Fujairah 3 Independent Power Project (IPP)

ESIA

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ABBREVIATIONS

Abbreviation	Definition
ADS	Abu Dhabi Specification
AIMS	Australian Institute of Marine Science
BOD	Biochemical Oxygen Demand
BS	British Standard
BWRO	Brackish Reverse Osmosis System
CCW	Closed Cooling Water
CEMS	Continuous Emissions Monitoring Systems
CESMP	Construction Environmental and Social Management Plan
CGRFA	The International Treaty on Plant Genetic Resources for Food and Agriculture
CITES	Convention on International Trade in Endangered Species of wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
COD	Chemical Oxygen Demand
DAF	Dissolved Air Floatation
DDV	Drop Down Video
DM AWQO	Dubai Municipality's Ambient Water Quality Objectives
DMF	Dual Media Filter
DO	Dissolved Oxygen
EAD	Environment Agency – Abu Dhabi
EAD AWQS	EAD Ambient Marine Water Quality Objective
EPC	Engineering Procurement Construction
ESIA	Environmental and Social Impact Assessment
EWEC	Emirates Water and Electricity Company
FCSA	The Federal Competitiveness and Statistics Authority
FEED	Front-End Engineering Design
FM	Fujairah Municipality
FM-EPS	Environment Protection Section
FTAA	Fujairah Tourism and Antiquities Authority

Abbreviation	Definition
GCC	Gulf Cooperation Council
GLC	Ground Level Concentration
GT	Gas Turbine
HIP	High Pressure-Intermediate pressure
HP	High Pressure
HRSG	Heat Recovery Steam Generators
HSE	Health, Safety and Environmental
HVAC	Heating, Ventilation, Air Conditioning System
IEMA	Institute of Environmental Management and Assessment
IFC	International Finance Corporation
IoA	Institute of Acoustics
IP	Intermediate Pressure
IWPP	Independent Water and Power Plants
JBIC	Japan Bank for International Cooperation
LOEC	Lowest Observed Effect Concentration
LP	Low Pressure
MARPOL	Convention and Protocol on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter
MBE	Mixed Bed Exchanger
MDL	Minimum Detection Level
MOCCAE	Ministry of Climate Change and Environment
MOOPAM	Manual of oceanographic observations and pollutant analyses methods
MW	Mega Watt
NOC	Non-Objection Certificate
NOEC	No Observed Effect Concentration
NSW	New South Wales
OESMP	Operational Environmental and Social Management Plan
ORP	Oxidation-Reduction Potential
PCB	Polychlorinated Biphenyls

Abbreviation	Definition
PERSGA	The Regional Organization for the Conservation of the Environment of the Red Sea and Gulf of Aden
PRDS	Pressure Reducing and Desuperheating Station
RMZ	Regulatory Mixing Zone
RO	Reverse Osmosis
ROPME	Regional Organization for the Protection of the Marine Environment
SCR	Selective Catalytic Reduction
SRs	Sensitive Receptors
SSG	Seawater Specific Gravity
ST	Steam Turbine
SWMP	Site Waste Management Plan
SWRO	Seawater Reverse Osmosis System
TCA	Turbine Cooling Air
TDS	Total Dissolved Solids
TN	Total Nitrogen
TOC	Total Organic Carbon
ToR	Terms of Reference
TSHD	Trailing Suction Hopper Dredger
TSS	Total Suspended Solids
UAE	United Arab Emirates
US EPA	United States Environmental Protection Agency

GLOSSARY OF TERMS

Term	Description
Alternatives	Alternatives to the Project in its current form. This will include a 'no development' (or do nothing) option, or alternative approaches to the development such as an alternative location or design.
Avoidance	Amendments to a project which would result in an environmental impact being avoided. This could include for example a design change to avoid an area which is inhabited by a rare species. This is the most effective means of environmental protection.
Baseline Data	Existing or proposed baseline data which enumerates, or describes, the existing environmental conditions at a site prior to the implementation of a project. This would include, for example, the collection of air quality data to understand the current levels of pollutants or ecological surveys to identify the current status of habitats or protected species.
Compensation	Where impacts cannot be avoided or mitigated, a programme of compensation may be required. For example, if the habitat of a protected species would be lost it may be necessary to provide new compensation habitat at an alternative location.
Construction	The period of a project when it is under construction, which will include site preparation works through to commissioning.
Environmental and Social Impact Assessment	The process of Environmental and Social Impact Assessment (ESIA) which involves assessing existing baseline conditions and predicting impacts of a project. Where impacts are identified, the process requires that avoidance, mitigation or compensation measures are determined to reduce impacts to acceptable levels. Note that the process is distinct from an ESIA Report, which is a report which details the methodology, findings and outcomes of the ESIA process.
Geo-environmental	Systematic collection of data to determine the degree of contamination of a particular site. The main objective of a geo-environmental investigation is to gather sufficient information of the source, contamination paths and targets to support risk assessment studies and/or site remediation plan, if necessary.
Impact Assessment	Prediction and evaluation of environmental impacts and their significance resulting from a project.
Mitigation	Where impacts cannot be avoided they can potentially be reduced through the application of mitigation measures. This could include, for example, technologies to reduce emissions of pollutants to air to more acceptable levels.
Operation	The period of a project following construction when it becomes operational in part or full as per its intended long-term use.
Sabkah	Coastal salty mud plain
Significance	Environmental impacts are generally categorized according to their significance. For example, a small-scale impact upon a sensitive receptor of low value would be determined as an impact of minor significance. Conversely, a large impact upon a receptor of high sensitivity would be determined as being of major significance. Note that impacts can be positive as well as negative.
Sensitive Receptor	A sensitive receptor which could be adversely or positively impacted as a result of a project. This includes human receptors, such as a school or dwelling, ecological receptors such as an area of habitat or species or other environmental receptor such as soils and groundwater.

1- ملخص عن المشروع

1.1 -وصف المشروع :

المشروع هو وحدة توليد طاقة كهربائية عبر الاحتراق ثنائية الدورة مع استطاعة صافية في توليد الكهرباء بمقدار 2,400 ميجاوات. سوف يتم الاعتماد على الغاز الطبيعي كوقود أساسي بينما الديزل سوف يكون الوقود الثانوي وكوقود احتياطي أو في حالات الطوارئ فقط. يقع المشروع بالقرب من مرافق توليد الطاقة الحالية وهذا يشمل الموقع الفجيرة 1 باستطاعة صافية وقدرها 760 ميجاوات والفجيرة 2 باستطاعة صافية وقدرها 2000 ميجاوات.

الهدف الأساسي من المشروع هو تلبية متطلبات إمارة الفجيرة بشكل خاص ودولة الامارات العربية المتحدة بشكل عام من الطاقة الكهربائية من خلال توفير مصدر طاقة كافية في الوقت الذي يشهد فيه قطاع الطاقة والمياه تحولات هامة.

النقاط الأساسية الخاصة بالمشروع هي كالآتي:

وحدتي توليد كهرباء والتي سوف تتألف من:

- وحدة توربين الغاز
- مولدات تعمل بالبخار عن طريق الحرارة المستعادة
- وحدة توربين البخار
- المداخن الرئيسية (لدورة التوليد المشتركة الخاصة بمجموعة وحدتي التوليد بالغاز والبخار) والمداخن الجانبية (لدورة التوليد الاحادية الخاصة بتوربينات الغاز)
- أنظمة التحكم بانبعاثات الدخان والتي تشمل نظام عامل الاضافات الكيميائية المحفزة الذي باستطاعته تخفيض الانبعاثات من أكسيد الكربون بنسبة من 70 إلى 90% و
- أنظمة مراقبة الانبعاثات المستمر والتي تضمن معرفة كميات الانبعاثات في الهواء على نحو مستمر وفي جميع الأوقات وبالتالي القدرة على التعامل مع أي مسألة في هذا السياق.
- أنابيب توريد مياه البحر والتي تمتد على طول 485 متر تقريباً في البحر.
- أنابيب تصريف مياه البحر باتجاه البحر على طول 1.4 كيلومتر تقريباً مع وجود موزعات والتي سوف تقوم بتوزيع المياه المبردة في التيار الرئيسي.
- وحدة معالجة المياه بتقنية التناضح العكسي والتي سوف تقوم بمعالجة مياه البحر من أجل الحصول على مياه شرب و
- نظام معالجة المياه الملوثة وهذا النظام مصمم بغرض معالجة المياه الملوثة كيميائياً والمياه الزيتية ومياه الصرف الصحي إلى مستويات مقبولة قبل أن يتم تصريف هذه المياه عبر أنابيب تصريف المياه الى البحر.

1.2 -المخرجات:

حددت الدراسة المشاكل البيئية الرئيسية التي يمكن أن تؤدي إلى آثار بيئية واجتماعية سلبية في غياب تدابير التخفيف المناسبة، والتي تشمل الجوانب البيئية التالية:

- نوعية الهواء في البيئة المحيطة
- الضجيج في البيئة المحيطة
- التربة والمياه السطحية والجوفية
- مياه البحر ونوعية التربة الرسوبية البحرية
- البيئة البحرية
- النفايات
- الاجتماعي- الاقتصادي

يشمل الجدول 1 1 أدناه ملخص للآثار البيئية الرئيسية المحددة، وتدابير التخفيف وبرنامج الرصد

تم تحديد جميع التأثيرات الأخرى على أنها ذات أهمية بسيطة أو أقل ويمكن التحكم فيها بسهولة لضمان بقاء التأثير ضمن المستويات المقبولة.

الجدول 1.1: المسائل البيئية الأساسية:

