint;
- Associated facilities (e.g. access road);
- Any construction working areas (e.g. temporary laydown areas);
- Areas that may be impacted by secondary construction or operational effects related to surface water;

This section includes the following:

- Outcome of the scoping exercise;
- Applicable surface water standards & guidelines;
- Baseline overview of surface water;
- Identification of surface water receptors;
- Identification of potential impacts relating to the projects construction and operation;
- Potential Impact Assessment and assessment of significance (including any cumulative impacts);
- Environmental mitigation & management measures (Construction and Operational phases);
- Assessment of residual impacts following the application of mitigation & management measures; and
- Minimum monitoring measures.

10.2 Scoping Outcomes

Table 10-1 Surface Water Impacts for further Assessment at the ESIA

Potential Impact	Scoped In/Out of ESIA	Justification
Construction and Operation		
Local Wadi (water quality)	**Scoped Out**	There is no surface water within the project site area. The Wadi to the north of the site is expected to have water during the rainy season. Risk of pollution to the wadi can be controlled through the implementation of a robust CESMP and OESMP.

10.3 Standards and Regulatory Requirements

RD 114/2001 Law on Conservation of the Environment and Prevention of Pollution prohibits the discharge of environmental pollutants unless the levels of such pollutants are equal to or less than that identified within an associated environmental permit.

International financial institutions will require adherence to IFC Performance Standard 3 which requires the avoidance of pollution or, when avoidance is not feasible, minimise and/or control the intensity and mass flow of their release.

10.4 Observations and Baseline Conditions

Historical satellite imagery and observations from the initial site visit did not identify any evidence of surface water within the proposed project footprint. The wadi to the north of the project site has a large channel and is expected to have occasional flows of water during the Khareef season, or during significant rainfall events locally, for instance during localised thunderstorms that may result in flash flood events.

Figure 10-1 Location of Wadi North of Site

10.4.1 Sensitive Receptors

Table 10-2 Sensitive Receptors - Surface Water

Receptor	Sensitivity	Justification
Local Wadi System	**Low**	The wadi systems in the local areas have developed naturally over time to provide suitable capacity for drainage during rainfall and storms. Development of hard standing surfaces over time has likely resulted in higher volumes of wadi being transported in wadis, as there is less retention in soils and a shorter lag-time.

10.5 Potential Impacts

10.5.1 Construction

During construction, the presence of unprotected stockpiles, fuels and chemical stores could introduce the risk of pollution to the wadi to the north and foreshore marine environment in the event of a significant rain event, where a pathway for runoff is directed to the wadi. Instances of pollution could potentially result from the wash off of surface pollutants, particularly during the first flush of rainfall.

Impacts may be more likely form the access road construction works, due to the proximity to the edge of the wadi channel (less than 10m).

Erosion of surfaces adjacent to the wadi or wash-off of particles and sediments (including form any stockpiles) may runoff to the wadi during periods of rainfall.

It is noted that discharges to the wadi are not foreseen during construction.

Table 10-3 Potential Surface Water Impact Significance - Construction

Potential Impact	Potential Impact Magnitude	Receptor	Receptor Sensitivity	Potential Impact Significance
Local wadi water quality: Construction runoff and sediment loading	Negligible Negative	Local wadi system	Low	**Negligible or Minor**

10.5.2 Operational Phase

Increased areas of hardstanding are likely to result in an increase in runoff rates and sediment loading associated with first flush.

The EPC Contractor has confirmed that storm water will be collected in a retention pond prior to discharge and will ultimately be drained to the outfall. The retention pond is designed to regulate the storm water drainage flow and reduce impacts associated with the first flush of

pollutants during rainfall runoff events. As such, there should not be any effects to the wadi, or other surface water features during operation. Operational impacts are therefore neutral.

10.6 Minimum Mitigation Measures

10.6.1 Construction

Table 10-4 Mitigation Measures during Construction - Surface Water

Impact	Mitigation Measure
Storm water run-off	Adequate drainage systems will be provided to minimize and control erosion. Sediment traps (i.e. filter fabric) will be installed at specific discharge points for runoff. Where possible road gradient will be minimized (contour and slopes) in order reduce run-off induced erosion. Regular inspection of the sedimentation/erosion controls will be conducted to prevent flooding/pooling.

10.6.2 Operation

Table 10-5 Mitigation Measures during Operation - Surface Water

Impact	Mitigation Measure
Storm water run-off	Regular maintenance of the storm water system shall be conducted, in order to avoid blockages, sedimentation and resulting flood risk from pooling of water.

10.7 Residual impacts

10.7.1 Construction

Table 10-6 Soil, Geology & Groundwater – Residual Impacts – Construction Phase

Potential Impact	Receptor	Potential impact Significance	Mitigation	Impact Significance
Local wadi water quality: Construction runoff and sediment loading	Local Wadi System	Negligible or Minor	✓	**Negligible**

10.7.2 Operation

Operational impacts prior to mitigation are considered to be neutral.

10.8 Monitoring

The minimum expected requirements for the monitoring are outlined in the table below. The final monitoring methodology with specific monitoring details (i.e. locations, frequencies, durations, etc.) will be developed in the specific 'Environmental Monitoring Plan'.

Table 10-7 Minimum Monitoring Requirements: Surface Water

Monitoring	Parameters	Frequency & Duration	Locations	Standards
Construction				
Illicit discharges to wadi (project related)	Visual	Weekly (minimum), or when observed	At wadi adjacent to the project site.	n/a – no discharges should occur unless permitted by MECA.
Rainfall runoff	Visual	During rainfall events	At any runoff channels to wadi adjacent to the project site.	n/a – monitoring should check that runoff water is not loaded with sediments.
Operation				
Drainage interceptors/ retention basin	Visual	Quarterly	At each runoff interceptor and retention basin.	n/a - monitoring to check a need for maintenance or removal of oils/grease/sediment build up.

11 WASTE AND WASTEWATER MANAGEMENT

11.1 Introduction

This chapter outlines the projects expected generation of waste and wastewater at the construction and operational phases. It does not consider the significance of impacts with respect to a specific receptor, as such impacts with respect to wastewater and waste have been assessed in the respective sections of this ESIA, with respect to the soil, geology and groundwater, and marine chapters.

The primary purpose of this chapter is to identify specific management measures in regard to waste and wastewater generation in order to ensure compliance with applicable regulations and standards.

It is the intention of this chapter that the identified management measures will be consolidated into the specific CESMP & OESMP's (or complimentary management plans/ procedures) to be implemented during the construction and operational phases respectively.

This section includes the following:

- Applicable waste & wastewater regulations and standards;
- Existing waste & wastewater management situation in Oman;
- Identification of expected waste & wastewater generation quantities and streams relating to the projects construction and operation; and
- Management measures for waste & wastewater (Construction and Operational phases).

11.2 Scoping Outcome

11.2.1 Waste

The scoping study specified that should any evidence of contaminated materials be identified from the site soil investigation (presented in the soils, geology and groundwater chapter), the ESIA would consider appropriate disposal routes and potential acceptance criteria for any contaminated materials; which may include a requirement for additional analysis to provide a robust hazard classification. With regard to the outcomes of the soil analysis, no specific instances of soils quality exceedances have been identified, however there remains a risk of potential historic contamination on-site from the use of the area as a construction laydown for the Salalah IWPP project.

The scoping study indicated that the ESIA will include good practices for waste management; as part of the mitigation and management measures (presented in this chapter).

11.2.2 Wastewater

With regard to wastewater, the scoping study indicated that an inventory of the projects wastewater streams, pathways and receptors for each stream would also be included. A source-pathway-receptor model has been included to the 'Soils, geology & Groundwater' section of this ESIA, and the impacts of wastewater discharges upon the marine environment are included within the 'Marine Environment' chapter. As such, this chapter specifically outlines the mitigation and control requirements to be included by the project during construction and operation to suitably manage wastewater.

11.3 Standards and Regulatory Requirements

11.3.1 Oman

International Treaties

Oman has ratified the following international treaties which require specific management in regard to waste:

- Basel Convention on the Control of Trans-Boundary Movements of Hazardous Wastes and their Disposal, Basel, 1989 Amendment 2004.
- This accompanies the already existing National regulation for Hazardous waste disposal (as seen in the section below).
- Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter (LDL) (1972).

National Requirements

The Sultanate of Oman established principle controls for waste legislation through 2 ministerial decisions:

- Ministerial Decision No. (17/93) for the Regulations for the Management of Solid Non-Hazardous Waste
- Ministerial Decision No (18/93) for the Regulations for the Management of Hazardous Waste.

Omani Permissible Discharge Limits

Omani regulation MD 159/2005 describes the requirements and maximum allowable limits for wastewater discharge to the marine environment. Maximum permissible levels of organic and inorganic pollutants are provided below.

Table 11-1 Limits for Discharge to the Marine Environment

Parameter	Units	Standard
pH	pH Units	6 - 9
Temperature	°C	Δ<10°C
Biochemical Oxygen Demand (5 day BOD)	BOD	20.0
Chemical Oxygen Demand	mg/L	200.0
TSS	mg/L	30.0
Aluminum (as Al)	mg/L	5.0
TSS		30
Arsenic (as As)	mg/L	0.10
Barium (as Ba)	mg/L	2.0
Beryllium (as Be)	mg/L	1.0
Boron (as B)	mg/L	1.0
Cadmium (as Ca)	mg/L	0.010
Chromium (Total as Cr)	mg/L	0.05
Cobalt (as Co)	mg/L	0.05
Copper (as Cu)	mg/L	0.50
Cyanide (Total as CN)	mg/L	0.05
Electrical conductivity (EC)	µs/cm	2000
Faecal coliform bacteria	Number per 100 mL	200
Fluoride (as F)	mg/L	1
Iron (Total as Fe)	mg/L	1
Lead (as Pb)	mg/L	0.10
Lithium (as Li)	mg/L	0.07
Magnesium (as Mg)	mg/L	150
Manganese (as Mn)	mg/L	0.10
Mercury (as Hg)	mg/L	0.001
Molybdenum (as Mo)	mg/L	0.01
Nickel (as Ni)	mg/L	0.10
Nitrogen: Ammoniacal (as N): Nitrate (as NO3) **: Organic (Kjeldahl as N)**	mg/L	5 50 5
Oil and grease (Total extractable)	mg/L	0.50
pH	--	6–9
Phenols (Total)	mg/L	0.001
Phosphorus (Total as P)	mg/L	30
Selenium (as Se)	mg/L	0.02
Silver (as Ag)	mg/L	0.01
Sodium (as Na)	mg/L	200
Sodium absorption ratio (SAR)	--	10

Parameter	Units	Standard
Sulphate (as SO_4)	mg/L	400
Sulphide (Total as S)	mg/L	0.10
Suspended solids (SS)	mg/L	15
Total dissolved solids (TDS)	mg/L	1500
Vanadium (as V)	mg/L	0.10
Viable nematode ova	Number per L	<1
Zinc (as Zn)	mg/L	5

The following are Omani standards for re-use or disposal of sludge resulting from wastewater treatment. The sludge generated from the wastewater treatment may be applied on land for agricultural use (after obtaining permit from MECA for the same), subject to the conditions given in the table below.