المسائل البيئية	التأثيرات على البيئة	درجة التأثير	التدابير المخففة المقترحة	برنامج المراقبة المقترح
نوعية الهواء في البيئة المحيطة	غبار اعمال الانشاء على البيئة المحيطة	سلبي متوسط	– تطبيق خطة إدارة بيئية ومجتمعية اثناء البناء CESMP مع اجراءات تحكم تهدف الى تخفيض مستويات انبعاثات الغبار على المجتمع المحيط بالموقع.	**مراقبة نوعية الهواء خلال مرحلة البناء لضمان عدم وجود تأثيرات أساسية**
	على المدى القصير (خلال مدة ساعة) من تشغيل المحطة سوف يكون هناك تركيز اكسيد النتروجين في الهواء.	سلبي عالي	– عدم تشغيل محطة التوليد من خلال توربينات الغاز والبخار بشكل متزامن قبل تشغيل مصفيات الدخان SCR – مناقشات مع الجهات المنظمة بخصوص تبني المقاييس الاوروبية الخاصة بالهواء وليس المقاييس المحلية. – مواصفات اضافية خاصة بالمداخن F3 وتعديلات على مصفي الادخنة (ترقية) – تطبيق تخفيض أكبر في انبعاثات المرافق F1 وF2 بما يؤدي الى تخفيض تركيز التلوث في المحطات الثلاث.	**– أنظمة مراقبة الانبعاثات بشكل مستمر – مراقبة نوعية الهواء في مواقع**
الضجيج في البيئة المحيطة	زيادة في الضجيج لمستوى SR3 و SR8 بسبب اعمال البناء.	سلبي عالي	– تطبيق خطة إدارة بيئية ومجتمعية اثناء البناء CESMP مع اجراءات تحكم تهدف الى تخفيض مستويات انبعاثات الضجيج على المجتمع المحيط بالموقع.	**مراقبة مستويات الضجيج خلال مرحلة البناء للتأكد من عدم وجود درجات عالية منه.**
	احتمال حدوث زيادة في الضجيج لمستوى SR3 و SR8 بسبب تشغيل المحطة.	عالي	– اجراءات تحديث خاصة بتوقعات انبعاثات الضجيج (دراسات بيئية ومهنية) بناء على بيانات المعدات من الموردين خلال مرحلة التصميم والتوريد والانشاءات – تطبيق اجراءات مناسبة للحد من انبعاثات الضجيج الى الحد المقبول بالنسبة لأقرب مكان متضرر.	**مراقبة مستويات الضجيج خلال عمليات التشغيل للتأكد من عدم وجود درجات عالية منه.**
التربة والمياه السطحية والجوفية	احتمال حصول تلوث اثناء اعمال البناء.	سلبي عالي	– تطبيق خطة إدارة بيئية ومجتمعية اثناء البناء CESMP مع اجراءات منع حوادث التلوث.	**لا يطبق**
	احتمال حصول تلوث اثناء تشغيل المحطة.	سلبي عالي	– أفضل الممارسات في التصميم واجراءات منع التلوث وبشكل متزامن مع تطبيق خطة إدارة بيئية ومجتمعية اثناء البناء CESMPمع اجراءات منع حوادث التلوث.	**لا يطبق**
مياه البحر و نوعية التربة الرسوبية البحرية	احتمال أن تنتج اعمال الانشاءات مواد ضارة.	سلبي خفيف	– وضع سواتر\حواجز قبل اعمال البناء لاحتواء التربة الرسوبية – الاعتماد على أفضل الاساليب وصيانة المرافق.	**– مراقبة مياه البحر كل مدة 2 شهر في أربع مواقع – مراقبة التربة الرسوبية خلال عمليات التجريف**
	مياه سوف تصرف من تشغيل المحطة الى البحر وهذا يشمل تأثيرات الزيادة في الحرارة والملوحة والكلورين	سلبي خفيف	– لا حاجة إلى اجراءات بهذا الخصوص	**المراقبة المستمرة للتأكد من عدم وجود تأثيرات سلبية كبيرة**
البيئة البحرية	الاصطدام بالثدييات والكائنات البحرية اثناء اعمال الانشاءات.	سلبي متوسط	– تعيين مراقبين للثديات البحرية خلال أنشطة العمل والحد من نشاط السفن والمراكب. قدر الامكان.	**تسجيل وجود كائنات بحرية**
	ضخ المياه من الانابيب سوف ينتج عنه تأثير في حركة الكائنات البحرية	سلبي متوسط	– تصميم حواجز لمنع الكائنات البحرية الكبيرة والصغيرة من دخول الفتحات.	**لا يطبق**
النفايات	انتاج كميات من المخلفات أثناء اعمال الانشاءات	سلبي متوسط	– اعداد خطة ادارة النفايات خطة حسب خطة الادارة البيئية والمجتمعية ESMP والتي تشمل تطبيق أفضل الممارسات لتخفيض كميات النفايات وضمان تخزين النفايات ونقلها ومعالجتها بشكل صحيح.	**الاحتفاظ بسجلات النفايات بشكل مفصل وهذا يشمل انواع النفايات والكميات وطرق نقلها والتخلص منها ومعالجتها**
الاجتماعي- الاقتصادي	ازعاج للمجتمع المحلي المحيط بالمحطة وللاقتصاد في ذلك المجتمع خلال أعمال الانشاءات	سلبي عالي	– تطبيق خطة إدارة بيئية ومجتمعية اثناء البناء CESMP مع اجراءات تحكم تهدف الى تخفيض مستويات الازعاج على المجتمع المحيط بالموقع.	**سجلات الشكاوى من المجتمع المحيط وكيف تم التعامل مع الشكاوى وحلها**
	تعرض العاملين في المشروع لمواد ضارة (مثل الاسبستوس) خلال اعمال الانشاءات.	سلبي عالي	– تدريب كافة الموظفين والعمال على اجراءات الصحة والسلامة – اجراء مسوحات قبل ازالة الأبنية كافة وازالة مادة الاسبستوس قبل اعمال ازالة الابنية	**– الاحتفاظ بسجلات التدريب على الصحة والسلامة – التبليغ عن الوقائع والاجراءات التصويبية**

1. EXECUTIVE SUMMARY

1.1. Project Description

The Project is planned as a dual firing combined cycle power generation facility with a net power capacity of 2,400 MW. Natural gas will be the primary fuel and diesel oil will act as the secondary fuel, in back-up or emergency cases only. The Project is located adjacent to existing power generation facilities including Fujairah 1, with a capacity of 760 MW net, and Fujairah 2, with a capacity of 2,000 MW net.

The main rationale of this Project is to meet Fujairah's and more generally the overall future UAE's energy demands by providing a secure and energy efficient power supply, at a time when the power and water sector is currently undergoing significant changes.

The key features of the Project are as follows:

- Two Power Unit Groups, which will comprise:
  - Gas turbine unit;
  - Heat recovery steam generators;
  - Steam turbine unit
  - Main Stacks (for combined cycle operation – more efficient power generation using both gas turbine and steam turbines) and Bypass Stacks (for simple cycle operation using only gas turbines)
  - Environmental control systems including Selective Catalytic Reduction (SCR) which can reduce emissions of nitrogen oxides in the range of 80 to 95%;
  - Continuous Emissions Monitoring Systems (CEMS) to ensure that emissions to air are known at all times and any issues rectified immediately;
- Seawater intake pipelines, which extend approximately 485m offshore;
- Seawater outfall pipelines, which extend approximately 1.4km offshore, with diffuser sections which will be staggered to distribute the cooling water across the main direction of ambient flow;
- Reverse osmosis water treatment facility which will be used to treat seawater for process water and potable water supplies; and
- Wastewater treatment system which is designed to treat the chemical wastewater, oily wastewater and sanitary water to acceptable levels prior to discharge within the seawater outfall pipeline.

1.2. Findings

The ESIA has identified that the key environmental issues of concern, which could result in significant environmental and social impacts in the absence of appropriate mitigation measures, which include the following environmental aspects:

- Ambient air quality;
- Ambient noise;
- Soil, surface water and groundwater;
- Marine ecology;
- Waste; and
- Socio-economic.

A summary of the key identified environmental impacts, recommended mitigation measures and monitoring programme is set out within Table 1-1 below.

All other impacts have been identified as of minor or lower significance and can easily be controlled to ensure that impact remain within acceptable levels.

Table 1-1: Key environmental issues

Environmental Issue	Environmental Impacts	Significance of Impact	Recommended mitigation measures	Recommended monitoring program
Ambient air quality	Construction dust impacting on Sensitive Receptors	Moderate Negative	– Implementation of a Construction Environmental and Social Management Plan (CESMP) with key control measures to reduce dust impacts upon nearby sensitive receptors	– Air quality monitoring during construction to ensure that significant impacts do not occur
	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project operation	Major Negative	– The facility will not be operated in combined cycle mode without SCR in operation. – Discuss with regulators/ lenders the option of adoption of the short-term (1-hour) EU AAQS for the Project and not the Federal Standards.	– Continuous emissions monitoring systems – Ambient air quality monitoring during operation at sensitive receptor locations
Ambient noise	Noise increase at SR3 and SR8 as a result of construction noise	Major Negative	– Implementation of a Construction Environmental and Social Management Plan (CESMP) with key control measures to reduce noise impacts upon nearby sensitive receptors	– Noise monitoring during construction to ensure that significant impacts do not occur
	Potential noise increase at SR3 and SR8 as a result of operational noise	Major	– An update of all predictive noise models (Occupational and Environmental studies), based upon vendor equipment data during the EPC phase – Implementation of abatement measures if required to ensure that noise is attenuated to acceptable levels at the nearest sensitive receptor	– Noise monitoring during operation to ensure that significant impacts do not occur
Soil, surface water and groundwater	Potential for contamination events during construction activities	Major Negative	– Implementation of a Construction Environmental and Social Management Plan (CESMP) with key control measures to reduce the risk of contamination events.	– N/A
	Potential for contamination events during operational activities	Major Negative	– Best practice design and pollution control measures, together with the implementation of an Operational Environmental and Social Management Plan (CESMP) with key control measures to reduce the risk of contamination events.	– N/A
Marine water and sediment quality	Potential for sedimentation and spillage of hazardous materials from construction activities	Minor negative	– Installation of silt curtains prior to construction activities to contain sediment plume – Use of best practices and maintenance of facilities	– Bi-monthly monitoring of water quality at four locations – Ongoing sediment plume monitoring during dredging operations
	Discharges of water to marine environment during operation, including impacts from increased temperature, salinity and chlorine	Minor negative	– No mitigation required	– Ongoing monitoring to ensure there are no adverse impacts
Marine ecology	Collisions with marine mammals and reptiles during construction	Moderate negative	– Have marine mammal observers stationed during activities and reduce/limit vessel activities where possible	– Recording presence of marine fauna
	Pumping water from inlet pipeline resulting in entrainment of faunal species	Moderate negative	– Design of barriers to prevent large (e.g. turtles) and small (e.g. fish/snakes) fauna from entering inlets	– N/A
Waste	Generation of significant waste volumes during construction	Moderate negative	– Development of a Site Waste Management Plan as part of the ESMP, which will include the implementation of best practice measures to reduce wastes and ensure that any generated wastes are appropriately stored, transported and treated.	– Detailed waste records will be retained including waste types, amounts, transportation and disposal / treatment methods
Socio-economic	Disruption to the local economy and population during construction	Major negative	– Implementation of a Construction Environmental and Social Management Plan (CESMP) with key control measures to reduce disruption to the local community	– Records of complaints from local community and how complaints have been addressed and resolved
	Construction worker welfare and exposure to hazardous substances (including asbestos materials) during construction	Major negative	– All staff will be trained in appropriate health and safety best practice – Pre-demolition surveys of all structures and removal of asbestos where encountered prior to demolition.	– Maintenance of H&S training records – Incident recording and remedial measures

2. INTRODUCTION

2.1. Project Title and Project Proponent

The Fujairah 3 Independent Power Project (IPP) Project will be referred to as ‘the Project’ throughout this report. The Project is planned as a gas powered combined cycle facility with a net power capacity of 2,400 MW located in Fujairah Emirate, adjacent to the existing Fujairah 1 (F1), with a capacity of 760 MW net, and the existing Fujairah 2 (F2), with a capacity of 2,000 MW net.

The Project Proponent, **Emirates Water and Electricity Company *(‘EWEC’)***, have appointed ***Marubeni Corporation (‘Marubeni’)*** as first-ranked shortlisted bidder in relation to the F3 Project to develop, design, finance, engineer, procure, construct, commission, insure, complete, test, own, operate and maintain the F3 plant, together with ***Samsung C&T (“Samsung”)*** as EPC Contractor.

The main contact details are as follows:

Project Name		Fujairah 3 Independent Power Project (IPP)
Project Type		Power Project
Developer		**Marubeni Corporation**
	Contact Person:	Masashi Shirotake
		Project Manager
		Marubeni Corporation Power Project (Asset Management Department)
	E-mail:	Shirotake-M@marubeni.com
	Telephone:	+81 3 3282 7648
	Mobile:	+81 70 4192 4007

2.2. ESIA Consultants

Anthesis has been appointed as the independent Environmental Consultant by Marubeni to prepare environmental studies in accordance with the requirements of Fujairah Municipality Environmental Protection Section (FM-EPS), International Finance Corporation (IFC) and Japan Bank for International Cooperation (JBIC) in order to receive FM-EPS environmental approval for the Project.

This document is the second stage of the ESIA process, with the first stage being the approval of the Terms of Reference / Scope of Work (referred to as a ‘ToR’) and has been developed for submission to FM-EPS.

The contact details for Anthesis are as follows:

Environmental Consultancy Company	**Anthesis Consulting (UK) Limited (Dubai Branch)**
Contact Person:	Simon Pickup
	Managing Director
Address:	1605 Metropolis Tower, Business Bay, Dubai, P.O. Box 392563
Email:	Simon.Pickup@anthesisgroup.com
Telephone:	+971 4 277 8007
Fax:	+971 4 277 8006

The individual team members responsible for the preparation of this ESIA are set out within Table 2-1 below.

Table 2-1: ESIA technical team members

Team Member	Company	Role / Expertise	Project Involvement
Simon Pickup	Anthesis	Project Director	Technical review
Apolline Boudier	Anthesis	Project Manager	ESIA management, technical review and ESIA reporting
Karl McMullan	Anthesis	Project Team Support	Phase I survey, baseline noise monitoring survey and soil, surface water and groundwater ESIA chapter reporting
Adrian Hudson	Anthesis	Terrestrial Ecologist & Report Preparation	Terrestrial ecology survey, soil & groundwater chapter writing and marine ecology chapter
Kingsley Okwesia	Anthesis	Project Team Support	Waste ESIA chapter reporting & archaeology and cultural heritage
Nesma Othman	Anthesis	Project Team Support	Socio-economy ESIA chapter reporting
Luke Prowse	Element	Site Technician	Soil & groundwater collection & sampling and noise monitoring
Paul Wilson	Element	Laboratory Expert	Soil & groundwater laboratory testing
Ray Visitacion	WKC	Ecologist Expert	Marine and terrestrial ecology
Greg Ashcroft	WKC	Hydrodynamic modeller	Marine modelling technical review
Ravel Barnard	WKC	Hydrodynamic modeller	Marine modelling and marine water and sediment ESIA chapter reporting
Marc Blanché	WKC	Air quality and Noise Modeller	Air and noise modelling technical review

Team Member	Company	Role / Expertise	Project Involvement
Ian Goble	WKC	Air quality modeller	Air quality modelling and air quality ESIA chapter reporting
Yuvika Ramsaran	WKC	Noise modeller	Noise modelling and noise ESIA chapter reporting

2.3. Project Rationale

2.3.1. F3 Project Rationale

The Project is planned as dual firing, with natural gas being the primary fuel and diesel oil acting as the secondary fuel, powered combined cycle facility with a net power capacity of 2,400 MW located in Fujairah Emirate, adjacent to the existing Fujairah 1 (F1), with a capacity of 760 MW net, and the existing Fujairah 2 (F2), with a capacity of 2,000 MW net.

2.3.1.1. Meet UAE Future Power Demand

The main rationale of this Project is to meet Fujairah's and more generally the overall future UAE's energy demands by providing a secure power supply, at a time when the power and water sector is currently undergoing significant changes. For example, recent and future power projects in the UAE include Barakah Nuclear Plant (Abu Dhabi), Sheikh Mohammed Bin Rashid Al Maktoum Solar Park (Dubai) and Hatta Pumped Storage Power (Dubai). The Project therefore aims to provide cost-effective and efficient power capacity for the UAE.

2.3.1.2. Provide Power Flexibility in UAE and Complement Sustainable Power Projects

The Project is also understood to act as a complement to existing and future renewable energy generation in the UAE, such as Mohammed bin Rashid Al Maktoum Solar Park, which the largest single-site solar park in the world based on the Independent Power Producer model with a planned production capacity of 5,000 MW upon completion in 2030.

One of the main challenges of renewable energy is that electricity demand does not always coincide with the production of energy. During summer time in Dubai, the peak load hours of electricity are from 12pm to 6pm (1). While the peak load hours seem to match with the sunlight hours, the production of energy will not be always sufficient to respond to the energy demand. In addition, during the night-time or days where there is insufficient sun, the solar facility will not be able to generate energy.

Therefore, the Project, along with Hatta PSP and other thermal plants, will be required to cope with the ramping up and down of solar photovoltaic generation during sunrise and sunset. During winter nights, efficient gas plants, including the Project, will compensate for the lack of solar photovoltaic generation, while in the summer such efficient gas plants will satisfy night-time demand which is primarily driven by air conditioning.

Therefore, the Project, along with other thermal plants, will therefore support the following UAE Plans and Strategies:

- **Ministry of Energy Strategic Plan 2017 – 2021:** The Strategic Plan focus on organising and developing general policies and legislations under the consultation of the stakeholders involved in order to fit the energy sector as per the international standards and following up its implementation. Three of the five strategic goals comprise sustainability targets as follows:

– Achieving security and sustainability of the energy sector, water and mining;
– Regulation of the energy, water and mining sector, and buried gases emission to support economic development; and
– Sustainable development and integrated management of water resources.

- **UAE Energy Strategy 2050:** As illustrated in Figure 2-1 below, the UAE had set direct targets to reduce carbon emission and increase the use of clean energy such as wind power, solar power, hydropower etc. With the reduction of fossil fuels, use of cleaner fossil fuels such as clean coal and gas and the increase of clean energy, the UAE Energy Strategy targets re reduce 70% carbon emission from the power generating process.

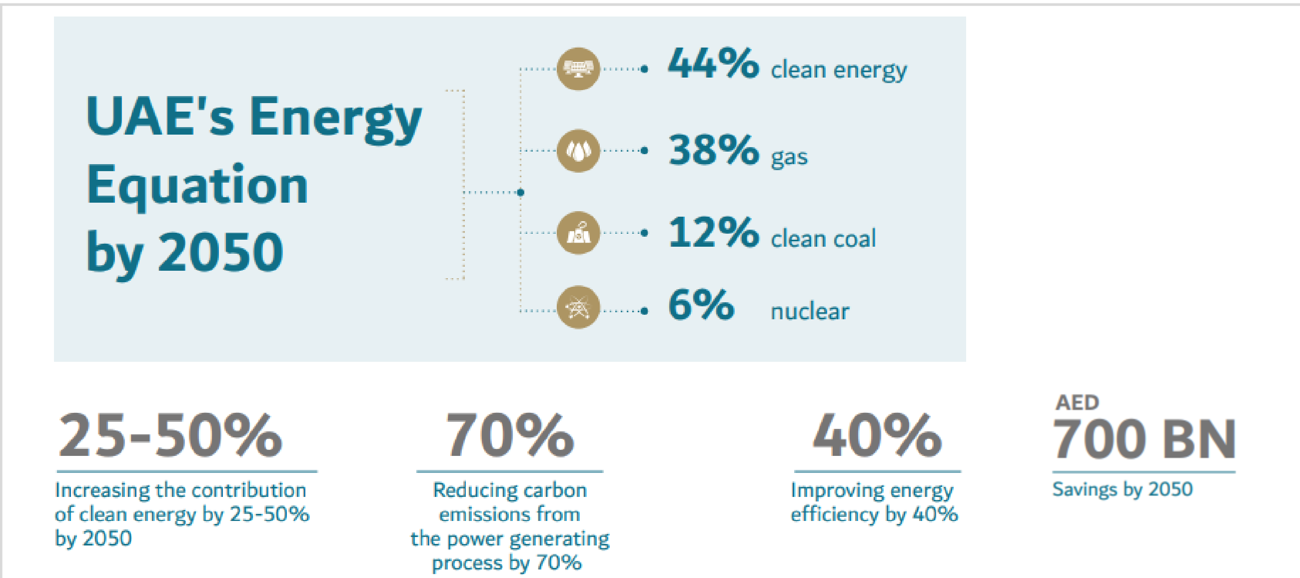


Figure 2-1: UAE Energy Strategy 2050 (2)

2.3.1.3. Promoting Investment and Providing Positive Socio-Economic Opportunities

Finally, additional objectives of the Project include promoting both local and foreign investment and private sector participation and creating employment and training opportunities in the UAE. This is further discussed in **Section 6.3.8: Socio-Economy.**

2.3.2. ESIA Rationale

The rationale of the production of this ESIA report is to meet and contribute to meet to the following goals:

- Ensure that the impacts of the construction and operation of the Project are minimised and the residual impacts (if any) are considered acceptable following the implementation of specific mitigation and monitoring measures. The standard approach to the assessment of impacts within this ESIA is presented in Figure 2-2 and in the below paragraphs;
- Meet FM-EPS requirements by receiving ESIA environmental approval for the Project prior the start of construction of the Project; and
- Meet JBIC requirements and ESIA approval to ensure JBIC funding for the Project.

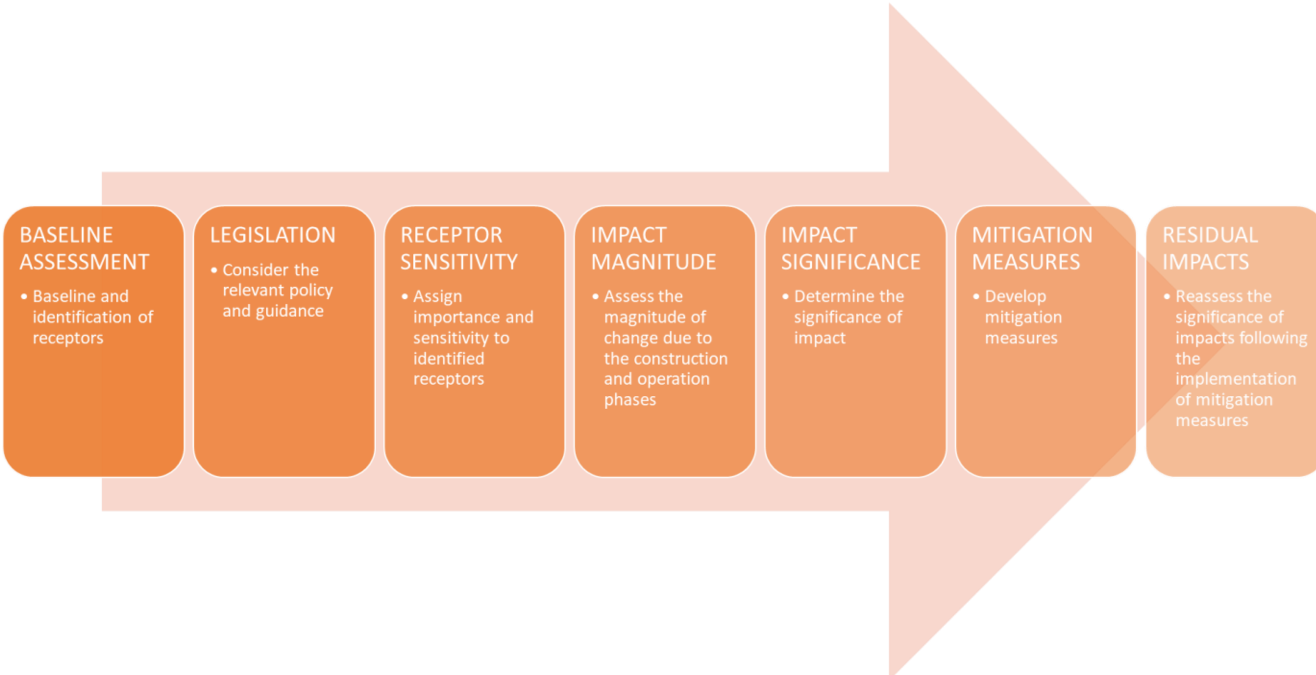


Figure 2-2: ESIA process flow chart

The assessment of the potential impacts of both the construction and operational phases of the Project will be based on a number of criteria, which are used to determine whether or not such impacts are 'significant'. These significant criteria will include:

- Local, national and international legislation, regulations and standards;
- Relationship with national planning policies or drivers;
- Sensitivity of the local environment;
- Reversibility or irreversibility and duration of the impact;
- Inter-relationship, if any, between the impacts, otherwise known as cumulative impacts; and
- Outcomes of consultations with relevant stakeholders.

The significance of impacts reflects judgements as to the importance or sensitivity of the affected receptors and the nature, magnitude and duration of the predicted changes.

The approach to identifying required mitigation and management measures has also been identified to ensure that, where significant impacts are identified, these can be reduced to acceptable levels.