Table 11-2 Wastewater Treatment Sludge re-use standards

Metal	Maximum concentration (mg/kg of dry solids)	Maximum Applicable rate (kg/ha)	Maximum permitted concentration in soil (mg/kg of dry solids)
Cadmium	20	0.15	3
Chromium	1000	10.00	400
Copper	1000	10.00	150
Lead	1000	15.00	150
Mercury	10	0.10	1
Molybdenum	20	0.10	3
Nickel	300	3.00	75
Selenium	50	0.15	5
Zinc	3000	15.00	300

After the spreading of the sludge, there must be at least three weeks period before grazing or harvesting of forage crops. Sludge use is prohibited in the following cases:

- On soils whilst fruits or vegetable crops, other than fruit trees, are growing or being harvested;
- For six months preceding the harvesting of fruit or vegetables, which grow in contact with the soil and which are normally eaten raw; and
- On soils with a pH < 7.0.

11.3.2 Lender Requirements

International financial institutions will require adherence to IFC General EHS Guidelines. These guidelines require that projects undertaken:

- Establish waste management priorities at the outset of activities.
- Identify EHS risks and impacts with regards to waste generation and its consequences.
- Establish a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes.
- Avoid or minimize the generation waste materials, as far as practicable.
- Identify where waste generation cannot be avoided but can be minimized or where opportunities exist for, recovering and reusing waste.
- Where waste cannot be recovered, or reused, identify means of treating, destroying, and disposing of it in an environmentally sound manner.

11.4 Overview of Local Waste Management

A December 2016 report by The Public Authority for investment Promotion & Export Development (Ithraa), has provided an overview of waste management on Oman referenced below.

Waste Management Companies

The Oman Environmental Services Holding Company S.A.O.C "be'ah" was established in 2007 and under Royal Decree No. 46/2009, has the legal status as the entity responsible for solid waste management in the Sultanate of Oman.

At present, Be'ah manages Oman's landfills. However, it is likely that new facilities will be built under BOOT or BOT contracts. With the large amount of MSW generated each day by Oman, there are considerable opportunities for waste management facilities.

Tenders - covering a 5 – 10 year period - have been issued to international waste collection operators for different regions in Oman by be'ah.

Municipal Soiid Waste

Uncontrolled dumpsites have existed for many years in Oman - containing mixed waste streams of hazardous and non-hazardous waste. It is estimated that more than 350 dumpsites are scattered across the country. None of these dumpsites have dielectric layers which reduce harmful gas emissions, prevent contamination of soil and the leaking of toxic fluids into groundwater sources.

In a concerted effort to control environmental damage, Be'ah has embarked on an aggressive plan to close all dumpsites and replace them with modern engineered landfills and transfer stations. As the infrastructure is established, outsource contracts are being floated as tenders, whereby experienced international companies will provide municipal waste management services that include pre-collection, collection, transportation, treatment and

disposal. Oman comprises of 11 governorates and based on the quantity of waste and distance, ten contracts have been developed to meet the sultanate's waste management needs.

Hazardous & Healthcare Waste

Healthcare waste has been either incinerated without strict emission controls or dumped in the open. Be'ah plans to establish three major healthcare treatment facilities, mostly based on autoclave technology and four smaller facilities to cater for the needs of remote areas.

As for hazardous industrial waste, in the absence of suitable treatment facilities, this is stored on Oman's industrial estates awaiting a solution or is dumped in open dumpsites. Be'ah has started working on an integrated hazardous waste treatment facility that would

treat almost all types of hazardous waste generated in Oman. The integrated industrial waste treatment facility will include a dedicated waste solidi cation facility; units for thermal, physical and chemical treatment designed to process different types of industrial waste;

as well as landfills. The facility will treat and process waste with maximum safety in accordance with international standards. Be'ah's plan for industrial waste will be carried out in phases

The Thumrait Plant, to be operated by be'ah will serve Dhofar, commissioning is planned for late July 2016. There are plans to construct small treatment units to serve remote areas though this has yet to be defined.

11.5 Potential Impacts

11.5.1 Construction

Waste

During construction, waste will be generated during earthworks, construction of the fences, paths, road accesses and buildings. Due to the underlying soil conditions, the main types of waste generated will be sand and gravel, whilst it is also expected that there may be some rock rubble or harder consolidated soil clusters. As identified in the 'Soil, Geology and Groundwater' chapter, there is a risk of encountering contaminated soils within the project footprint associated with past land use as a construction site laydown area.

Due to the nature of the project type and the construction works being undertaken, there will be a few hazardous materials used, and only expected in low volumes (i.e. without major stores on the site). Such materials may result in fuel containers waste, oily residues, paints, paint cans and wastes from chemical cleaning products.

Although the hazardous fraction of construction waste represents a relatively small portion of the total amount of construction waste likely to be generated, its management requires careful consideration, as the impacts associated with hazardous waste can potentially result in contamination to soils and potentially groundwater, as assessed in the respective sections of this ESIA.

Inappropriate management, storage, handling, transfer or transportation may lead to accidental spills or leaks to the soil or groundwater and potentially could result as a pollution source to receptors. Downstream pollution may also occur off-site, where transportation and management by waste contractors is not effective, or where unlicensed companies are engaged.

Waste streams expected to be associated with the project during construction are listed in the table below.

Table 11-3 Anticipated Waste Streams Associated with the Project

Subject	Construction
Inert	Subsoil and Rock
	Glass
Non-Hazardous	Marine sediments
	Concrete
	Asphalt
	Scrap metal
	Plastic
	Wood
	Municipal waste from construction workers
Hazardous	Contaminated subsoil and rock
	Resins and paints
	Waste oil
	Waste solvents and thinners
	Waste fuel and chemicals
	Batteries
	Used spill kits and clean up materials
Wastewater	Sanitary waste water
	Commissioning wastewater (e.g. hydro-test, steam and acid cleaning)

Wastewater

Wastewater generation during the construction and commissioning phases will include the following key streams:

- Sanitary and Domestic Wastewater;
- Concrete washout;
- Commissioning Wastewater (e.g. from hydro testing and steam cleaning);
- Storm water runoff;

For sanitary and domestic wastewater, it is anticipated that there will be a significant number of workers at the peak period of the construction (numbers of workforce are still to be confirmed, but are unlikely to exceed 1000 for the scale of the project). The quantities of sanitary & domestic wastewater can be estimated as an average of 100 litres/person/day. Therefore, sanitary wastewater as a worst case is estimated to total 100 m^3/day up to at peak periods of construction, for wastewater on-site and at any accommodation areas associated to the construction phase. Wastewater generated on-site area will be stored within septic tanks for removal by a licensed wastewater contractor.

A large portion of the water used during commissioning will be for the testing of the pipes and tanks (hydro testing) and for the cleaning of the equipment (steam cleaning). Such wastewater may contain oily/grease residues and potential low concentrations of heavy metals. This wastewater is expected to be held in a holding tank, tested for quality and may either be removed from site for treatment, or may be discharged directly to the sea if all the required quality standards are met (pending appropriate permit from MECA).

Other water uses such as wetting down of temporary roads for dust prevention will not generate wastewater.

11.5.2 Operation

Non-Hazardous Waste

The operation of the proposed Project will generate small amounts of non-hazardous domestic waste from the operation of the administration facilities and activities of the employees, which are not directly associated with the production processes. This waste can be classified as both recyclable and non-recyclable. Recyclable waste includes paper, tin cans, plastics, cartons, rubber, and glass, while non-recyclables will consist mainly of food residues and other organic waste. The quantity of domestic waste will be small given the few personnel required to run the plant the number of personnel employed onsite.

Other non-hazardous wastes will include organic matter collected via intake entrainment such as: floating matter, algae, mussels, fish or jellyfish. These will be collected by screens prior to the RO processes and will be collected in a container placed by the screening equipment.

Hazardous waste

This fraction of the waste streams can potentially cause significant adverse impacts on human health and the environment if managed inadequately.

Examples of likely hazardous waste streams that may arise during the operation of the Project include the following:

- Used chemical containers and drums;
- Used RO filters;
- Dewatered Sludge:
- Waste oil, oily sludge, waste chemicals;
- Miscellaneous wastes such as batteries:
- General clean-up materials and solvents from general maintenance of on-site plant and machinery.

In regard to dewatered sludge, this will mainly consist of fine inorganic and organic particles suspended in the sea raw water and iron salts produced by the coagulant dosed upstream the filters. The sludge produced in the effluent treatment will be storage in a silo by the effluent treatment plant. It will be removed via trucks for disposal to approved landfill sites.

Wastewater

During operation, the principle wastewater stream will be the discharge of brine and RO backwash to the marine environment (impacts upon the marine environment are as assessed in the 'Marine Environment' chapter of this ESIA). The Brine wastewater will discharge directly into the Indian Ocean where it will mix and dilute with seawater to background concentrations within the projects mixing zone. Given that the brine wastewater is more dense than ambient seawater, it will likely sink through the water column as mixing takes place; such impacts of brine is assessed fully in the Marine Environment Chapter of this report.

The SWRO project is expected to require approximately 20 operational staff, and will generate domestic wastewater from the kitchen and sanitary wastewater from the toilet/bathroom facilities. This wastewater will be treated at the on-site sewage treatment plant to ensure that effluents will meet the appropriate limits. The treated effluent will be mixed with all other treated effluents and discharged at the sea outfall.

Waste streams likely to be associated with the project during operation are listed in the table below.

11.6 Mitigation & Management Measures

Waste Characterization

Waste can exhibit certain characteristics according to the process stream from which it is generated and any pre-treatment processes that are undertaken. Different types of waste require different management and disposal techniques according to the potential risk that the material poses to human health or the environment. In order to categories the different risks to these receptors, it is often useful to demarcate the streams into 3 main categories that effectively equate to the level of the management and disposal which are required for each:

- **Hazardous waste** - materials which pose a potential hazard to the environment or health of employees or the general public;
- **Non-hazardous wastes** - solid materials which are not hazardous and degrade, chemically or biologically in the environment; and
- **Non-water soluble wastes** - materials that do not breakdown in the environment, and are otherwise inert.

Hazardous waste refers to waste with properties that pose danger or can be potentially harmful to human health or the environment. It exhibits any of the following characteristics:

- Ignitibility - Ignitable waste can create fires under certain conditions, are spontaneously combustible, or have a flash point less than 60 °C (140 °F). Examples include waste oils and used solvents.
- Corrosivity - Corrosive wastes are acids or bases (pH less than or equal to 2, or greater than or equal to 12.5) that are capable of corroding metal containers, such as storage tanks, drums, and barrels.
- Reactivity - Reactive waste are unstable under "normal" conditions. They can cause explosions, toxic fumes, gases, or vapours when heated, compressed, or mixed with water. Examples include lithium-sulphur batteries and explosives.
- Toxicity - Toxic waste are harmful or fatal when ingested or absorbed (e.g., containing mercury, lead, etc.).

It is considered likely that the proposed project may use or generate hazardous materials in all of the categories listed above during the construction and/or operational phases.

Waste Management Hierarchy

The waste management hierarchy is a well-known method for ensuring appropriate and sustainable use of resources and waste by Preventing, Reducing, Re-using, Recycling, Recovering and Disposing of waste. The hierarchy as illustrated below should form a key element of any waste management strategy and if implemented effectively will achieve maximum reductions on waste quantities combined with the limited use of resources and landfill space. The waste management hierarchy also has the potential to reduce costs that

may be incurred by the main contractor or the proponent for handling, transportation and the disposal of waste.