2.4. Referenced Documents

This ESIA refers to a number of documents which are mentioned in totality in **Appendix 3**.

3. LEGAL FRAMEWORK

3.1. Legislation

3.1.1. Regulatory Framework in the United Arab Emirates

Federal Law No. (24) of 1999, Protection and Development of Environment is the key environmental law within the UAE. This law broadly outlines environmental protection across different environmental aspects (such as marine pollution, chemical materials, hazardous wastes and air pollution) and outlines the requirement for adequate environmental impact assessments of projects. The overall aim of Law No. (24) of 1999 is to protect the natural environment. The primary tools for achieving the objectives outlined by this law are regulations regarding the environmental impact of major projects, environmental monitoring, and protection, natural reserves, hazardous substances and compensation issues in case of environmental damage. The law aims to achieve the following goals:

- Protection and conservation of the quality and natural balance of the environment;
- Control of all forms of pollution and avoidance of any immediate or long-term harmful effects resulting from development;
- Handling of hazardous substances, hazardous wastes and medical waste;
- Development of natural resources and conservation of biological diversity in the region and the exploitation of such resources with consideration of present and future generations;
- Protection of society, human health and the health of other living creatures from activities and acts that are environmentally harmful or impede authorized use of the environmental setting;
- Protection of the UAE environment from the harmful effects of activities undertaken outside the region of the UAE; and
- Compliance with international and regional conventions ratified or approved by the UAE regarding environmental protection, control of pollution and conservation of natural resources.

In addition to the requirements of Federal Law 24, a number of Executive Regulations deal with specific environmental areas, including:

- Regulation for the Environmental Effects of Installations. This regulation requires an EIA to be carried out for certain projects before an Environmental License to develop and operate the project is issued by the Competent Authority; and
- Regulation for the Protection of the Maritime Environment. This is concerned with the prevention of pollution of the marine environment from vessels, land-based sources and offshore platforms.

Furthermore, the Executive Guidelines for Federal Law No. (24) for 1999, Concerning Environmental Protection and Development, Decree No. (37) of 2001, state the requirement to have a permit for new projects and also states that *"when analysing the expected environmental reactions, the following elements must be taken into consideration when conducting an EIA:*

a) Any environmental impact on the ecological system that might be affected by the project / activity; and

b) *Any impact on an Area/Place/or building that has an archaeological, amusement, architectural, cultural, historical, scientific, or social values, or has other environmental characteristics that form a value for the existing or future generations."*

Table 3-1 below details additional Federal laws, which are of potential relevance to the Project.

Table 3-1: UAE laws & standards

Legislation	Scope
Federal Law Number 7, 1993 Establishment of FEA and its amendments	Articles establishing the Federal Environmental Agency as a legal entity.
Federal Law Number 23, 1999 Protection and Development of Marine Resources	Governs exploitation, protection and development of marine biological resources.
Federal Law Number 9, 1983 UAE Hunting Law	Law regulating the hunting of birds and animals (mammals and reptiles).
Federal Law Number 11, 2002 Regulation and Control of Trade in Endangered Species and Wild Fauna and Flora and its Executive Order	Controls trade in internationally recognized endangered species and wild flora and fauna.
Law No 1, 2002 and its amendment by the Federal Law No 20, 1996 regarding the Regulation and Control of the use of Radioactive Sources and Protection against their Hazards	This law aims to control the use of radioactive sources in the UAE and control associated hazards. The law stipulates the establishment of the Federal Environment Agency which coordinates, controls and develop emergency plans at a country level for radioactive sources and potential environmental impacts. * Note, no radioactive materials will be used during the construction phase of the project.
Ministerial Order (12) 2006, pertaining to the protection of Air Quality.	Establishes the relevant Ambient Quality Standards in the UAE for: Sulphur dioxide, Nitrogen dioxide, Ozone and Particulate matter less than 10m.
UAE standards EMS 477 / 2006	The standard composition of the new diesel has been approved by the Emirates Standardization and Metrology Agency (EMS 477/2006).
Ministerial Order Number 12 and the Federal Environment Agency's Noise Emission limit values.	Establishes limits for noise levels within residential areas with light traffic, residential areas downtown, industrial areas, commercial areas, and residential areas which include some workshops, commercial business or residential areas near the highways.
Ministerial Decision 42 of 2008	This Ministerial Decision is to ensure that any structure that is to undergo demolition must be free of Asbestos Containing Materials prior to demolition.
Ministerial Decision No 32, 1982	This law is concerned with the protection of Health and Safety of workers, it contains provisions to ensure that employers take the necessary measures to prevent employees being exposed to risks from work related accidents and diseases.
Law No. (4), 1989	Concerning the establishment of the National Avian Research Centre.
Law No. (2) 1999	Pertaining to the protection of environment against abuse of the use of insecticides, pesticides and chemical fertilisers.

3.1.2. Regulatory Framework in Fujairah

The Competent Authority for environmental affairs in Fujairah is Fujairah Municipality Environmental Protection Section (FM-EPS). Fujairah adopts the legislation as set out within Federal Law No. (24) of 1999, Protection and Development of Environment (refer to **Section 3.1.1**) and additional Emirate level environmental standards are not in place.

Table 3-2 below presents FM-EPS EIA report format, as set out within the EP&DD Standard EIA Report format, Guidelines for EIA Report, Format for the Submission of Environmental Impact Assessment Reports). This ESIA Report has been developed to be consistent with the required structure.

Table 3-2: Fujairah Municipality EIA structure

FM-EPS Standard EIA Report Format		
General	The report should include; (i) Title Page, (ii) Table of Contents, (iii) List of tables, (iv) List of Figures, (v) List of Pictures, (vi) List of Maps and (vii) Table of Abbreviations, which should be kept to a minimum within the body of the report.	
Chapter No.	**Title**	**Contents**
1-	**Executive Summary**	Project Description. Findings
2-	**Introduction**	(2.1) Project Title and Project Proponent. (2.2) EIA Consultants (2.3) Project Rationale (2.4) Referenced Documents
3-	**Legal Framework**	List legislation (Federal, local) as well as international Conventions and Treaties, which may apply to the Project.
4-	**Project Description**	(4.1) Statement of Need (4.2) Concept and Phases (4.3) Location, Scale and Scheduling of Activities (4.4) Project Status (4.5) Waste Streams and Emissions
5-	**Description of the Environment**	(5.1) Baseline Conditions (5.2) Components Likely To-Be-Affected.
6-	**Impact Prediction and Evaluation**	(6.1) The Most Important Environmental Impacts (6.2) The EIA Matrix (6.3) Impact Assessment
7-	**Mitigation Measures**	(7.1) Recommendations

FM-EPS Standard EIA Report Format		
		(7.2) Additional Mitigation Measures (7.3) Residual Impacts (7.4) EMPs/Statement of Commitments
8-	**Alternatives**	Enlist alternatives to the main technology/philosophy used in the project. All assumptions must be clearly stated in all of the alternatives considered.
9-	**Monitoring Program**	(9.1) Monitoring Program for Compliance of Monitoring Measures. (9.2) Monitoring Program for Residual Impacts.
Annexes		
Annex 1	**Data on Existing Environment**	Detailed relevant description of the Environment
Annex 2	**Methodologies and Data Analysis**	Detailed methodologies; not only references.
Annex 3	**List of References**	-
Annex 4	**TOR and Consultation Activities**	TOR for EIA Consultants List of consultation held. Details of involvement of key stakeholders (how, when, who). Quality of relevant background documents. Quality assurance of data presented. Reliability of data sources.

3.2. Environmental Regulations & Standards

3.2.1. Air Quality

3.2.1.1. Ambient Air Quality

Cabinet Decree 12 of 2006, pertaining to the protection of air quality sets out ambient air quality standards sets out ambient air quality standards which are presented within Table 3-3 below. It should be noted that the Project is required to adopt more stringent 1-hour standards for NO_2 and SO_2 of 200 µg/m^3 specified by EWEC, as described in **Section 3.7.2**.

Table 3-3: Ambient air quality standards

Air Polluting Parameter	Averaging Period		Maximum Allowable Concentration in the Ambient Air (μg/m³)
Sulphur Dioxide	1	Hour	350
	24	Hour	150
	1	Year	60
Carbon Monoxide	1	Hour	30,000
	8	Hour	10,000
Nitrogen Dioxide	1	Hour	400
	24	Hour	150
Ozone	1	Hour	200
	8	Hour	120
Total Suspended Particulates	24	Hour	230
	1	Year	90
Particulate Matter <10 micron (PM_{10})	24	Hour	150
Lead	1	Year	1

3.2.1.2. Emissions Standards

Cabinet Decree 12 of 2006, pertaining to the protection of air quality sets out ambient air quality standards sets out maximum allowable emission limits of air pollutants emitted from stationary sources and emitted from hydrocarbon fuel combustion sources (Annex 1 & Annex 2) which apply at the Federal level. These are set out within Table 3-4 and

Table 3-5 below. It should be noted that the Project is required to adopt more stringent emissions standards for NO_x and CO specified by EWEC, as described in **Section 3.7.3**.

Table 3-4: Maximum allowable emission limits of air pollutants emitted from stationary sources for the UAE (Annex 1)

Substance	Symbol	Sources	Emission Limits (mg/Nm^3)
Visible Emissions	-	Combustion sources Other sources	250 none
Carbon Monoxide	CO	All sources	500
Nitrogen Oxides (expressed as nitrogen dioxide)	NO_x	Combustion sources Material producing industries Other sources	*Refer to Annex (2) (* Table 3-5 *below)* 1500 200
Sulphur Dioxide	SO_2	Combustion sources Material producing industries Other sources	500 2000 1000
Sulphur Trioxide Including Sulphuric Acid Mist (expressed as Sulphur Trioxide)	SO_3	Material producing industries Other sources	150 50
Total Suspended Particles	TSP	Combustion sources Cement industry Other sources	250 15 150
Ammonia and Ammonium Compounds (expressed as ammonia)	NH_3	Material producing industries Other sources	50 10
Benzene	C_6H_6	All sources	5
Iron	Fe	Iron & steel foundries	100
Zinc and its compounds (expressed as Zinc)	Zn	Electroplating/Galvanizing Industries	10
Lead and its Compounds (expressed as lead)	Pb	All sources	5
Antimony and its Compounds (expressed as antimony)	Sb	Material producing industries Other sources	5 1
Arsenic and its Compounds (expressed as arsenic)	As	All sources	1

Substance	Symbol	Sources	Emission Limits (mg/Nm^3)
Cadmium and its Compounds (expressed as cadmium)	Cd	All sources	1
Mercury and its Compounds (expressed as mercury)	Hg	All sources	0.5
Nickel and its Compounds (expressed as nickel)	Ni	All sources	1
Copper and its Compounds (expressed as copper)	Cu	All sources	5
Hydrogen Sulphide	H2S	All sources	5
Chloride	Cl^-	Chlorine works Other sources	200 10
Hydrogen Chloride	HCl	Chlorine works Other sources	200 20
Hydrogen Fluoride	HF	All sources	2
Silicon Fluoride	SiF4	All sources	10
Fluoride and its Compounds Including HF & SiF4 (expressed as fluoride)	F^-	Aluminum smelters Other sources	20 50
Formaldehyde	CH2O	Material producing industries Other sources	20 2
Carbon	C	Odes production Waste incineration	250 50
Total Volatile Organic Compounds (expressed as total organic carbon (TOC))	VOC	All sources	20
Dioxins & Furans		All sources	1 ($ng\ TEQ/m^3$)

<u>Notes:</u>

- The concentration of any substance specified in the first column emitted from any source specified in the third column shall not at any point before admixture with air, smoke or other gases, exceed the limits specified in the fourth column.
- "mg" means milligram.
- "ng" means nanogram.
- "Nm^3" means normal cubic meter, being that amount of gas which when dry, occupies a cubic meter at a temperature of 25 degree Centigrade and at an absolute pressure of 760 millimeters of mercury (1 atm).

Substance	Symbol	Sources	Emission Limits (mg/Nm^3)
- The limit of "Visible Emission" does not apply to emission of water vapor and a reasonable period for cold start-up, shutdown or emergency operation. - The measurement for "Total Suspended Particles (TSP)" emitted from combustion sources should be @ 12% reference CO_2. - The total concentration of the heavy metals (Pb, Cd, Ni, Hg, Cu, As & Sb) must not exceed 5 mg/Nm^3. - VOC limit is for unburned hydrocarbons (uncontrolled). - The emission limits for all the substances exclude "Dioxins and Furans" are conducted as a daily average value. - "Dioxins and Furans": Average values shall be measured over a sample period of a minimum of 6 hours and a maximum of 8 hours. The emission limit value refers to the total concentration of dioxins and furans are calculated using the concept of toxic equivalence in accordance with *Annex 5.*			

Table 3-5: Maximum allowable emission limits of air pollutants emitted from stationary sources for the UAE (Annex 2)

Substance	Symbol	Sources	Maximum Allowable Emission Limits (mg/Nm^3)
Visible Emissions	-	All sources	250
Nitrogen Oxides [expressed as Nitrogen Dioxide (NO_2)]	Nox	Fuel Combustion Units – having a gross heat input above 100,000 MJ excluding glass furnaces: – Gas Fuel – Liquid Fuel Turbine Units: – Gas Fuel – Liquid Fuel	 350 500 70 150
Sulfur Dioxide	SO_2	All sources	500
Total Suspended Particles	TSP	All sources	250
Carbon Monoxide	CO	All sources	500

Notes:

- The concentration of any substance specified in the first column emitted from any source specified in the third column shall not at any point before admixture with air, smoke or other gases, exceed the limits specified in the fourth column.
- ''mg'' means milligram.
- ''Nm^3'' means normal cubic meter, being that amount of gas which when dry, occupies a cubic meter at a temperature of 25 degree Centigrade and at an absolute pressure of 760 millimetres of mercury (1 atm).
- The limit of "Visible Emission" does not apply to emission of water vapor and a reasonable period for cold start-up, shutdown or emergency operation.
- The "Nox" emission limit of any existing turbine units operated by gas fuel, prior to the issuance and adoption of this regulation will be 125 mg/Nm^3.
- The measurement for "Total Suspended Particles (TSP)" emitted from combustion sources should be @ 12% reference CO_2.

3.2.2. Noise

3.2.2.1. National Legislation

Federal Law 12 of 2006 sets out permissible ambient noise levels for specific types of land use, as shown Table 3-6. A project cannot emit noise levels that cause exceedance of these limits.

Table 3-6: Allowable limits for noise (dB(A))

Classification of Receptor	Allowable Limits for Noise Levels (L_{Aeq} dB(A))	
	Daytime (7:00 – 22:00)	Night-Time (22:00 – 7:00)
Residential - Light Traffic	40-50	30-40
Residential - Downtown	45-55	35-45
Mixed Residential/Commercial Residential Near Highway	50-60	40-50
Commercial	55-65	45-55
Industrial	60-70	50-60

The United Arab Emirates (UAE) federal regulations are consistent with the guidelines of the World Health Organisation (WHO) and those of the World Bank.

3.2.2.2. International Guidelines

The international standards/guidelines that have been applied to the Project are the International Finance Corporation (IFC) General Environmental, Health and Safety (EHS) Guidelines (3). The EHS Guidelines are technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP).

IFC refers to guidance from the WHO on establishing community noise levels (4). The guidance indicates that noise levels at receptors should not exceed the levels presented in Table 3-7 below, or result in a maximum increase in background levels of 3 dB(A) at the nearest receptor location off-site (3).

Table 3-7: Maximum permissible noise levels for general environment (3)

Classification of Receptor	Allowable Limits for Noise Levels (L_{Aeq} dB(A))	
	Daytime (7:00 to 22:00)	Night-Time (22:00 to 07:00)
Residential, Institutional/Educational	55	45
Industrial or Commercial	70	70

3.2.2.3. Allowable Limits Summary

A summary of the most stringent limits from both standards is presented in Table 3-8 below.

Table 3-8: Most stringent noise levels for general environment (5) (6)

Receptor (Outdoors)	Allowable Limits for Noise Levels (dBA)	
	Daytime	Night-Time
Residential - Light Traffic	50 (Federal)	40 (Federal)
Residential - Downtown	55 (Federal & IFC)	45 (Federal & IFC)
Institutional/Educational	55 (IFC)	45 (IFC)
Mixed Residential/Commercial Residential Near Highway	60 (Federal)	50 (Federal)
Commercial	65 (Federal)	55 (Federal)
Industrial	70 (Federal & IFC)	60 (Federal)

3.2.3. Marine Environment

3.2.3.1. Marine Water and Sediments

3.2.3.1.1. Federal Standards

Protection of the marine environment is regulated under the 'Regulation for the Protection of Maritime Environment', UAE Cabinet (7). The principle requirements of Chapter 3 of this regulation, pertaining to this scope of works, are as follows:

- No discharge of plastic materials including but not limited to, synthetic rope, synthetic fishing nets, plastic bags;
- No discharge of garbage including products, ceramics, glass and bottles, wood, lining and packing materials; and
- Food leftovers generated from marine vessels, rigs or barges, if to be disposed of into marine environment the discharge location must be as far as possible from land but not less than 12 nautical miles from the nearest shoreline.

In accordance with the Council of Ministers' Decision No 37 – 2001 – Protection of the Marine Environment, the non-degradable pollutants / Illegal compounds to be discharged into marine environment are presented in Table 3-9 below.

Table 3-9: Prohibited substances for discharge to marine environment (7)

Type of Prohibited Substances	Prohibited Substances
Organophosphorus Pesticides	Dimethoate
	Malathion
Polychlorinated Biphenyls	PCBs
	Aroclor
	Tetrachlorobiphenyl
	Trichlorobiphenyl
Organochlorine Pesticides	Aldrin
	Dieldrin
	DDT
	Chlordane
	Eldrin
Polynuclear Aromatic Hydrocarbons (PAH)	Benzo (a) pyrene
	Naphthalene

3.2.3.1.2. Fujairah Standards

No marine standards are in place within Fujairah. Nevertheless, it is understood that as part of the development of the Environment and Social Scoping Report prepared by Mott MacDonald (12th September 2019), Fujairah Municipality confirmed during a consultation meeting with Mott MacDonald, that the project shall comply with Abu Dhabi environmental standards and guidelines. These have therefore been referred to in **Section 3.2.3.1.3** below.

Separately, the Project is required to adopt effluent discharge limits specified by EWEC, as described in **Section 3.7.4**.

3.2.3.1.3. Adopted Abu Dhabi Guidelines

The EAD Technical Guidance Document Standards and Limits for Pollution to Air and Marine Environments includes Recommended Ambient Marine Water Quality Standards as presented in Table 3-10 below.

Table 3-10: Recommended Ambient Marine Water Quality Objectives (EAD AWQS)

Parameters	Maximum Concentration	Units
Physical Indicators		
Floating Particles / Floatable / Debris	Nil	mg/m^2
Temperature	+/- 3	^oC of background
Turbidity	10	NTU
Transparency	≥10	Meter of Secchi Depth
Salinity	≤5	% background concentration
BOD	5	mg/l
Odour	Not objectionable	-
Colour	No change from background	-
Chemical Indicators		
Ammonia	0.004	mg/L
Arsenic	0.005	mg/L
Cadmium	0.001	mg/L
Chorine Residual	0.01	mg/L
Chromium	0.01	mg/L
Copper	0.01	mg/L
Cyanide	0.004	mg/L
Lead	0.01	mg/L
Mercury	Not given	Not given
Oil and grease	Not visible	mg/L
Petroleum Hydrocarbon	5	mg/L
Dissolved Oxygen	≥4	mg/L
Total Suspended Solids	≤33	mg/L
pH	6.5 – 8.5	mg/L

Parameters	Maximum Concentration	Units
Phenols	0.001	mg/L
Phosphorus Total	0.001	mg/L
Phosphate	34	Microgram/L
Sulphides	0.004	mg/L
Total Organic Carbon	2.5	mg/L
Zinc	0.01	mg/L
Nickel	20	Microgram/L
Iron	0.3	mg/L
Vanadium	9.4	Microgram/L
NO_3	95	Microgram/L
NO_2	34	Microgram/L

Furthermore, the Abu Dhabi Specification (ADS) for Ambient Marine Water and Sediments Specifications are also in place. Which are presented in Table 3-11 and Table 3-12 below.

Table 3-11: Maximum allowable concentrations for ambient marine water (ADS)

Parameter	Unit	General Use Areas	Marine Protected Use Areas
Cadmium	µg/l	0.7	0.3
Chromium	µg/l	0.2	0.2
Copper	µg/l	3.0	3.0
Lead	µg/l	2.2	2.2
Mercury	µg/l	0.1	0.1
Nickel	µg/l	7.0	3.0
Zinc	µg/l	15.0	15.0
Total Petroleum Hydrocarbons (TPH)	µg/l	7.0	7.0
Total Polychlorinated Biphenyls (PCBs)	µg/l	0.03	0.03

Parameter	Unit	General Use Areas	Marine Protected Use Areas
Chlorophyll (a)	µg/l	1.0	0.7
DO*	mg/l	4.0	4.0
Enterococci	CFU or MPN/100 ml	35	35
Note: µg/l: micrograms per liter; mg/l: milligram per liter; CFU: Colony Forming Unit; MPN: Most Probable Number; **: minimum allowable concentration*			

Table 3-12: Maximum allowable concentrations for ambient marine sediments (ADS)

Parameter	Unit	General Use Areas	Marine Protected Use Areas
Arsenic (As)	mg/kg	7.0	7.0
Cadmium (Cd)	mg/kg	0.7	0.2
Chromium (Cr)	mg/kg	52	11
Copper (Cu)	mg/kg	20.0	20.0
Lead (Pb)	mg/kg	30.0	5.0
Mercury (Hg)	mg/kg	0.2	0.2
Nickel (Ni)	mg/kg	16.0	7.0
Zinc (Zn)	mg/kg	125.0	70.0
Total Polychlorinated Biphenyls (PCBs)	µg/kg	22.0	22.0
Total Polycyclic Aromatic Hydrocarbons (PAHs)	mg/kg	1.7	1.7
Note: mg/kg: milligram per kilogram; µg/kg: micrograms per kilogram; DW: Dry Weight			

3.2.3.1.4. Additional Reference Standards

In addition to the adopted Abu Dhabi standards set out within the preceding section, reference has also been made to the Ambient Water Quality Objectives (AWQO) for Dubai, which includes standards for residual chlorine not included within the Abu Dhabi standards. These are provided in Table 3-13 below.

Table 3-13: Dubai Ambient Water Quality Objectives

Parameter	Sea and Coastal Zone (mg/l) Standards
Physicochemical Parameters	
BOD5	20
Chlorine, total residual	0.01
Dissolved Oxygen	Not less than 5 mg/l or 90% saturation
Nitrogen -ammonia (NH3-N)	0.1
Nitrogen – nitrate	0.5
Nitrogen- total	2.0
Petroleum hydrocarbons	0.001 (aromatic fraction)
pH	1 pH unit from ambient level
Phosphate-Phosphorus	0.05
Temperature	20°C from background level
Total Dissolved Solids	2% from background levels
Turbidity/Colour	75 NTU or none that will reduce light penetration by more than 20% from background levels.
Surfactants	0.02
Suspended Solids	10 mg/l mean 25 mg/l maximum
Trace Metals	
Aluminium	0.2
Arsenic	0.01
Cadmium	0.003
Chromium	0.01
Copper	0.005
Iron	0.2
Mercury	0.001
Zinc	0.02
Bacteriological	
Bacteria (E. Coli)	200 Organisms per 100 ml water

3.2.3.2. Marine Ecology

Federal Law No. (24) of 1999 Protection and Development of the Environment sets out control measures with respect to the development of natural resources and conservation of biological diversity in the region.