Figure 11-1 Waste Hierarchy

Initially, options to prevent or reduce waste should be considered. Where waste generation cannot be avoided or further reduced at source, opportunities for reuse of materials should be explored, either for use for the same or a different purpose. Disposal to landfill is the least favoured option in the waste hierarchy and is the last resort after all other options have been considered.

Such an approach is also used in other areas of the world. The US-EPA's Waste Minimisation Program presents the following objectives:

- Complete elimination of, or substitution for priority chemicals, wherever possible;
- Minimising the amount of priority chemicals used whenever elimination or substitution is not possible;
- Maximising recycling whenever elimination, substitution, or minimisation is not possible, creating closed loop materials management systems that eliminate or constrict release pathways;
- Promoting cradle-to-cradle waste management instead of cradle-to-grave waste management.

11.6.1 Construction

Table 11-4 Solid Wastes – Management Measures for Construction

Impact/ Source	Management Measures
Waste Management	A site waste management plan will be developed and implemented in accordance and consistent with the provisions of the CESMP.
Solid waste volumes/quantities	Where appropriate, waste concrete and masonry can be re-used in road construction and base fillings.
	Where appropriate, waste timber generated can be reduced through ensuring accurate measurements and orders are placed, and re-use for general construction purposes.
	Where appropriate, waste metal can readily be recycled, 100% of this waste stream can be eliminated, through sale to local scrap metal dealers.
	Where appropriate, it is conservatively estimated that 80% of oils can be refurbished or reused through energy recovery.
	Ordering materials that have reusable packaging and/or in bulk can significantly reduce waste generated.
	Suppliers will be requested to use minimal packaging. Where possible, chemicals will be ordered in returnable drums. "Buy-back" arrangements will be made with key suppliers so that any surplus chemicals or materials can be returned;
	Refillable containers will be used, where possible, for collection of waste fluids such as waste oil, hydraulic oils, and used grease.
Housekeeping	Separation of waste streams to facilitate recycling.
	Mandatory training program for employees to increase their awareness of waste management protocols including proper handling and storage of waste, and emergency response and contingency plans.
Waste Storage	Adequate storage facilities for non-hazardous waste storage in designated areas to prevent waste from dispersing throughout the site.
	Food waste must be stored within a sealed metal or plastic skip or bin, in order to prevent vermin/pests gaining access.
	Lightweight waste e.g. paper, cardboard, plastics: Must be stored within a skip sealed with a secured tarpaulin/netting sufficient to prevent any material being dispersed.
	Heavy waste may be contained within an open skip, providing that segregation occurs effectively enough to remove all lightweight material that could be blown away.
	All storage areas will be well organised and waste appropriately managed through segregation of hazardous and non-hazardous waste. Waste within each category will be further segregated by type (paper, plastic, metal) and whether the material is recyclable or non-recyclable. Construction waste will be separated into combustible and non-combustible, and all flammable substances must be kept away from sources of ignition.
	For litter (food waste, domestic waste), an adequate number of bins will be placed throughout the site at locations where construction workers and staff consume food. These will be regularly collected and taken to the main waste storage area. On-going housekeeping training will be provided to all staff on the importance of the need to avoid littering.

Impact/ Source	Management Measures
	Waste containers will be clearly marked with appropriate warning labels to accurately describe their contents and detailed safety precautions. Labels will be waterproof, securely attached, and written in English and Arabic. Wherever possible, chemicals will be kept in their original container
	Waste generated during construction will only be transported off-site for disposal by an appropriately licensed contractor. This contractor will follow the proper protocols to ensure that all waste handling and disposal from the site is carried out according to accepted environmental regulations. A record for all streams of generated waste Including chains of custody) will be kept onsite by EPC.
Hazardous Waste	Implement best practice and regulations procedures for adequate handling, establishment of secure temporary storage areas, and disposal of waste by approved contractors.
	Procedures and rules will be developed for hazardous waste handling. Training in regard to this procedure will be provided to those staff involved in hazardous waste handling.
	Hazardous waste shall be stored temporarily in bunded containers stored in dedicated, covered storage areas with impermeable bases, sufficient containment capacity, ventilation, and equipped with spill kits. The bunded base will have the capacity to contain 110% of the total volume of stored materials. This area must be placed away from any sources of ignition.

Table 11-5 Construction Wastewater Management

Impact/ Source	Management Measure
Wastewater Management	A site wastewater management plan will be developed and implemented in accordance and consistent with the provisions of the CESMP.
Sanitary wastewater	Toilet blocks with in-built septic tanks will be installed on site and at the labour accommodation and administration buildings. The septic tanks will be above ground where possible, though if buried will be placed in secure areas, away from general vehicle traffic, in order to prevent any damage to the tanks.
	The number of toilet blocks and septic tanks will be increased in proportion to the increased number of workers on site.
	No treated or untreated sanitary wastewater shall be discharged on site or directly to areas off site.
	Site inspections will be carried out regularly by the EPC contractor to ensure that all wastewater generated is properly managed, and no leakages or spill over occur. In the event of a spill or overflow, immediate action will be taken in accordance with spill containment procedures and clean up procedures (to be developed in line with the CESMP).
	In common with the IFC EHS Guidelines, effort will be made in training construction personnel to minimise water consumption for ablutions and to ensure an understanding of water resource and wastewater issues.
	Prior to demobilisation from the construction site, the EPC contractor will develop procedures for the removal of septic tanks to ensure that contamination to the site or accommodation area does occur during the demobilisation period.

Impact/ Source	Management Measure
Construction Wastewater	Oily wastewater (e.g. from hydro testing and steam cleaning) will be treated via interceptors, or the on-site oil/water separator (if functioning at this time). A specialist contractor will remove the recovered oil for recycling. Any residual sludge will be taken to a licensed hazardous waste facility.
	If required, a dedicated area for vehicle and machinery maintenance (lubrication, oil and filter changes, repair work, etc.) will be established on site. This is to include an impermeable surface and side bund/gutter collection.
	Considered should be given to the construction of a settlement basin to retain water until particles have settled. Wastewater from the cleaning of concrete trucks that could include cement and concrete waste should be directed to this basin. The water part can be used for wetting down of unpaved roads, stockpiles and excavations.
	Treated effluents that cannot be re-used on site, must be removed by a licensed contractor and taken to a licensed disposal point or external licensed treatment facility.
	Following the completion of construction, all wastewater storage provisions and containment systems must be duly dismantled. The dismantling shall include the final drainage of any existing water and sludge, removal of impermeable linings, filling of any excavated pits and assurance that the land is re-instated to its initial state. All excess products must be taken to an appropriate waste management facility for treatment/disposal.
	Measures to minimise water use during commissioning, such as recycling shall be implemented by the contractor. These include re-use of the hydro-testing water, until this phase of testing is completed and the water is no longer serviceable. Subsequently, the wastewater will be sent to the evaporation pond.

11.6.2 Operation

Table 11-6 Solid Wastes –Management Measures for Operation

Impact/ Source	Management Measures
Waste Management	A site waste management plan will be developed and implemented in accordance and consistent with the provisions of the OESMP.
Waste Volumes and Hazardous Wastes	Segregation and storage of different types of waste in separate labelled containers, to promote the re-use and/or recycling of materials.
	Use high quality raw material to reduce the quantities of waste generated.
	Reduce packaging of materials and order in bulk. If appropriate, request supplier to minimise packaging. Recycle paper, metal, plastic and packaging.
	Undertake regular inspections, audits, and monitoring of waste streams generated to ensure that all necessary management measures are being implemented.
	Hazardous waste shall be stored temporarily in bunded containers stored in dedicated, covered storage areas with impermeable bases, sufficient containment capacity, ventilation, and equipped with spill kits. The bunded base will have the capacity to contain 110% of the total volume

	of stored materials. This area must be placed away from any sources of ignition.
	Hazardous waste will be collected and transported by appropriately licensed transporters to approved hazardous waste disposal sites. Consignment details and records of the hazardous waste generated shall be maintained in the facility.
	Only trained personnel will be permitted to handle hazardous waste.
	General household and domestic waste generated by Project staff will be stored in clearly marked containers. Separate colour coded and labelled waste bins will be provided at several locations throughout the Project site.
	Training will be provided to employees to increase awareness of waste management including proper waste; training and orientation on waste minimisation, segregation and good housekeeping practices.

Table 11-7 Wastewater – Management Measures for Operation

Impact/ Source	Management Measures
Wastewater Management	A site wastewater management plan will be developed and implemented in accordance and consistent with the provisions of the OESMP.
Wastewater	Where not treated at the wastewater treatment facilities on-site, liquid wastes and wastewater (containing hydrocarbons, lubricants, and solvents) should be appropriately contained and disposed. A licensed contractor will remove the recovered oil for recycling. The project will install monitoring devices at the treatment plant and at the outfall to demonstrate compliance with applicable treatment and discharge standards.

12 ARCHAEOLOGY AND CULTURAL HERITAGE

12.1 Introduction

This chapter describes the potential impacts and effects that may occur as a result of the projects construction and operational activities to archaeology and cultural heritage and identifies the measures that will be undertaken and implemented in order to mitigate these impacts.

The study area assessed in this section is delineated as follows:

- The projects footprint;
- Construction working areas;
- The projects access road.

This section includes the following:

- Applicable cultural heritage and archaeological regulations and best practice guidelines;
- Baseline observations and information from secondary sources;
- Identification of any specific cultural or archaeological receptors;
- Identification of potential impacts relating to the projects construction;
- Potential Impact Assessment;
- Mitigation & management measures (Construction phase only); and
- Assessment of residual impacts following the application of mitigation & management measures.

The cultural heritage and archaeological assessment takes into account that archaeological and cultural resources are finite and therefore consideration for their preservation will always be addressed.

For the purpose of this assessment, these resources may include, but not be limited to:

- Archaeological remains, buried and/or above ground;
- Historical structures and sites e.g. tombs or forts; and
- Any other structure of archaeological and/or cultural/historical significance.

12.2 Scoping Outcome

Impacts associated with the construction and operational phases of this project have been assessed to be scoped in or out of detailed assessment within this ESIA. A list of the potential

project impacts and the scoping decision from the scoping report are detailed in the following table.

Table 12-1 Cultural Heritage & Archaeology Impacts for Detailed Assessment in the ESIA

Potential Impact	Scoped In/Out of ESIA	Justification
Construction		
Damage to Unknown Buried Archaeology	**Scoped In**	Impacts are generally not expected due to the lack of cultural or known archaeological features at the project site. However, due to the rich heritage of the local area, the impacts cannot be scoped out at this stage.

12.3 Standards and Regulatory Requirements

12.3.1 Omani Requirements

The safeguard of cultural heritage and archaeology in the sultanate of Oman is established through the 1980 Law on the protection of National Cultural Heritage as implemented though the Ministry of Heritage and Culture.

12.3.2 Lender Requirements

International financial institutions will require adherence to IFC Performance Standard 8, which requires the identification and protection of features of cultural heritage value.

12.4 Observations and Baseline Conditions

Historically, Salalah holds many important archaeological sites such as the ruins of the coastal town of Al Baleed, ruins of ancient buildings in Raysut and remains of a fort at Ayn Hamraan. It is also an attractive tourist destination for its geological beauty that ranges between beaches, mountains, and wadis.