3.2.4. Waste Management

The following key pieces of legislation sets out control measures for waste production, storage, transportation and treatment within the UAE:

- Executive Order of Federal Law No. (24) Regulation for Handling Hazardous Materials, Hazardous Wastes and Medical Wastes and the Federal Law No. 12 of 2018 on the Integration of Waste Management;
- Ministerial Decree No. (98) of 2019 On using Refuse Derived Fuel (RDF) produced from waste treatment procedures in cement plants; and
- Ministerial Resolution No. (21) on the use of recycled aggregates from construction and demolition waste for road construction and infrastructure projects.

Furthermore, the UAE Vision 2021 sets an overall UAE target of 75% of waste generated shall be diverted from landfill.

3.2.5. Soil & Groundwater

There are no soil or groundwater standards which have been adopted within Fujairah. It is therefore proposed to adopt the Dutch Intervention Values (2009) for soil, which are presented within Table 3-14 below and target and intervention values for groundwater, which are presented in Table 3-15 below.

Table 3-14: Dutch intervention values for soils (2009)

Parameter	Dutch Intervention Values (mg/kg)
Metals	
Antimony	22
Aluminium	-
Arsenic	76
Barium	(1)
Cadmium	13
Chromium Hexavalent (Cr6+)	78
Chromium Trivalent (Cr3+)	180
Copper	190
Lead	530
Nickel	100
Zinc	720
Molybdenum	190
Pesticides	
Chlorodane (sum)	4
DDT (sum)	1.7
DDE (sum)	2.3

Parameter	Dutch Intervention Values (mg/kg)
DDD (sum)	34
Aldrin	0.32
Drins (sum)	4
α-endosulphan	4
α-HCH	17
β-HCH	1.6
γ-HCH (lindane)	1.2
Heptachlor	4
Heptachlor epoxide (sum)	4
Organotin compounds (sum)	2.5
MCPA	4
Atrazine	0.71
Carbaryl	0.45
Carbofuran	0.017
Other Inorganic Compounds	
Cyanide (free)	20
Cyanide (complex)	50
Phenols	14
Cresols (sum)	13
Polynuclear Aromatic Hydrocarbons (PAH)	
PAH (total)	40[(2)]
Chlorinated Hydrocarbons	
Monochloroethene (Vinylchloride)	0.1
Dichloromethane	3.9
1,1-dichloroethane	15
1,1-dichloroethane	6.4
1,1-dichloroethane	0.3
1,2-dichloroethene (sum)	1
Dichloropropanes (sum)	2
Trichloromethane (chloroform)	5.6
1,1,1-trichloroethane	15
1,1,2-trichloroethane	10
Trichloroethene (Tri)	2.5

Parameter	Dutch Intervention Values (mg/kg)
Tetrachloromethane (Tetra)	0.7
Tetrachloroethene (Per)	8.8
Monochlorobenzene	15
Dichlorobenzenes (sum)	19
Trichlorobenzenes (sum)	11
Tetrachlorobenzenes (sum)	2.2
Pentachlorobenzenes	6.7
Hexachlorobenzene	2.0
Monochlorophenols (Sum)	5.4
Dichlorophenols (Sum)	22
Trichlorophenols (Sum)	22
Pentachlorophenol	21
PCBs (sum 7)	12
BTEX Compounds	
Benzene	1.1
Ethylbenzene	110
Toluene	32
Total Xylenes	17
Other Substances	
Monochloroanilines (sum)	50
Dioxin (sum I-TEQ)	0.00018
Chloronaphthalene (sum)	23
Asbestos	100
Cyclohexanone	150
Dimethyl phthalate	82
Diethyl phthalate	53
Di-isobutyl phthalate	17
Dibutyl phthalate	36
Butyl benzyl phthalate	48
Dihexyl phthalate	220
Di(2-ethylhexyl)phthalate	60
Mineral oil	5,000
Pyridine	11

Parameter	Dutch Intervention Values (mg/kg)
Tetrahydrofuran	7
Tetrahydrothiophene	8.8
Tribromomethane (bromoform)	75

(1) The barium standard has been repealed because the intervention value for barium proved to be lower than the concentration naturally occurring in the soil. In the case of increased barium concentrations compared to the natural background due to an anthropogenic source, this concentration can be assessed on the basis of the former intervention value for barium of 920 mg/kg d.s. This former intervention value is substantiated in the same manner as the intervention values for most of the other metals, and for barium it includes a natural background concentration of 190 mg/kg d.s.

(2) Based on the sum of 10 individual PAH species.

(3) Original Guidelines for specific values

Table 3-15: Dutch target and intervention values for groundwater (2009)

Parameters	Groundwater (µg/L in solution)	
	Target value for shallow groundwater (<10m bgl)	Intervention value
I – Metals		
Antimony	-	20
Arsenic	10	60
Barium	50	625
Cadmium	0.4	6
Chromium	1	30
Cobalt	20	100
Copper	15	75
Mercury	0.05	0.3
Lead	15	75
Molybdenum	5	300
Nickel	15	75
Zinc	65	800
II – Inorganic compounds		
Cyanides-free	5	1500
Cyanides-complex (pH<5)	10	1500
Cyanides-complex (pH >5)	10	1500
Thiocyanates (sum)	-	1500
Bromide (mg Br/l)	0.3mg/L[2]	-

Parameters	Groundwater (µg/L in solution)	
	Target value for shallow groundwater (<10m bgl)	Intervention value
Chloride (mg Cl/l)	100mg/L[2]	-
Fluoride (mg F/l)	0.5mg/L[2]	-
III – Aromatic compounds		
Benzene	0.2	30
Ethyl benzene	4	150
Toluene	7	1000
Xylenes	0.2	70
Styrene (vinyl benzene)	6	300
Phenol	0.2	2000
Cresols (sum)	0.2	200
Catechol(o-dihydroxybenzene)	0.2	1250
Resorcinol(m-dihydroxybenzene)	0.2	600
Hydroquinone(p-dihydroxybenzene)	0.2	800
IV – Polycyclic aromatic hydrocarbons (PAH)		
PAH (sum 10)	-	-
Naphthalene	0.01	70
Anthracene	0.0007	5
Phenatrene	0.003	5
Fluoranthene	0.003	1
Benzo(a)anthracene	0.0001	0.5
Chrysene	0.003	0.2
Benzo(a)pyrene	0.0005	0.05
Benzo(ghi)perylene	0.0003	0.05
Benzo(k)fluoranthene	0.0004	0.05
Indeno(1,2,3-cd)pyrene	0.0004	0.05
V – Chlorinated hydrocarbons		
Vinyl Chloride	0.01	5
Dichloromethane	0.01	1000
1,1-dichloroethane	7	900
1,2-dichloroethane	7	400
1,1-dichloroethene	0.01	10

Parameters	Groundwater (µg/L in solution)	
	Target value for shallow groundwater (<10m bgl)	Intervention value
1,2-dichloroethene (cis and trans)	0.01	20
Dichloropropane	0.8	80
Trichloromethane (chloroform)	6	400
1,1,1-trichloroethane	0.01	300
1,1,2-trichloroethane	0.01	130
Trichloroethene (Tri)	24	500
Tetrachloromethane (Tetra)	0.01	10
Tetrachloroethene (Per)	0.01	40
Chlorobenzenes (sum)	-	-
Monochlorobenzene	7	180
Dichlorobenzenes	3	50
Trichlorobenzenes	0.01	10
Tetrachlorobenzenes	0.01	2.5
Pentachlorobenzene	0.003	1
Hexachlorobenzene	0.00009	0.5
Chlorophenols (sum)	-	-
Monochlorophenols (sum)	0.3	100
Dichlorophenols	0.2	30
Trichlorophenols	0.03	10
Tetrachlorophenols	0.01	10
Pentachlorophenol	0.04	3
Chloronaphthalene	-	6
Monochloroaniline	-	30
Polychlorobiphenyls (sum 7)	0.01	0.01
VI – Pesticides		
DDT/DDE/DDD	0.004ng/L	0.01
Drins (sum)	-	0.1
Aldrin	0.009ng/L	
Dieldrin	0.1ng/L	
Endrin	0.04ng/L	
HCH-compounds	0.05	1

Parameters	Groundwater (µg/L in solution)	
	Target value for shallow groundwater (<10m bgl)	Intervention value
α-Hch	33ng/L	
β-Hch	8ng/L	
γ-Hch	9ng/L	
Atrazine	29ng/L	150
Carbaryl	2ng/L	50
Carbofuran	9ng/L	100
Chlorodane	0.02ng/L	0.2
Endosulfan	0.2ng/L	5
Heptachloro	0.005ng/L	0.3
Heptachloro-epoxide	0.005ng/L	3
Maneb	0.05ng/L	0.1
Mcpa	0.02	50
Organotin compounds	0.05*-16ng/L	0.7
VII – Other contaminants		
Cyclohexanone	0.5	15000
Phthalates (sum)	0.5	5
Mineral oil	50	600
Pyridine	0.5	30
Tetrahydrofuran	0.5	300
Tetrahydrothiophene	0.5	5000
Tribromomethane	-	630
VIII – Aromatic compounds		
Dodecylbenzene	-	0.02
Aromatic solvents	-	150
IX – Chlorinated hydrocarbons		
Dichloroaniline	-	100
Trichloroaniline	-	10
Tetrachloroaniline	-	10
Pentachloroaniline	-	1
4-chloromethylphenols	-	350
Dioxin	-	0.00 1ng/L

Parameters	Groundwater (µg/L in solution)	
	Target value for shallow groundwater (<10m bgl)	Intervention value
X – Pesticides		
Azinphos-methyl	0.1* ng/L	2
XI – Other contaminants		
Acrylonitrile	0.08	5
Butanol	-	5600
1,2-butylacetate	-	6300
Ethylacetate	-	15000
Diethylene glycol	-	13000
Ethylene glycol	-	5500
Formaldehyde	-	50
Isopropanol	-	31000
Methanol	-	24000
Methyl-tetra-butyl ether (MTBE)	-	9200
Methylethylketone	-	6000

3.2.6. Terrestrial Ecology

The following Federal Laws will apply for the protection of ecological resources:

- Federal Law No. (24) of 1999 Protection and Development of the Environment sets out control measures with respect to the development of natural resources and conservation of biological diversity in the region;
- Federal Law number (81) of the year 1974 on the admission of the United Arab Emirates to the International Convention on Trade in Endangered Species of Wild Fauna and Flora;
- Federal Law number (11) of the year 2002 Concerning Regulating and Controlling the International Trade in Endangered Species of Wild Fauna & Flora; and
- Decree No. 224 of 2015 on protecting wild plants species which list Endangered, Vulnerable and Near Threatened species within the UAE.

3.2.7. Cultural Heritage

3.2.7.1. Overview

Archaeological and cultural heritage sites are protected by the Federal Law No 11 of 2017 (hereafter referred to as the Antiquities Law). The most relevant and essential articles of the Antiquities Law are discussed.

3.2.7.2. Legal Definition of Antiquities

In article 1 of Federal Law No 11 of 2017, the governmental protection of all cultural heritage is declared. All such cultural heritage is considered governmental property. This includes both tangible and intangible heritage. The term “mobile antiquities” is equal to the archaeological technical term “small finds”, while archaeological and cultural heritage sites (traditional villages) are addressed as “immobile antiquities” in the text of the Antiquities Law.