The wider Dhofar Governorate has a large number of archaeological sites of regional and national significance, including ruins of the ancient city of Dhofar at Khawr Baleed, which was extensive in the 14th century as a port for the export of frankincense.

The closest know archeologically site is located is the Sumhuram Archaeological Park, part of the UNESCO World Heritage List, 'Land of Frankincense' designation. This area is located adjacent to the Khawr Rawi Nature Reserve and incorporates a recognised important archaeological site. The remains found on the banks of the reserve are understood to be associated with an outpost dating back to the 3rd Century BC – 1st Century AD. The ancient site is described as the most important pre-Islamic settlement in the Dhofar region and in the

centre of frankincense production areas. Protected by a natural harbour and on the lagoon of Khor Rawi, Sumhuram, was an important seaport with a vast international trading network.

Plate 12-1 Sumhuram Archaeological Park

Figure 12-1 Archaeological Remains at Sumhuram Archaeological Park

The Sumhuram Archaeological Park is located approximately 5km from the proposed project footprint, and as such will not be affected by the works.

During the desk based study and the site visit, no signs or visual evidence of cultural/archaeological artefacts, objects or structures were identified within the Project site. Due to the active history in the Dhofar region, it is however possible that unknown archaeological remnants may be present on the project site. Any items that were located above ground would likely have been uncovered during past works for the laydown area of the Salalah IWPP.

In December 2017, 5 Capitals staff visited the Ministry of Culture and Heritage in Salalah to request baseline information regarding any known or present archaeology or cultural features in the footprint of the project site or in the immediate local area (including associated facilities). Further to the meeting (see notes in ESIA Consultation section previously), the Ministry requested a formal letter to be issued as a request for information. The letter was prepared in Arabic (ref. Appendix K) and issued directly to the offices. To date, a response hasn't been received, however, it is the intention that if there are instances of known archaeology in the project footprint, or immediate working areas that these would be managed under a specific cultural heritage management plan, as part of the respective construction/operational ESMS'.

12.4.1 Sensitive Receptors

Table 12-2 Archaeology and Cultural Heritage – Sensitivity of Receptors

Receptor	Sensitivity	Justification
Undiscovered artefacts within the Project Area	**Low**	Archaeology may be of importance of a local scale

12.5 Potential Impacts

12.5.1 Construction

The current project site has been subject to previous earthworks and is unlikely that impacts to archaeology will occur. It is anticipated that any unknown buried features would have been identified during previous earthworks. Given the historical land use of the region as well at the documentation of the nearby Khawr Rawi UNESCO World Heritage Site, the likelihood that artefacts may be uncovered during earthworks should however be considered.

In particular, construction activities, particularly those relating to earthworks and excavations have the potential to cause disturbance or damage to any unknown buried archaeological

or cultural features. The resulting impacts may result in the loss of such features or degradation of their preserved quality.

Where there is risk to unknown archaeology, this will be addressed by best practice mitigation measures during the construction phase. The intention is to include the mitigation and management measures included to this ESIA into the respective CESMP for effective management and implementation on-site. This would link to a chance finds procedure to be developed during the construction phase, to establish the protocol for ensuring that any finds are managed and handled appropriately.

Table 12-3 Cultural Heritage and Archaeology - Magnitude of Construction Impacts

Impact	Magnitude	Justification
Destruction of unknown archaeological remains onsite	**Major Negative**	Construction activities could cause the destruction or part destruction of archaeological remains onsite, resulting in damage or loss of the archaeological features.
Effects on off-site archaeological sites	**No Change**	Construction activities will have no impacts on archaeological sites outside the project boundaries.

Table 12-4 Cultural Heritage and Archaeology - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Destruction of unknown archaeological remains onsite	Major Negative	Undiscovered artefacts within the Project Area	Low	**Minor or Moderate**
Effects on off-site archaeological sites	No Change	Identified archaeological sites	High	**Neutral**

12.5.2 Operation

As earthwork activities will be limited to the construction phase, impacts to unknown buried archaeology are not expected to occur during operation.

12.6 Mitigation & Management Measures

12.6.1 Construction

Table 12-5 Archaeology and Cultural Heritage – Mitigation during Construction

Impact	Mitigation
Damage to undiscovered artefacts	Tool Box Talks will be provided to the workforce in relation to the identification of potential archaeology. These will include processes linked to the Chance Finds Procedure for stopping works and informing the Ministry for Culture and Heritage.
	A chance finds procedure will be developed during construction as part of the CESMP. This will include protocols to stop works and methods preserve potential finds, as well as reporting requirements and co-ordination with the Ministry of Heritage and Culture.

12.6.2 Operation

Mitigation and management measures are not considered necessary for operation.

12.7 Residual Impacts

12.7.1 Construction

Archaeology and Cultural Heritage – Residual Impacts - Construction

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Damage to undiscovered artefacts	Undiscovered artefacts within the Project Area	Slight or Moderate	✓	**Minor**

12.8 Monitoring

12.8.1 Operation

The minimum expected requirements for the monitoring are outlined in the table below. The final monitoring methodology with specific monitoring details (i.e. locations, frequencies, durations, parameters etc.) will be developed in the specific 'Environmental Monitoring Plan'.

Table 12-6 Minimum Monitoring Requirements: Archaeology

Monitoring	Parameters	Frequency & Duration	Locations	Standards
Construction				
Archaeology	Undiscovered artefacts within the Project Area	Daily continued visual observations by site staff involved in excavations.	In all areas requiring land grading or earthworks.	Any applicable regulation, includes IFC PS8.

13 LANDSCAPE AND VISUAL IMPACTS

13.1 Introduction

This chapter describes the potential impacts and effects that may occur as a result of the projects construction and operational activities and identifies the measures that will be undertaken and implemented in order to mitigate these impacts. The assessment of impacts has been measured against applicable Omani, International Finance Corporation (IFC) standards, guidelines & regulations; or best practices.

The study area assessed in this section is delineated as follows:

- The projects footprint;
- Construction working areas;
- The projects access road.

This section includes the following:

- Applicable landscape and visual impacts best practice guidelines;
- Baseline observations;
- Identification of landscape character and any specific visual receptors;
- Identification of potential impacts relating to the projects construction phase;
- Potential Impact Assessment;
- Mitigation & management measures; and
- Assessment of residual impacts following the application of mitigation & management measures.

13.2 Outcome of Scoping Report

Impacts associated with the construction and operational phases of this project have been assessed to be scoped in or out of the ESIA for detailed assessment. A list of the potential impacts as well as a justification of why they have been scoped in or out during the ESIA is detailed in the following table.

Table 13-1 Potential Landscape and Visual Impacts for detailed Assessment at the ESIA

Potential Impact	Scoped In/Out of ESIA	Justification
Construction		
Change in Landscape Character	**Scoped Out**	Impacts in regard to landscape and visual impacts are likely to be minimal and are therefore not scoped in for further assessment.
Reduction in Visual Amenity	**Scoped Out**	

13.3 Standards and Regulatory Requirements

There are no Omani or applicable international standards and regulations regarding Landscape and Visual Impacts for projects.

13.4 Observations and Baseline Conditions

13.4.1 Landscape Character

The wider landscape to the north of the project site is dominated by an undulating horizon of mountainous terrain and valley slopes predominantly free of vegetation and development. Some patches of vegetation are evident, which are anticipated to become more apparent during the Khareef season.

The project site is located on a cliff top plain that is relatively flat and free of vegetation. Soils in the project area provide distinctive sandy orange/brown colouration, which is widespread locally. To the immediate north of the project site is a wadi channel that forms a wide corridor within the landscape.

Although largely static, the landscape in the Salalah area and southern part of Dhofar Governorate is dynamic during the Khareef season as the tail end of the Indian Monsoon brings sustained light rain and grey skies to the area for several months. The landscape changes and becomes green as vegetation grows.

The local project areas on the clifftop plain is becoming more developed over time and is starting to develop a more industrialised feel. This is affected primarily by the Salalah IWPP, as well as temporary worker accommodation for the highway construction works that also includes a construction laydown area.

Plate 13-1 Wider Landscape to the North (photo during Khareef Season)

Plate 13-2 Wadi to the North of the Project Site

At the southern extent of the main project site is a steep cliff that leads to a sandy beach prior to the Indian Ocean. Besides the rock armour protection on the adjacent Salalah IWPP intake and outfall structures, the seascape as viewed from the site is free of peninsulas or island outcrops.

Plate 13-3 Cliff and Slope Towards the Sea

Figure 13-1 Seascape from Project Site

13.4.2 Visual Amenity

Although the local area has limited development, the project site is located adjacent to the Salalah IWPP, an industrial facility of importance within Dhofar Governorate. The Salalah IWPP consists of 1-2 storey buildings, turbine structures, several stacks and bulky cooling tower units. These facilities and structures are prominent above the cliff top landscape due to the vertical intrusion above the horizon.

The Salalah IWPP does however provide visual shelter to areas to the west of the proposed project site, due to the vertical instruction. This includes blocking of the project site form the local Scout camp, camel herder shelters and temporary worker accommodation for the Highway works.

Figure 13-2 Typical from Project Site to Salalah IWPP

13.4.3 Sensitive Receptors

The only anticipated visual receptor for the site is the adjacent Salalah IWPP. There are few other permanent local receptors in the local area that have views directly to or over the proposed project site.

Table 13-2 Potential Landscape and Visual Receptors

Receptor	Sensitivity	Justification
Landscape Character	**Medium**	The landscape is of medium to high importance on a local and regional scale, with limited potential for substitution. This is primarily due to the seasonal effects of the Khareef on the landscape that are unique to this region of Oman.
Visual Amenity - Salalah IWPP	**Low**	As an industrial facility, the visual amenity from such features are less sensitive to change.

13.5 Potential Impacts

13.5.1 Construction

Landscape Character

Impacts upon the landscape character will occur where the landscape will visibly or intrinsically change due to development, or other changes such as adjustments in topography, vegetation type and coverage, or other factors. in situations where the visual horizon is disturbed by a development. Such impacts may include the anthropogenic intrusion of the landscape by buildings/structures where no intrusion previously existed; or the change in the landscape character of an area, which could arise from new/out of place development or from changes in the land use.

In the initial stages of the construction, the contractor will commence with levelling, grading and preparation for development. As the site is relatively flat and barren, there will be little change in topography and vegetative cover. The construction equipment and facilities required will return the site to it previous temporary character that was experienced during the construction of the Salalah IWPP.

The local landscape at the project site has a growing industrialised character. The development of the Salalah IWP project will further enhance this feeling, although the impacts will not be unprecedented, as the structures will be of a similar nature to the adjacent Salalah IWPP.

Visual Impacts

Visual impacts may occur when the line of sight to and/or from a receptor (e.g. residential areas, area of natural beauty) is intersected or blocked.

Given the absence of any permanent residential or commercial receptors, the impacts associated with this phase of the project are discernible. Views to the project site from the Scout Camp, camel herder shelters and temporary worker accommodation area are expected to be screened by the Salalah IWPP.

Table 13-3 Landscape & Visual Impacts - Magnitude of Construction Impacts

Impact	Magnitude	Justification
Change to Landscape Character	**Minor Negative**	Local changes to the landscape may result in some minor losses of amenity locally, and are not expected to be unprecedented duet to similar development at the adjacent existing Salalah IWPP.
Visual impacts	**Minor Negative**	The project will be located immediately adjacent to an existing facility of a similar nature. Impacts to visual amenity will be minor and may result in some noticeable change to receptors.