Provided by article 2, the Federal Law No 11 of 2017 defines the aims to be achieved by the regulations.

It can be translated to the enrichment of the cultural development of the country and suggests the importance of such national heritage to strengthen national identity.

Article 3 of the antiquities law limits the application of the law explicitly to antiquities situated geographically inside the territory of the UAE.

The articles 4 to 11 provide regulations on the administration of antiquities within the territory of each union state of the UAE.

Article 12 provides a legal obligation to protect any movable antiquity, discovered accidentally, and to inform a governmental authority about their existence in order to follow up by the responsible authorities.

In Chapter 3, Article 18 to 24, regulations are provided for immovable antiquities, which translates to legal treatment of archaeological and cultural heritage sites according to the definition provided in Article 1. Namely, it is legally prohibited to conduct any work that could potentially harm such sites.

3.2.7.3. Protection, preservation and education as legal aims

In article 2 of the Antiquities Law, it is the declared aim of the State of UAE is to protect and preserve the national cultural heritage. Furthermore, the promotion of the knowledge about the cultural heritage of the State of UAE is explicitly mentioned.

In Article 2 of the Antiquities Law, education about the national heritage of the UAE is defined as a legal aim. The responsible Authority is tasked with executing both objectives, preservation and education; at present, the legal obligations are transferred to the constituted Emirate Departments of Antiquities. These are the responsible authorities to define, preserve and administer any cultural heritage of the State of UAE.

The research and systematic excavation of archaeological sites in the UAE is subject to the legal regulations provided in Chapter 5 of the Antiquities Law. The potential involvement of scientists or scientific institutions from abroad is explicitly mentioned and sanctioned.

3.2.7.4. Requirement for development projects

Article 20 states that the execution of major development or construction projects or infrastructure projects may only be commenced after the competent authority undertakes archaeological surveys, in accordance with the procedures applied by the competent authority. Cooperation between the responsible Authorities and the responsible town planning and development Authorities (e.g. Municipalities and relevant local Ministries) therefore is required to schedule the planning of major infrastructure accordingly.

3.2.7.5. Regulations on the violation of the Antiquities Law

The non-compliance with the Antiquities Law is subject to penalties. Penalties apply for any damage, removal, deformation or destruction of antiquities, movable or immovable. Penalties include significant fines and imprisonment.

3.3. International Treaties

The UAE is party to a number of regional and international treaties and conventions related to the environment as presented in Table 3-16.

Table 3-16: International conventions related to the environment in the UAE

Convention Name	Status: Approval, Acceptance, Accession, Succession or Ratification	Date of Approval, Acceptance, Accession, Succession or Ratification	Globally Date of Agreement
The International Treaty on Plant Genetic Resources for Food and Agriculture (CGRFA)	Ratified	24/01/2004	Rome, 04/11/2002
Convention on International Trade in Endangered Species of wild Fauna and Flora (CITES)	Ratified	9/05/1990	Washington, D.C, 03/03/1973
Vienna Convention for the Protection of the Ozone Layer	Ratified	29/12/2004	Vienna, 22/03/1985
Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified	29/12/2004	Montreal, 16/09/1987
Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified	16/02/2005	London, 29/06/1990
Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified	16/02/2005	Copenhagen, 25/11/1992
Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified	16/02/2005	Montreal, 17/09/1997
Amendment to the Montreal Protocol on Substances that Deplete the Ozone Layer	Ratified	16/02/2005	Beijing, 3/12/1999
The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal	Ratified	3/03/1990	Basel, 22/03/1989
United Nations Convention to Combat Desertification	Ratified	21/10/1998	Paris, 14/10/1994
Convention on Biological Diversity (CBD)	Ratified	24/11/1999	Rio de Janeiro, 05/06/1992
Protocol Nagoya – Kuala Lumpur Supplementary to the Cartagena Protocol on Biosafety on liability and redress	Ratified	23/07/2014	Pyeongchang, 10/10/2010

Convention Name	Status: Approval, Acceptance, Accession, Succession or Ratification	Date of Approval, Acceptance, Accession, Succession or Ratification	Globally Date of Agreement
Cartagena Protocol on Biosafety	Ratified	23/07/2014	Montreal, 29/01/2000
Nagoya Protocol on access to genetic resources and the fair and equitable sharing of benefits arising from their use	Ratified	23/07/2014	Nagoya, 29/10/2010
Intergovernmental Platform on Biodiversity and Ecosystem services	Ratified	11/01/2015	Panama City, 01/04/2012
Stockholm Convention on Persistent Organic Pollutants	Ratified	11/07/ 2002	Stockholm, 22/ May/ 2001
Convention on Wetlands of International Importance – Ramsar	Ratified	29/12/2007	Australia, 08/05/1974
United Nations Framework Convention on Climate Change (UNFCCC)	Ratified	20/11/1995	New York, 09/05/1992
Kyoto Protocol to the United Nations Framework Convention on Climate Change	Ratified	29/12/2004	Kyoto, 11/12/1997
Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade	Ratified	11/08/2002	Rotterdam, 10/10/1998)
Regional Organization for the Protection of the Marine Environment (ROPME)	Ratified	01/04/1979	Kuwait, 24/04/1978
Protocol Concerning Regional Cooperation In Combating Pollution By Oil And Other Harmful Substances In Cases Of Emergency	Ratified	01/04/1979	Kuwait, 24/April/1978
Protocol Concerning Marine Pollution resulting from Exploration of the Continental Shelf	Ratified	16/07/1990	Kuwait, 1/03/1989
Protocol for the protection of the Marine Environment against Pollution from Land – Based Source	Acceptance	21/02/1990	Kuwait, 1/02/1990
Convention on the sanitary and phytosanitary (SPS)	Accession	10/04/1996)	Kuwait, 1/01/1995
International Plant Protection Convention	Accession	02/10/2005	Rome, 6/12/1951
Minamata Convention on Mercury	Ratified	25/03/2015	Kumamoto, 10/10/2013
Agreement on Agriculture	Accession	10/04/1996	Kuwait, 1/January/1995
Convention on the Conservation of Migratory Species of Wild Animals (CMS)	Ratified	01/05/2016	Bonn, 23/06/1979

Convention Name	Status: Approval, Acceptance, Accession, Succession or Ratification	Date of Approval, Acceptance, Accession, Succession or Ratification	Globally Date of Agreement
Convention on Conservation of Wildlife and its Natural Habitats in the GCC	Ratified	2003	Kuwait, 2001
Paris Agreement on Climate Change	Acceptance	22/04/2016	Paris, 12/12/2015
The International Treaty on Plant Genetic Resources for Food and Agriculture (CGRFA)	Ratified	9/05/1990	Washington, D.C, 3/03/1973

3.4. World Bank / International Finance Corporation

3.4.1. Overview

The IFC is part of the World Bank Group and fosters sustainable economic growth in developing countries by financing private sector investment. The IFC have developed their Performance Standards to ensure that their operations are sustainable. The IFC Standards have also been widely adopted by a wide range of groups including Export Credit Agencies through the Common Approaches and financial institutions which have signed up to the Equator Principles (referred to as Equator Principal Financial Institutions (EPFIs).

3.4.2. Performance Standards

All IFC projects or projects where IFC Performance Standards (updated 2012) are adhered to must meet with the following Performance Standards on Social and Environmental Sustainability:

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

3.4.3. IFC Environmental Health & Safety Guidelines

The IFC has prepared a series of Environmental Health and Safety Guidelines (EHS), which provide general and sector specific guidance. The EHS Guidelines are indeed technical reference documents with general and industry-specific examples of Good International Industry Practice (GIIP) and are referred to in the World Bank's Environmental and Social Framework and in IFC's Performance Standards. These documents provide details of the required levels and considerations when undertaking an ESIA for a project.

In relation to this Project, the following are considered to be relevant:

- **General EHS Guidelines (2007):** The General EHS Guidelines covers four main subjects which include environment, occupational health and safety, community health and safety and construction and decommissioning; and
- **EHS Guidelines for Thermal Power Plants (2007):** The Thermal Power Guidelines are applicable to combustion processes fuelled by gaseous, liquid and solid fossil fuels and biomass and designed to deliver electrical or mechanical power, steam, heat, or any combination of these, regardless of the fuel type (except for solid waste).

3.5. Equator Principles

In October 2002, the IFC convened a meeting of banks in London to discuss environmental and social issues in project finance. It was decided to try to develop a banking industry framework for addressing environmental and social risks in project financing which led to the drafting of the Equator Principles (Eps). The Eps apply globally to all industry sectors and to four financial products; 1) Project Finance Advisory Services 2) Project Finance 3) Project-Related Corporate Loans and 4) Bridge Loans.

On June 4th, 2003, 10 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. To date, 94 Equator Principles Financial Institutions (EPFIs) operating in 37 countries worldwide have adopted the Equator Principles. EPFIs commit to implementing the Eps in their internal environmental and social policies, procedures and standards for financing projects and will not provide Project Finance or Project-Related Corporate Loans to projects where the client will not, or is unable to, comply with the Eps.

The Eps present ten key principles:

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

3.6. Japanese Bank for International Cooperation

3.6.1. Overview

The Project will require financing from the Japan Bank for International Cooperation (JBIC). In January 2015 JBIC released their Guidelines for the Confirmation of Environmental and Social Considerations, which was adopted in April 2015 and replaced earlier editions of the guidelines.

As part of this JBIC requires that project proponents undertake appropriate environmental and social considerations so as to prevent or minimize the impact on the environment and local communities, and not to bring about unacceptable effects.

In making its funding decisions, JBIC conducts screenings and reviews of environmental and social considerations to confirm that the requirements are duly satisfied. JBIC makes the utmost efforts to ensure that appropriate environmental and social considerations are undertaken, in accordance with the nature of the project for which JBIC provides funding, as stated in the Guidelines, through such means as loan agreements.

JBIC undertakes the following process to ensure that projects are environmentally and socially acceptable:

a) classifies the project into one of three categories, based upon environmental and social sensitivity, referred to as “screening”;
b) conducts a review of environmental and social considerations when making a decision on funding, to confirm that the requirements are duly satisfied (referred to as “environmental review”); and
c) conducts monitoring and follow-up after the decision has been made on funding (referred to as “monitoring”).

JBIC ascertains whether a project complies with environmental laws and standards of the host national and local governments concerned, as well as whether it conforms to their environmental policies and plans. JBIC also ascertains whether a project meets the relevant aspects of World Bank Safeguard Policy regarding environmental and social considerations. On the other hand, for private sector limited or non-recourse project finance cases, or where appropriate, JBIC ascertains whether the project meets the relevant aspects of International Finance Corporation Performance Standards (which are discussed in **Section 3.4** above).

3.6.2. JBIC Project Categorisation

A proposed project is classified as Category A if it is likely to have significant adverse impacts on the environment. A project with complicated or unprecedented impacts which are difficult to assess is also classified as Category A. The impact of Category A projects may affect an area broader than the sites or facilities subject to physical construction. Category A, in principle, includes projects in sensitive sectors (i.e., sectors that are liable to cause adverse environmental impact) or with sensitive characteristics (i.e., characteristics that are liable to cause adverse environmental impact) and projects located in or near sensitive areas.

An illustrative list of sensitive sectors, characteristics and areas is provided within the Guidelines. Within this list Thermal Power is included as Point 12. Given the fact that the Project could result in significant environmental impacts and that these impacts could extend beyond the sites or facilities subject to physical construction, for the purposes of this ESIA it is assumed that the Project would be classified as Category A. On this basis, the ESIA has adopted the conditions set out within the JBIC Guidelines for ESIA Reports for Category A Projects.