Table 13-4 Cultural Heritage and Archaeology - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Change to Landscape Character	Minor Negative	Landscape Character	Medium	**Minor**
Visual impacts	Minor Negative	Visual Amenity - Salalah IWPP	Low	**Negligible or Minor**

13.5.2 Operation

Once operational, the project will continue to contribute to the developed feel of the project area. Given the size of the proposed plant in relation to the adjacent IWPP, it is anticipated that the IWPP will remain the most prominent landscape feature in the vicinity.

The design of the project and the related buildings have been developed focusing on the combination of operational suitability and efficiency while ensuring minimization of the environmental and visual impact, by utilizing cultural features in design. Please see example below of the building design, which has sought to use local architectural design and features.

Figure 13-3 Salalah IWP Cultural Building Design

The site area will be visible at night due to the requirement for security lighting and the on-going continuous operations of the project.

Table 13-5 Landscape & Visual Impacts - Magnitude of Construction Impacts

Impact	Magnitude	Justification
Visual impacts - Lighting	**Minor Negative**	A new area of land will be illuminated at night time, but will appear to adjoin to the existing Salalah IWPP facility,

Table 13-6 Cultural Heritage and Archaeology - Significance of Construction Impacts

Impact	Magnitude	Receptor	Sensitivity	Impact Significance
Visual impacts - Lighting	Negligible Negative	Visual Amenity - Salalah IWPP	Low	**Negligible or Minor**

13.6 Mitigation & Management Measures

13.6.1 Construction

Table 13-7 Landscape and Visual – Mitigation Measures during the Construction Phase

Impact	Mitigation
New features in the landscape	Where appropriate, construction laydowns and working areas on and off the site shall be screened to reduce the visual intrusion to existing off site receptors. When not in use, cranes and other construction plant hall be lowered, so they are at their minimum height and do not protrude unnecessarily within the visual envelope of local receptors.
New features impacting views	Mitigation & Management Measures relating to the generation of dust (as detailed in the air quality mitigation section) shall be implemented to ensure that visual impacts are not caused through construction activities.
Light Pollution	Any flood lights required during night time will be directed onto the working areas, with a maximum position angle of 30° from vertical, and back spill shields, therefore minimising any unwanted light spill and impacts at night.

13.6.2 Operation

Table 13-8 Landscape and Visual – Mitigation Measures during the Operational Phase

Impact	Mitigation
Light Pollution	Any flood lights required during night time will be directed onto the working areas, with a maximum position angle of 30° from vertical, and back spill shields, therefore minimising any unwanted light spill and impacts at night.

13.7 Residual Impacts

13.7.1 Construction

Archaeology and Cultural Heritage – Residual Impacts - Construction

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Change to Landscape Character	Landscape Character	Minor	✓	**Minor**
Visual impacts	Visual Amenity - Salalah IWPP	Negligible or Minor	✓	**Negligible or Minor**

13.7.2 Operation

Archaeology and Cultural Heritage – Residual Impacts - Operation

Impact	Receptor	Impact Significance	Mitigation	Residual Impact Significance
Visual Impacts - Lighting	Visual Amenity - Salalah IWPP	Negligible or Minor	✓	**Negligible**

13.8 Monitoring

Landscape and visual impacts will not specifically be monitored, however, any landscape or visual based grievances received via the grievance mechanism will be monitored for follow up.

14 SOCIO-ECONOMICS

14.1 Introduction

The primary purpose of this chapter is to identify specific management measures in regard to factors that may affect socio-economic conditions, and where practical to recommend management measures, which may either reduce negative impacts or ameliorate positive effects.

It is the intention of this chapter that the identified management measures will be consolidated into the specific CESMP & OESMP's (and/or complimentary management plans/ procedures) to be implemented during the construction and operational phases respectively.

This section includes the following:

- An overview of the local socio-economic condition;
- Local and site observations;
- Identification of potential impacts relating to the projects construction and operation; and
- Management measures to reduce negative impacts or ameliorate positive effects (Construction and Operational phases).

14.2 Outcome of Scoping Report

Impacts associated with the construction and operational phases of this project have been assessed to be scoped in or out of detailed assessment in the ESIA. A list of the potential impacts as well as a justification for the scoping decision is detailed in the following table.

Table 14-1 Socio-Economic Impacts for detailed Assessment in the ESIA

Potential Impact	Scoped In/Out of ESIA	Justification
Construction & Operation		
Land Use Change & Restrictions on Access	**Scoped In**	During the site visits a small camel herd was observed on-site. Although the project will not result in land acquisition, it is necessary for the ESIA to identify any informal land users and the rights of these land users, to determine what (and if any) mitigation measures, or compensation requirements may need to be issued to such users.

14.3 Standards and Regulatory Requirements

14.3.1 Lender Requirements

International financial institutions will require adherence to the following:

IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement

Establishes requirements associated with to physical and/or economic displacement as a result of project-related land acquisition and/or restrictions on land use.

IFC Performance Standard 7: Indigenous Peoples

Establishes requirements to ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples.

14.4 Observations and Baseline Conditions

Socio-Economic

Dhofar is the largest of the eleven Governorates in Oman. It is located on the southern region of the Sultanate, on the coast of the Arabian Sea by the Oman / Yemeni Border.

The National centre for Statistics and Information of the Sultanate of Oman issued their latest Population Statics on July 2016. According to the report, the total population of Oman is 4,414,051, the population of Dhofar Governorate is 434,952. The Majority of the population are male expatriates between the ages of 29 and 34.

The largest city and within Dhofar is Salalah, where 81% of the Dhofar population resides. Historically, during the 13th century, Salalah was a key player in the incense trades. Salalah currently houses one of the largest ports in the Arabian Peninsula connecting Africa, the Middle East and Asia.

The majority of the Omani population in Salalah is Muslim, Arabic is the official written and spoken language. The unofficial and unwritten language used by some people locally is known as the Shehri or Jebali (of the mountain tribes), a language that belongs to the Semitic Languages. This language is occasionally spoken amongst the people in Salalah as well as Arabic.

Land Ownership

The project site is owned by the Ministry of Housing (ref. Krooki in Appendix D) and will be leased under a Land Lease Agreement for the duration of the construction and operational phases. Therefore, no land acquisition or compensation will be required.

There are no permanent residential settlements or community provisions within or adjacent to the proposed project area, the only facility being the Salalah IWPP and the nearby Scout camp. Other features are temporary, or are used seasonally.

Access to the proposed project site is only available via the access road for the IWPP and a gravel track to the north of the plant. There are no existing through-routes or expectations for the general public to visit the area.

Land Use

The projects land is not used under any formal use and was rehabilitated in 2016 following use as the construction laydown and staging area for the Salalah IWPP project.

During the site visit made in summer 2016 camels were observed on the site lands and were grazing on the remnants of the landscaped areas that had been developed for the Salalah IWP temporary offices. These landscaped areas, as well as all organic matter and other vegetation have now been removed. The remainder of the site is barren and provides little opportunity for any grazing. Camels were however observed to be grazing on shrubs in the wadi to the north of the project site during the summer 2017 visit. These camels were using an access point along the planned project access road as a means of entering the wadi. During the site visit in December 2017, there was no sign of the camels in the local area, and it was made clear by Salalah IWPP staff during the consultations that their presence is seasonal in this area; and during the Khareef season.

14.4.1 Sensitive Receptors

Camel Herder Camp

During the site visits, en-route to the proposed project site, several small temporary camel herder camps were noted on the hillside to the north, more than 1km from the project site. In addition, a small number of temporary herder shelters were identified close to the existing access leading to the Salalah IWPP, approximately 2km form the proposed project site.

Figure 14-1 Temporary Camel Herder Camp (July 2017)

Consultation with the Salalah IWPP and other informal discussions with local people has indicated that the presence of the camels (and their herders) in the local area is a seasonal activity during the Khareef. It is undertood that at other times of the year, the herders take the camels inland to the mountains. At the time of the visit in December 2017 there was no sign of camel activity in this area and the temporary structures had been de-mobilised, as shown in the image below.

Figure 14-2 Temporary Camel Herder Camp (December 2017)

During the consultation, Salalah IWPP staff indicated that herders are permitted access to accessible land in the area for grazing. This primarily includes grazing and movements along the cliff top plain between Khawr Rawri and the Salalah IWPP (to the west of the proposed IWP), as well as some movements via the wadi (to the north of the proposed IWP).

Access to the proposed Salalah IWP project site by the camels is possible, and was observed during a visit in Summer 2016. Access to this area was either made via the wadi (as observed in 2016), or via the proposed project access road corridor to the rear of the Salalah IWPP. Since the site rehabilitation in 2016, there is no potential for grazing due to the barren nature of the land and lack of vegetation; as such there have been no further siting's of the camels using or in proximity to the site.

Scout Camp

The Scout Camp is a permanent collection of small 1-storey buildings situated on the cliff top plain approximately 1km to the west of the existing Salalah IWPP. The access to the Scout Camp is situation on the same hardstanding access road that leads to the Salalah IWPP and will ultimately also provide access to the project site during both construction and operation.

During the site visit undertaken in summer 2017, the consultants spoke with staff at the Scout Camp who explained the purpose of the area and that the camp is used for approximately 2-weeks a year for short duration residential visits and activities; during the Khareef season.

Plate 14-1 Scout Camp Buildings

Temporary Worker Accommodation for Highway Works

A temporary accommodation area for the local highway works is located approximately 1.2km west of the proposed project site and can be accessed via the same existing access road as the Scout Camp and Salalah IWPP. The accommodation area includes cabins, and also a construction laydown areas where equipment and vehicles are stored.

From the ESIA consultations undertaken in December 2017, it is known that there are approximately 500 residents at the camp which is managed by the Galfar Construction company. The camp and laydown area will largely be demobilised subsequent to the end of the highway construction works (originally scheduled for completion by March 2018, but likely to be completed by July 2018). Approximately 50 Galfar staff will remain at the camp after this for other project work in the Dhofar region.

Plate 14-2 Temporary Worker Accommodation for Highway Works

Figure 14-3 Satellite Imagery of Temporary Worker Accommodation Area (Source: Google Earth)

14.5 Potential Impacts

14.5.1 Construction

Economic Factors

The primary economic impact during construction is likely to result from employment creation during this phase. As well as the direct monetary uplift to the families of those employed, money paid to workers will also stimulate the local economy via the multiplier effect, whereby money earned on the project expended locally will re-circulate within the local economy. Whilst we have no evidence quantifying the multiplier effect within Oman, studies undertaken in Europe and the US suggests the impact of expenditure on a local economy prior to leakage to be in the order of 4:1.

In addition to the direct monetary impact of employment created during construction, there also exists the potential for the project to promote the dissemination of construction and construction support skills from expatriate workers into the local labour force.

A secondary impact that is likely to arise from spending on local and foreign goods and services during the construction process. The nature of the development, and specialised

nature of required materials, suggests that these will be sourced internationally, apart from construction materials (e.g. concrete etc.).

Local Access

Observations of camels on the project land in 2016, and in the wadi to the immediate north of the project, indicates that the wadi and proposed site access road corridor to the north to the Salalah IWPP is being used by the camels and herders to traverse west to east in this area. It is therefore possible that unless otherwise managed, access to movements may be restricted temporarily during the construction phase due to the access road preparations in this corridor.

Figure 14-4 Project Access Road Alignment

Land Use

It is unlikely that the project will have a negative impact on local receptors, as there are no identifiable uses of the projects land, particularly following the rehabilitation of the project site in 2016 to open plat and barren ground; following use as a construction laydown area. However, there is potential for adverse perception of the project from local people and camel herders associated with land-use change affiliated with the project.

Impacts to Other Receptors

It Is not expected that any direct impacts will occur upon other local receptors such as the Scout Camp and temporary worker accommodation area. Secondary impacts as a result of construction phase such as additional traffic flows may impact upon the access road, as construction vehicles travel to the project site. Such impacts are not expected to be significant on these receptors.

14.5.2 Operation

Utilities

At a strategic level the operation of the SWRO facility offers potential to support the continued growth of the local and national economies, through the ability to provide an important source of potable water to the Omani potable water network.

Economic Factors

As with the construction phase, a significant economic impact during operation will result from any local employment created by the project. Whilst the size of the required workforce is significantly smaller, the type of work and the increased time-scales involved offer an opportunity for greater dissemination of skills. A targeted system of local recruitment and investment in the human capital of the local workforce will enhance this process and consequently increase the benefit to the local economy.

Local Access

Local access to land to the east of the project will not be unduly affected during operations, as the projects access road will be publicly available. This will allow the movements of local populations and as necessary camels & herders.

14.6 Mitigation & Management Measures

Mitigation and monitoring measures associated with the Socio-Economic aspect of the project will be addressed in the HR Policy and related procedures, training provisions and supply chains.

14.6.1 Construction

Table 14-2 Socio-Economic – Management Measures during the Construction Phase

Impact / Source	Management Measures
Local Access	During construction, the project will need to ensure that a safe and accessible route for camel herders is maintained along the proposed access road alignment. This shall enable herders to move freely to the east and west of the project along the cliff top plain without severance, or hindrance to movement.
Population Influx	Population influx will be minimised where possible by employment of local sub-contractors and existing workforce populations at the construction phase. The projects recruitment policy will ensure a preference for local workers where suitable applicants and local companies are available.
	First Aid facilities and clinic room will be available to construction personnel on-site. This will reduce demand upon existing local services in regard to the additional population during construction.
Employment Opportunities	The EPC and Sub-Contractors HR Policy will be prepared to ensure consistency in line with local labour laws and international ILO and UN conventions. The EPC Contractor is to ensure that this is applied as an overarching policy for all sub-contractor company HR policy as part of their contractual arrangements.
Training and Dissemination of Skills	All project workers will receive induction training at the project, as well as vocational specific training for on-site construction works.
	All workers will receive training in regard to health and safety, as well as environmental awareness.
	Tool-Box talks will be conducted before work on each day to ensure workers are reminded of key topics.

Education of locals	An information board for project related information will be erected at the project main entrance. Access to the projects grievance mechanism will also be made available at the site entrance.
	Appropriate dialogue signage and notification will communicate any key construction related events to the local communities (as applicable).
Demand on Utilities	Use of diesel generators on-site for electrical generation.
	Water will be sourced tankered supply, or bottled supply (for drinking).
	Site sanitary wastewater will be collected in septic tanks and removed by a licensed contractor for treatment off-site.
	Licensed waste contractors will be engaged to remove all waste from the site for re-use, recycling, recovery or disposal off-site.

14.6.2 Operation

Table 14-3 Socio-Economic –Management Measures during the Operational Phase

Impact / Source	Management Measures
Employment Opportunities	The projects recruitment policy will ensure a preference for local populations where appropriately skilled workers are available locally (or if unskilled positions are available).
	The HR Policy will be prepared to ensure consistency with the ACWA Power corporate policy which will ensure compliance with local labour laws and international ILO and UN conventions.
	It is recommended that key supply chains are monitored periodically during operations to ensure that material, goods and service providers do not employ forced or child labour, whilst ensuring the suppliers have a suitable occupational health and safety record.
Training and Dissemination of Skills	All plant personnel will receive induction training at the project, as well as vocational specific training for their duties.
	All workers will receive training in regard to health and safety, as well as environmental awareness. Training will be updated on a yearly basis as a minimum.
	Workers will be encouraged to develop their careers and may be provided with opportunities to attend training courses and other career development processes.
Education of locals	Appropriate dialogue signage and notification (e.g. by external notice boards) will communicate key operational related events.
Demand on Utilities & Services	The SWRO will provide a highly significant local source of potable water that will provide enhanced stability to the local area.
	Process wastewater streams will be treated at the wastewater treatment plants on-site.
	Licensed waste contractors will be engaged to remove all waste from the site for re-use, recycling, recovery or disposal off-site.

14.7 Monitoring

Socio-Economic provisions and management measures (such as HR Policy and related procedures, training provisions and supply chains) will be audited during the wider internal and independent environmental and social audits; during construction and operation

External grievance mechanisms will be monitored and all incoming grievances will be recorded and followed up as appropriate.

15 COMMUNITY HEALTH, SAFETY & SECURITY

15.1 Introduction

This chapter outlines and assess the impacts relating to the safety and security of the local community who live and work in the surrounding area and may be subject to project related impacts.

Project related activities can result in the increase of risks associated to the local communities who live and work in the areas of impacts surrounding projects. In particular, certain projects may have specific impacts upon vulnerable groups, which need to be assessed and suitably managed.

The majority of secondary impacts relating to the local community in terms of air quality, noise, wastewater, waste etc., have been addressed in specific chapters elsewhere in this ESIA. This chapter therefore concentrates more specifically on the potential emergency impacts that could relate to the project and the security of the project to avoid instances of trespass, or other misdemeanors.

The primary purpose of this chapter is therefore to identify specific management measures in regard to community, health, safety and security.

It is the intention of this chapter that the identified management measures will be consolidated into the specific CESMP & OESMP's (or complimentary management plans/ procedures) to be implemented during the construction and operational phases respectively.

This section includes the following:

- Applicable regulations and guidelines;
- Potential impacts relating to the projects construction and operation; and
- Management measures (Construction and Operational phases).

Specifically, the 'Emergency Preparedness and Response Plan' for the project will ensure many risks relating to the projects construction and operation are covered in regard to community safety and security, whilst outlining what response will be taken for certain situations. The 'Emergency Preparedness and Response Plan' will be prepared by the EPC Contractor and O&M Company for the construction and operational phases of the project respectively.

15.2 Standards and Regulatory Requirements

15.2.1 Lender Requirements

The project lenders will require compliance with IFC Performance Standard 4: Community Health, Safety and Security. The objectives of IFC PS4 are to:

- To anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances.
- To ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.

The project will therefore need to ensure:

- Suitable design of the SWRO and related infrastructure to ensure safe operation.
- Minimising the potential for community exposure to hazardous materials and substances that may be released by the project.
- Avoidance of community exposure to disease (e.g. from worker influx or supply of contaminants or other water related illness in the supply of potable water).
- Consideration of any third-party impacts to project emergencies and disaster scenarios (or vice versa impacts form external sources to the project), including preparing emergency response plans.
- Appropriate training of security personnel employed by the projects, including appropriate consideration of hiring protocols, training of staff, code of conduct, provision of weapons and weapons protocols.

IFC PS4 also has considerations for impacts to ecosystem services, however the project is not expected to impact such ecosystem services.

15.3 Observations and Baseline Conditions

Community Risks

The project will be located adjacent to a power and desalination facility (Salalah IWPP) that has the potential to impact local receptors and any future facilities, such as, significant fuel stores on-site, incoming gas lines. Furthermore, these facilities discharge treated wastewater effluents directly to the sea.

External risks to the Project

These operations of external facilities also present risks that may affect the SWRO projects operation in the event of fire, or spillage to sea.

Security

The Salalah IWPP is expected to employ its own security team, but is likely to receive support from the Omani military as a facility of key importance. It is therefore possible that security staff at the entrances to the facility may be armed.

Transportation

Road Transportation

The major road network leading to the project site is Highway 49, which runs parallel to the coastline from Salalah.

Access to the project can be made via an exit from Highway 49 and then a short journey along tarmacked roads to the Salalah IWPP. Access to the project site can currently be gained via a compacted track to the north of the Salalah IWPP.

15.4 Potential Impacts

15.4.1 Construction

All construction projects have potential risks relating to public safety that could arise, particularly in regard to the use of high powered equipment, heavy construction plant, excavations, transportation amongst others, including fire and pollution releases.

Public risks during construction have the potential to result in isolated incidents, which could be of a devastating magnitude to a person or group of people in the wrong place at the wrong time.

Risks to public safety will be appropriately addressed and prepared in the construction phase 'Emergency Preparedness and Response Plan' and training.

The construction phase may present an unwanted opportunity for local communities to access the site, in terms of trespassing, with associated risks to those working at the site and those who are trespassing. Under such circumstances there is potential for incidents to occur particularly as a construction site is a high-risk area and should only be accessed by trained personnel who are wearing adequate personal protective equipment.

Worker Influx and Disease

Due to the required workforce during the construction phase, there is the potential for additional influx to the local area and for associated impacts such as spread of disease to any local communities. The locations of worker accommodation areas have not been confirmed at this stage, however it is expected that the majority of site staff will be sub-contractor workers who will be based off-site, but in the local area, and therefore may come into contact with local populations.

Security Staff

The project will also include site based security at the gates and on patrol around the site.

Following suitable security risk assessment by the EPC Contractor, the security arrangements should be guided by UN Code of conducts for law enforcement officials and UN basic principles on the use of Force and Firearms by law enforcement officials (if staff are armed). In addition to this, security personnel will receive internal training in regard to grievances, reporting such grievances and dialogue with any members of the local community.

Transportation

The key reason for vehicle use during construction will be the transfer of labourers on the site on a daily basis, as well as the delivery of materials and equipment for construction activities.

It is anticipated that traffic levels (particularly HGV's) will increase on local roads during the construction phase. The volume of traffic will vary over the course of construction depending on the phases of construction and the demand for materials, removals and construction personnel on site. The main factors that will affect the number of vehicles on the roads will be related to manpower needs, material usage and waste generation.

The site will be accessed via the proposed access road to the immediate north of the existing IWPP. The access road will connect the hardstanding roads in the secure industrial zone to the site.

Other forms of direct transport to the site (e.g. by sea, or by air) are not anticipated to be widely used, however sea transportation of large items may initially come through Salalah Port, before being delivered by road to the site. Such deliveries will be guided by a Traffic Management Plan.

15.4.2 Operation

Public/Community Safety

The project will carry various risks that could result in impacts to public safety where such impacts are transferred or received outside of the project site. Such impacts may relate to fire, un-warranted releases of wastewater and security/safety concerns of trespassers.

The extent of such impacts may range outside of the projects boundaries and require the involvement of outside agencies to help manage and abate such impacts (e.g. Civil Defence, Police and Army).

Although public risks during operation of the SWRO are expected to be limited, there may be significant risks to receptors if realised, such as an unwarranted release of wastewater to the

sea. Risks to public safety will be appropriately addressed and prepared for in the operational phase 'Emergency Preparedness and Response Plan' and via appropriate training of staff.

Security Staff

The project constitutes a facility of high importance due to the generation of potable water for consumption. The project will include site based security at the project access road entrance and at the project gates, who will patrol the site.

As is consistent with the construction phase, the O&M Contractor will undertake a security risk assessment to determine the appropriate level of security required at the facility. Security arrangements should be guided by UN Code of conducts for law enforcement officials and UN basic principles on the use of Force and Firearms by law enforcement officials (if staff are armed). In addition to this, security personnel will receive internal training in regard to grievances, reporting such grievances and dialogue with any members of the local community.

Transportation

In general, transportation impacts during operations are not expected to be significant, as the operation of the SWRO will not require continuous delivery of materials, or other equipment in order to operate.

Occasional deliveries and waste removals will add a very small amount of traffic on local roads, but is not expected to result in a noticeable increase of vehicle traffic.

Staff movements will also contribute to a minimal additional vehicle flows on local roads.

15.5 Minimum Mitigation Measures

15.5.1 Construction

Table 15-1 Community Health, Safety & Security – Management Measures during the Construction Phase

Impact	Mitigation
Emergency Situations	Risks to public safety will be appropriately addressed and prepared for in the operational phase 'Emergency Preparedness and Response Plan' and training. The plan will include the appropriate procedure to respond to any such incidents, as well as site specific contact details and details of external agencies who may be required.
	All high-risk areas including fuel storage areas will be secured with internal fencing and will be patrolled by security throughout the day. Appropriate mechanisms for emergency control (e.g. firefighting equipment) will be placed at suitable positions around the site.
Exposure to Disease	The Health and Safety Teams on site will provide advice during training/inductions on exposure to disease.

	During construction, staff will have access to medical professionals and suitable medical facilities, which will aim to prevent the spread of disease internally and externally.
	Any reportable disease shall be diagnosed by the authorized occupation health centre doctor. Diagnosis includes identifying any new symptoms or any significant worsening of existing symptoms.
	Any external and internal spreading diseases shall be diagnosed and take the precautions as per the instructions from the national/local medical authority. The potential for exposure to water-borne, water-based, vector-borne diseases and communicable diseases as a result from project activities will be avoided or minimised.
Security	The Project will employ its own security staff who will provide 24*7 security control across the site and dedicated security staff at gatehouses.
	The project will be fenced prior to construction.
	All vehicles entering the site will require pre-approved clearance and will need to register to enter the site. Project security will record all instances of incoming vehicles.
	CCTV will be installed at key locations around the site and at gatehouses. Appropriate lighting will be provided at gatehouses for security personnel to ensure that unauthorised access cannot be gained.
	Project personnel will only be provided access to the construction site with valid ID cards and permits to work in line with HSE requirements of the site. People trying to gain unauthorised access to the site without appropriate permits and PPE will not be permitted, or will be ejected.
Grievance Mechanism	The project will implement an appropriate system to allow external parties to raise a grievance in regard to the project. The Grievance Mechanism will be designed to allow engagement of applicable project stakeholders. The mechanism will be clearly defined, transparent and accessible to identified stakeholders.
Infrastructure and Equipment Design Safety	Design, planning and construction of new buildings and structures needs to be provided and incorporate: • Consideration of public exposure to operational accidents and/or natural hazards; • Consistency with universal design; • Conformance with national and international requirements for fire and safety.
Hazardous Materials Management and Safety	The Project will avoid and/or minimise community exposure to hazardous materials and substances that may be released by the Project. The transport and disposal of the Project's hazardous waste through communities must be avoided and/or minimised.

15.5.2 Operation

Table 15-2 Community Health, Safety & Security – Management Measures during the Operational Phase

Impact	Mitigation
Emergency Situations	Risks to public safety will be appropriately addressed and prepared for in the operational phase 'Emergency Preparedness and Response Plan' and training. The plan will include the appropriate procedure to respond to any such incidents, as well as site specific contact details and details of external agencies who may be required.

Impact	Mitigation
	The plant will have a purpose built primed firefighting infrastructure to respond to instances of fire.
	The plant will have various mitigation controls to protect against spillage of hazardous liquids and materials, including fuels (as detailed elsewhere in this ESIA).
Security	The project will employ its own security provisions to provide 24*7 security control across the plant.
	The project will be fenced with a high-grade security fence and internal lighting.
	All vehicles entering the site will require pre-approved clearance and will need to registered to enter the site. Project security will record all instances of incoming vehicles.
	CCTV will be installed at key locations around the project, boundaries and gatehouses. Appropriate lighting will be provided at gatehouses for security personnel.
	Project personnel will only be provided access to the plant with valid ID cards and permits to work in line with HSE requirements of the site.
Grievance Mechanism	The project will implement an appropriate system to allow external parties to raise a grievance in regard to the project. The Grievance Mechanism will be designed to allow engagement of applicable project stakeholders. The mechanism will be clearly defined, transparent and accessible to identified stakeholders.
Infrastructure and Equipment Design Safety	Design, planning and construction of new buildings and structures needs to be provided and incorporate: • Consideration of public exposure to operational accidents and/or natural hazards; • Consistency with universal design; • Conformance with national and international requirements for fire and safety.
Hazardous Materials Management and Safety	The Project will avoid and/or minimise community exposure to hazardous materials and substances that may be released by the Project. The transport and disposal of the Project's hazardous waste through communities must be avoided and/or minimised.

16 LABOUR AND WORKING CONDITIONS

16.1 Introduction

Any construction project will introduce health and safety risks associated with the use of plant, machinery and construction processes. Risks can be severe depending on the type of activities required, materials used and site condition.

For projects in isolated locations or where the local population/skill sets require influx of people from other regions/countries. In such a scenario, a project will need to consider requirements associated with accommodation, welfare, sanitary provision, health care, hygiene, food potable water etc.

16.2 Standards and Regulatory Requirements

16.2.1 Omani Requirements

'Oman's 2003 Labour Law governs employee/employer relations in the private sector, and enumerates the protections afforded all legally resident workers, except for domestic workers. The law sets the minimum working age at 15, provides clear guidelines on working hours, and specifies the penalties for noncompliance with its provisions.' (Source: https://www.export.gov/article?id=Oman-Labor, Accessed on 31/05/2017).

16.2.2 Lender Requirements

The following applicable IFC Performance Standards aim to identify and ensure that social and economic impacts of a project are addressed in the relevant areas, in particular:

- Performance Standard 2: Labour and Working Conditions;

In accordance with IFC Performance Standard 2 (Labour and Working Conditions) there is a requirement to align with the following conventions:

- ILO Convention 87 on Freedom of Association and Protection of the Right to Organize;
- ILO Convention 98 on the Right to Organize and Collective Bargaining;
- ILO Convention 29 on Forced Labour;
- ILO Convention 105 on the Abolition of Forced Labour;
- ILO Convention 138 on Minimum Age (of Employment);
- ILO Convention 182 on the Worst Forms of Child Labour;
- ILO Convention 100 on Equal Remuneration;
- ILO Convention 111 on Discrimination (Employment and Occupation);

- UN Convention on the Rights of the Child, Article 32.1; and
- UN Convention on the Protection of the Rights of all Migrant Workers and Members of their Families.

16.3 Potential Risks and Impacts

16.3.1 Construction

HR Policy, Freedom of Association and Collective Bargaining

The overarching ACWA Power HR Policy will provide the basis upon which the projects HR Policy will be developed (to be adopted by the EPC Contractor in their construction HR policy). The HR Policy will ensure alignment with Omani labour law and will ensure consistency with international ILO and UN conventions required by the lenders.

Note: In line with the above, the ACWA Power HR Policy the minimum age of working is 18 years. Freedom of Association (Foal) and collective bargaining is included to the ACWA Power annual sustainability reports and our "Our Commitments" policy under "making certain of human rights, the safety and welfare of workers, fair employment and equal opportunity practices across our operations", where Human Rights is intended to cover FoA and Collective Bargaining.

Occupational Health and Safety

Common activities undertaken during construction such as the movement of heavy machinery, excavation, handling of chemicals, works undertaken at height etc. can all introduce significant risk to the health and safety for the associated work force. In particular, risks are more likely to be apparent for those who are not familiar with the type of works undertaken and/or the associated hazards.

The type of hazards attributable to a construction site will vary significantly dependant on the construction methods employed and the degree of control implemented by the EPC and affiliated sub-contractor. It is therefore of the utmost importance that the EPC and affiliated sub-contractors demonstrate consideration of health and safety risks as part of their chosen construction methods and that these risks are appropriately mitigated.

The EPC Contractor will manage Occupational Health and Safety on site via a dedicated Health, Safety and Environment (HSE) Team. Sub-contractor companies will have dedicated HSE Managers who will be responsible for implementing the sites HSE plan in their working areas. The EPC's HSE Plan will be subject to approval by ACWA Power and the Project Company. ACWA Power and the Project Company will periodically audit the project in line with the necessary HSE requirements.

Working Conditions

Labour exploitation on construction sites unfortunately has become a reality in some parts of the world. Inequalities in income, education and opportunities has led to opportunistic immoral practices with labourers and site staff suffering as a consequence.

To ensure the wellbeing of the staff associated with the project, the EPC and associated subcontractors will need to plan for necessary provisions relative to the requirement of the required workforce. This includes appropriate labour accommodation plans and mechanism for inspections and corrective actions.

16.3.2 Operation

Occupational Health and Safety

The risks associated with the operational phase of the project are anticipated to be significantly less than during the construction phase due to reduced site activity and requirements for heavy plant and machinery.

There will however be incoming electrical connections on-site and the movement of large volumes of water by high powered pumps, all of which pose a significant risk to worker health and safety. Maintenance and inspection will also require the use of site vehicles and activities that pose risks to human health and safety.

The severity and likelihood of risks during the operational phase will be dependent on the frequency and requirements for planned and unplanned maintenance. The operation and maintenance team will need to ensure that a robust plan is in place to appropriately manage these risks.

Human resource policies and procedures will be prepared on the basis of the ACWA Power Corporate HR Policy template for Project Companies. The EPC Contractor and sub-contractor companies will be required to reflect the ACWA Power Corporate requirements in their own HR Policies. In general, the HR Policies will be adapted appropriate to the size of the workforce required for the project. Policies and procedures must be prepared to demonstrate consistency with the requirements of national legislation and IFC Performance Standard 2, particularly in regard to the full implementation of all ILO standards.

16.4 Management Measures

16.4.1 Construction

Table 16-1 Labour & Working Conditions – Management Measures during the Construction Phase

Impact	Mitigation
Human Resources Policies and Procedures	Human resource policies and procedures will be prepared on the basis of the ACWA Power Corporate HR Policy template for Project Companies. The EPC Contractor and sub-contractor companies will be required to reflect the ACWA Power Corporate requirements in their own HR Policies. In general, the HR Policies will be adapted appropriate to the size of the workforce required for the project. Policies and procedures must be prepared to demonstrate consistency with the requirements of national legislation and IFC Performance Standard 2, particularly in regard to the full implementation of all ILO standards.
Child Labour	The EPC contractor will comply with all relevant national laws provisions related to the employment of minors. In any event, the client will not employ children.
Forced Labour	The EPC contractor will not employ forced labour, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements.
Non-discrimination and equal opportunity	The EPC contractor will comply with IFC requirements on non-discrimination related to employment. In particular, the EPC contractor will: - Not make employment decisions on the basis of personal characteristics, such as gender, race, nationality, ethnic origin, religion or belief, disability, age or sexual orientation, unrelated to inherent job requirements; - Base the employment relationship on the principle of equal opportunity and fair treatment, and will not discriminate with respect to all aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, accommodation, access to training, promotion, termination of employment or retirement, and discipline. Please note that special measures of protection or assistance to remedy past discrimination or promote local employment opportunities or selection for a particular job based on the inherent requirements of the job, which are in accordance with national law, will not be deemed discrimination.
Working Relationships	The EPC contractor will document and communicate to all workers their working conditions and terms of employment including their entitlement to wages, hours of work, overtime arrangements and overtime compensation, and any benefits (such as leave for illness, maternity/paternity, or holiday).
Working Conditions and terms of employment	The EPC contractor will provide a plan detailing how working conditions and terms of employment are compliant with national labour, social security and occupational health and safety laws. Employment relationship shall be on the principle of equal opportunity and fair treatment, and will not discriminate with respect to any aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. Special measures of protection or assistance to remedy past discrimination or promote local employment opportunities or selection for a particular job based on the inherent requirements of the job, which are in accordance with national law, will not be deemed discrimination.

Impact	Mitigation
Workers organisations	The EPC contractor will enable means for workers to express their grievances and protect their rights regarding working conditions and terms of employment. The EPC contractor will not discourage workers from forming or joining workers' organisations of their choosing or from bargaining collectively, and will not discriminate or retaliate against workers who participate, or seek to participate, in such organisations or bargain collectively.
Wages, benefits and conditions of work	Wages, benefits and conditions of work offered should, overall, be comparable to those offered by equivalent employers in the relevant region of that country/region and sector concerned.
Occupational Health and Safety (OHS)	The EPC contractor will provide the workers with a safe and healthy work environment, taking into account inherent risks and specific classes of hazards associated with the project. The EPC contractor shall implement and maintain an OHS management system taking into account specific risks associated with the project, legal requirements and duty of care. The EPC contractor shall be responsible for ensuring that all affiliated sub-contractors comply with the OHS management system. The OHS management system shall be in-line with recognised international best practice and as a minimum, this plan shall include: - Means of identifying and minimising, so far as reasonably practicable, the causes of potential hazards to workers. - Provision of preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances. - Provision of appropriate equipment to minimise risks, and requiring and enforcing its use. - Training of workers, and provision of appropriate incentives for them to use and comply with health and safety procedures and protective equipment. - Documentation and reporting of occupational accidents, diseases and incidents. - Emergency prevention, preparedness and response arrangements.
Worker Accommodation	Where/if accommodation is provided for workers, the accommodation shall be appropriate for its location and be clean, safe and, at a minimum, meet the basic needs of workers. In particular, the provision of accommodation shall meet national legislation and international good practice in relation, but not restricted, to the following: - the practice for charging for accommodation. - the provision of minimum amounts of space for each worker. - provision of sanitary, laundry and cooking facilities and potable water. - the location of accommodation in relation to the workplace. - any health, fire safety or other hazards or disturbances and local facilities. - the provision of first aid and medical facilities. - heating and ventilation. Workers freedom of movement to and from the employer-provided accommodation shall not be unduly restricted. The accommodation services will be provided in a manner consistent with the principles of non-discrimination and equal opportunity.

Impact	Mitigation
Retrenchment	If the EPC contractor anticipates collective dismissals associated with the proposed project, the EPC contractor shall develop a plan to mitigate the adverse impacts of retrenchment, in line with national law and good industry practice and based on the principles of non-discrimination and consultation. Without prejudice to more stringent provisions in national law, such consultation will involve reasonable notice of employment changes to the workers' representatives and, where appropriate, relevant public authorities so that the retrenchment plan may be examined jointly in order to mitigate adverse effects of job losses on the workers concerned. The outcome of the consultations will be reflected in the final retrenchment plan.
Grievance Mechanism	The EPC contractor will provide a grievance mechanism for workers to raise reasonable workplace concerns. The client will inform the workers of the grievance mechanism at the time of hiring, and make it easily accessible to them. The mechanism should involve an appropriate level of management and address concerns promptly, using an understandable and transparent process that provides feedback to those concerned, without any retribution. The mechanism should not impede access to other judicial or administrative remedies that might be available under law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.
Supply chain	The EPC contractor shall devise a supply management system to ensure the mitigation measures identified above can be demonstrated by associated sub-contractors. Potential adverse impacts associated with supply chains will be considered where low labour cost is a material factor in the competitiveness of the item supplied. In such circumstances, the EPC contractor will take reasonable steps to inquire about the use of child labour and forced labour in its supply chain in relation to goods and materials which are central to the core functions of the project.

16.4.2 Operation

Table 16-2 Labour & Working Conditions – Management Measures during the Operational Phase

Impact	Mitigation
Human Resources Policies and Procedures	Human resource policies and procedures will be adapted appropriate to the size of the workforce required for operation and maintenance requirements. Policies and procedures must be prepared to demonstrate consistency with the requirements of national legislation and IFC Performance Standard 2.
Child Labour	The O&M Company will comply with all relevant national laws provisions related to the employment of minors. In any event, the client will not employ children in a manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. Young people below the age of 18 years will not be employed in hazardous work and all work of persons under the age of 18 shall be subject to an appropriate risk assessment.

Impact	Mitigation
Forced Labour	The O&M Company will not employ forced labour, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements.
Non-discrimination and equal opportunity	The O&M Company will comply with EU requirements on non-discrimination related to employment. In particular, the O&M Company will: - Not make employment decisions on the basis of personal characteristics, such as gender, race, nationality, ethnic origin, religion or belief, disability, age or sexual orientation, unrelated to inherent job requirements; - Base the employment relationship on the principle of equal opportunity and fair treatment, and will not discriminate with respect to all aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, accommodation, access to training, promotion, termination of employment or retirement, and discipline. Please note that special measures of protection or assistance to remedy past discrimination or promote local employment opportunities or selection for a particular job based on the inherent requirements of the job, which are in accordance with national law, will not be deemed discrimination.
Working Relationships	The O&M Company will document and communicate to all workers their working conditions and terms of employment including their entitlement to wages, hours of work, overtime arrangements and overtime compensation, and any benefits (such as leave for illness, maternity/paternity, or holiday).
Working Conditions and terms of employment	The O&M Company will provide a plan detailing how working conditions and terms of employment are compliant with national labour, social security and occupational health and safety laws. Employment relationship shall be on the principle of equal opportunity and fair treatment, and will not discriminate with respect to any aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. Special measures of protection or assistance to remedy past discrimination or promote local employment opportunities or selection for a particular job based on the inherent requirements of the job, which are in accordance with national law, will not be deemed discrimination.
Workers organisations	The O&M Company will enable means for workers to express their grievances and protect their rights regarding working conditions and terms of employment. The O&M Company will not discourage workers from forming or joining workers' organisations of their choosing or from bargaining collectively, and will not discriminate or retaliate against workers who participate, or seek to participate, in such organisations or bargain collectively.
Wages, benefits and conditions of work	Wages, benefits and conditions of work offered should, overall, be comparable to those offered by equivalent employers in the relevant region of that country/region and sector concerned.

Impact	Mitigation
Occupational Health and Safety (OHS)	The O&M Company will provide the workers with a safe and healthy work environment, taking into account inherent risks and specific classes of hazards associated with the project. The O&M Company shall implement and maintain an OHS management system taking into account specific risks associated with the project, legal requirements and duty of care. The O&M Company shall be responsible for ensuring that all affiliated sub-contractors comply with the OHS management system. The OHS management system shall be in-line with recognised international best practice and as a minimum, this plan shall include: - Means of identifying and minimising, so far as reasonably practicable, the causes of potential hazards to workers. - Provision of preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances. - Provision of appropriate equipment to minimise risks, and requiring and enforcing its use. - Training of workers, and provision of appropriate incentives for them to use and comply with health and safety procedures and protective equipment. - Documentation and reporting of occupational accidents, diseases and incidents. - Emergency prevention, preparedness and response arrangements.
Worker Accommodation	Where/if accommodation is provided for workers, the accommodation shall be appropriate for its location and be clean, safe and, at a minimum, meet the basic needs of workers. In particular, the provision of accommodation shall meet national legislation and international good practice in relation, but not restricted, to the following: - The practice for charging for accommodation. - The provision of minimum amounts of space for each worker. - Provision of sanitary, laundry and cooking facilities and potable water. - The location of accommodation in relation to the workplace. - Any health, fire safety or other hazards or disturbances and local facilities. - The provision of first aid and medical facilities. - Heating and ventilation. Workers freedom of movement to and from the employer-provided accommodation shall not be unduly restricted. The accommodation services will be provided in a manner consistent with the principles of non-discrimination and equal opportunity.
Retrenchment	If the O&M Company contractor anticipates collective dismissals associated with the proposed project, the O&M Company contractor shall develop a plan to mitigate the adverse impacts of retrenchment, in line with national law and good industry practice and based on the principles of non-discrimination and consultation. Without prejudice to more stringent provisions in national law, such consultation will involve reasonable notice of employment changes to the workers' representatives and, where appropriate, relevant public authorities so that the retrenchment plan may be examined jointly in order to mitigate adverse effects of job losses on the workers concerned. The outcome of the consultations will be reflected in the final retrenchment plan.

Impact	Mitigation
Grievance Mechanism	The O&M Company will provide a grievance mechanism for workers to raise reasonable workplace concerns. The client will inform the workers of the grievance mechanism at the time of hiring, and make it easily accessible to them. The mechanism should involve an appropriate level of management and address concerns promptly, using an understandable and transparent process that provides feedback to those concerned, without any retribution. The mechanism should not impede access to other judicial or administrative remedies that might be available under law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.
Supply chain	The O&M Company shall devise a supply management system to ensure the mitigation measures identified above can be demonstrated by associated sub-contractors. Potential adverse impacts associated with supply chains will be considered where low labour cost is a material factor in the competitiveness of the item supplied. In such circumstances, the O&M Company will take reasonable steps to inquire about the use of child labour and forced labour in its supply chain in relation to goods and materials which are central to the core functions of the project.

17 CUMULATIVE IMPACTS

17.1 Introduction

This ESIA has assessed cumulative impacts of several environmental parameters in in the main sections of this ESIA. For instance, construction road noise impacts and operational marine discharges have considered the measured baseline conditions in combination with the predicted process contributions. As a result, this has provided an assessment of cumulative impacts, as a result of the project itself.

In accordance with the projects Environmental Scoping Study (ref. Appendix A), this specific cumulative impact assessment chapter should therefore considers the cumulative impacts relating to potential future development and works in the projects area of influence. In this instance, the projects predicted impacts have been assessed in combination with other known future developments to determine the potential longer-term impacts upon related environmental parameters.

17.1.1 Local Projects

The assessment of cumulative impacts should be based upon solid documented development plans/strategies and announced projects. In the case of this cumulative impacts assessment, there is no available information regarding confirmed future development plans in the local project area.

As such, it is not possible in this ESIA to speculate on the potential cumulative impacts relating to future projects.

Therefore, the assessment of cumulative impacts with reference to this project goes as far as those cumulative impacts upon specific receptors as a result of the proposed project and existing impacts form other local facilities. As described above, these cumulative impacts have already been assessed in the respective sections of this ESIA.