3.6.3. JBIC ESIA Requirements

Borrowers and related parties must submit an ESIA report and environmental permit certificates issued by the host governments or other appropriate authority for Category A projects.

The environmental review process for both Category A and B projects examines the potential negative and positive environmental impact of projects. JBIC evaluates measures necessary to prevent, minimise, mitigate or compensate for potential negative impact, and measures to promote positive impact if any such measures are available.

3.6.4. Disclosure

Prior to making decisions on funding and depending on the nature of the project, JBIC discloses information in principle as set out below. JBIC endeavours to disclose information in a manner that allows adequate time before decisions are made on funding and realise further information disclosure by working on project proponents to this end through the borrowers and related parties, in compliance with the relevant laws and ordinances in the host country, as follows:

- Upon completion of the screening of a project, JBIC discloses the project name, country, location, outline and sector of the project, and its category classification, as well as the reasons for that classification; and
- In the case of Category A and Category B Projects, JBIC publishes on its website the status of acquirement of the ESIA reports and environmental permit certificates confirming environmental and social considerations.

3.7. EWEC Requirements

3.7.1. Overview

EWEC have specified within their Request for Proposal (RFP) conditions that a range of environmental parameters are met. These are presented within the following sections.

EWEC have confirmed that the following standards shall be applied:

- European Union standards (for requirements not covered by those listed below);
- Standards and requirements as stated in the PPA and applicable in the UAE; and
- Other national requirements, consents and licenses.

3.7.2. Ambient Air Quality

3.7.2.1. RFP Requirements

For the F3 Plant, the maximum permissible air pollutant concentration at ground level and within a reference period of one hour (1-hour average) shall be as follows:

- Nitrogen dioxide NO_2 200 µg/m^3; and
- Sulphur dioxide SO_2 200 µg/m^3.

Note that this is more stringent than that required within Ministerial Order (12) 2006, pertaining to the protection of Air Quality, which sets standards of 400 µg/m^3 for NO_2 and 350 µg/m^3 for SO_2 (refer to **Section 3.2.1**). These more stringent standards have therefore been adopted within the assessment conducted as part of this ESIA.

3.7.2.2. European Union (EU) Legislation

The EU has established the following legislation, which defines ambient air quality limits as summarised in Table 3-17 below:

- **Directive 2008/50/EC** on ambient air quality and cleaner air for Europe including the following elements:

- The merging of most of existing legislation into a single directive (except for the Fourth Daughter Directive) with no change to existing air quality objectives;
- New air quality objectives for $PM_{2.5}$ (fine particles) including the limit value and exposure related objectives;
- The possibility to discount natural sources of pollution when assessing compliance against limit values;
- The possibility for time extensions of three years (PM_{10}) or up to five years (NO_2, benzene) for complying with limit values;

- **Directive 2004/107/EC** of the European Parliament and of the Council relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air (Fourth Daughter Directive);
- **Directive 2015/1480/EC of** 28 August 2015 amending several annexes to Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council laying down the rules concerning reference methods, data validation and location of sampling points for the assessment of ambient air quality; and
- **Commission Implementing Decision 2011/850/EU:** Commission Implementing Decision of 12 December 2011 laying down rules for Directives 2004/107/EC and 2008/50/EC of the European Parliament and of the Council as regards the reciprocal exchange of information and reporting on ambient air quality (notified under document C(2011) 9068).

Table 3-17: EU air quality standards

Pollutant	Concentration	Average Period	Permitted Exceedences Each Year
Fine Particles ($PM_{2.5}$)	25 µg/m³	1-year	N/A
Sulphur dioxide (SO_2)	350 µg/m³	1-hour	24
	125 µg/m³	24-hour	3
Nitrogen dioxide (NO_2)	200 µg/m³	1-hour	18
	40 µg/m³	1-year	N/A
PM_{10}	50 µg/m³	24-hour	35
	40 µg/m³	1-year	N/A
Lead (Pb)	0.5 µg/m3	1-year	N/A
Carbon Monoxide (CO)	10 mg/m3	Maximum daily 8-hour mean	N/A
Benzene	5 µg/m³	1-year	N/A
Ozone	120 µg/m³	Maximum daily 8-hour mean	25 days averaged over 3 years
Arsenic (As)	6 ng/m3	1-year	N/A
Cadmium (Cd)	5 ng/m3	1-year	N/A

Pollutant	Concentration	Average Period	Permitted Exceedences Each Year
Nickel (Ni)	20 ng/m3	1-year	N/A
Polycyclic Aromatic Hydrocarbons	1 ng/m3 (expressed as concentration of Benzo(a)pyrene)	1-year	N/A

3.7.3. Emissions to Air

The maximum permissible air emission levels, which are to be met within the specified temperature range between minimum stable load (which is expected at about 30% load) and maximum continuous rating of each gas turbine including supplementary firing are shown in the table below.

Table 3-18: Maximum permissible air emission levels

Emission	Unit	Simple Cycle (at Bypass stack)		Combined Cycle (at HRSG stack)	
		NG (3)	FO	NG (3)	FO
Nox (as NO_2)	mg/Nm^3	50	120 1)	20	120 1)
CO	mg/Nm^3	50	50	50	50
SO_2	mg/Nm^3	2)	2)	2)	2)
Smoke number	Bacharach	2	2	2	2
Ammonia Slip	ppm	-	-	5	-
Reference – O_2	Vol. %	15	15	15	15

Notes:

1) Nox emissions for Back-up Fuel (FO) are based on maximum fuel bound nitrogen content of 0.015 % by weight.

2) according to sulphur content in the fuel.

3) Emission guarantees are given for a daily average and for steady state operation and normal loading and deloading transients. Emissions guarantees will not apply to grid code compliance or frequency following transients.

For the stacks of the HRSGs, the RFP also specifies the following:

- The main stack height above ground level shall be a minimum of 60m;
- The bypass stacks height above ground level shall be a minimum of 30m; and

- A flue gas dispersion study is to be performed by the Bidder as part of the Environmental Impact Assessment, which has been undertaken as part of this ESIA and is presented within **Section 6.3.1**.

The following mitigation measures are also required to implemented:

- For the limitation of NOx when burning natural gas in turbines, such turbines shall be equipped with dry low NOx combustion. When burning fuel oil in gas turbines, the NOx emission shall be controlled by water injection if required;
- For the limitation of NOx when burning natural gas in supplementary fired HRSGs, such steam generators shall be equipped with low NOx burners;
- HRSGs shall be equipped with a SCR system with ammonia injection to meet NOx emission limits.
- For the limitation of particulates, CO and unburnt hydrocarbons, the steam generators shall be equipped with modern burner management systems and satisfactory burner design;
- Determination of final stack height shall be based on calculations mentioned above; and
- The plant shall be equipped to continuously monitor and record NOx, SO_2, CO and O_2 emissions.

3.7.4. Marine Discharges

Permissible effluent limits for aqueous discharges into the sea as mandated by EWEC are shown in Table 3-19 below.

Table 3-19: Permissible effluent limits

Constituents	Maximum Limits (mg/1)
Ammoniacal nitrogen	0.5
Arsenic (As)	0.05
Bio-chemical oxygen demand (BOD)	30
Cadmium (Cd)	0.1
Chlorine (residual) 1)	0.15
Chromium, total (Cr)	0.5
Copper (Cu)	0.5
COD	100
Cyanide (CN)	0.1
Oil	10
Iron, total (Fe)	1.0
Lead (Pb)	0.1
Manganese (Mn)	1.0
Mercury (Hg)	0.001

Constituents	Maximum Limits (mg/1)
Nickel (Ni)	0.5
pH	6.5 – 8.5
Phenols	0.1
Phosphate (total as P)	2.0
Selenium (Se)	0.05
Silver (Ag)	0.1
Sulphide	0.2
Suspended solids	30
Vanadium	1.0
Zinc (Zn)	0.5
TDS above receiving water at the edge of the mixing zone (100 m from point of discharge point)	< 5%
Max. cooling seawater temperature rise at edge of mixing zone (100 m from point of discharge point)	3 K
1) The limit refers to continuous chlorination. In case of shock chlorination (according to WB limit), the maximum value is 2 mg/l for up to 2 hours, not to be repeated more frequently than once in 24 hours, within a 24 hours average of 0.2 mg/l. 2) The provided values shall be verified from Fujairah Municipality and other local authorities as necessary, and the values which are more stringent shall be used.	

3.7.5. Soil Contamination

The F3 Plant shall be designed, operated and maintained in an adequate way to prevent any soil contamination.

3.7.6. Permissible Noise Levels

The design of the facility must ensure compliance with the following noise pressure levels during the performance tests, as set out within the RFP:

- At 1 meter outside the F3 Plant, when all equipment is in operation: max. 60 dB (A);
- At 1 meter distance of open air installations or turbine buildings: max. 85 dB (A);
- At 1 meter distance of each equipment inside turbine buildings: max. 90dB (A);
- Within the central control room: max. 50 dB (A); and
- Within other machine rooms and workshops: max. 85 dB (A).

3.8. ESIA Approach and Methodology

This Chapter sets out the approach and methodology which has been adopted as part of the ESIA process for the Project. This includes the approach to determine the existing environmental and socio-economic conditions, including identification of sensitive receptors and the general methodology for the assessment of environmental impacts likely to be associated with the Project.

3.8.1. ESIA Terms of Reference

The ESIA Terms of Reference was submitted to FM-EPS on the 8th February 2020 which is presented in **Appendix 4.1**. FM-EPS issued comments on the 23rd February 2020 which are presented in **Appendix 4.2.** FM-EPS comments and Anthesis responses are presented in Table 3-20 below.

Table 3-20: FM-EPS Terms of Reference responses

No.	FM-EPS Comments	Anthesis Response
-	Environment Protection Section has no objection on the Term of Reference, and you may process with the EIA study of the Project.	Noted.
-	The Project proponent / Environmental Consultant should clarify the following points within the ESIA report:	The following has been addressed in the ESIA:
1	Provide detailed description about Reverse Osmosis Unit to be used and associated waste generation (RO membranes, RO Sludge) and disposal.	Details regarding Reverse Osmosis is presented in **Section 4.2.2.2.3.15: Water Treatment System.** Discussion on waste impacts and mitigation measures are presented in **Section 6.3.7.2.2.3**, **Section 7.2.7** and **Section 7.3.1.7**
2	Intake / Outfall studies and surveys that have been conducted to identify the ideal locations must be submitted, including hydrodynamic studies.	As part of this ESIA, a detailed hydrodynamic modelling study has been undertaken which is presented in **Appendix 2.4** and summarised in **Section 6.3.5.2**. This has been developed based upon initial recirculation studies undertaken previously on behalf of EWEC and based upon detailed project design information to ensure that the acceptability of the intake and outfall configuration is fully determined.
3	Flue gas dispersion study and stack height calculation must be attached.	A full air dispersion modelling has been undertaken as part of this ESIA which is presented in **Appendix 2.2**. The ESIA assessment including reference to the stack height analysis undertaken by Mott MacDonald is discussed in **Section 6.3.1.3.3**. Mott MacDonald stack height analysis is presented in **Appendix 2.1**.
4	Does construction work of both intake and outfall require dredging? (If yes, this should be considered as part of the	Yes, dredging will be required and this has been assessed in this ESIA.

No.	FM-EPS Comments	Anthesis Response
	impact assessment for marine environment)	
5	CEMP must included both land and marine works activities	Noted, the CESMP will cover both land and marine works as detailed in **Section 7.4.1: Framework Construction Environmental and Social Management Plan (F-CESMP).**

3.8.2. Methodology

The standard approach to the assessment of impacts within this ESIA is presented in Figure 2-2 below. A detailed methodology for conducting baseline studies and impact assessments for each environmental aspect is presented within each respective technical chapter.

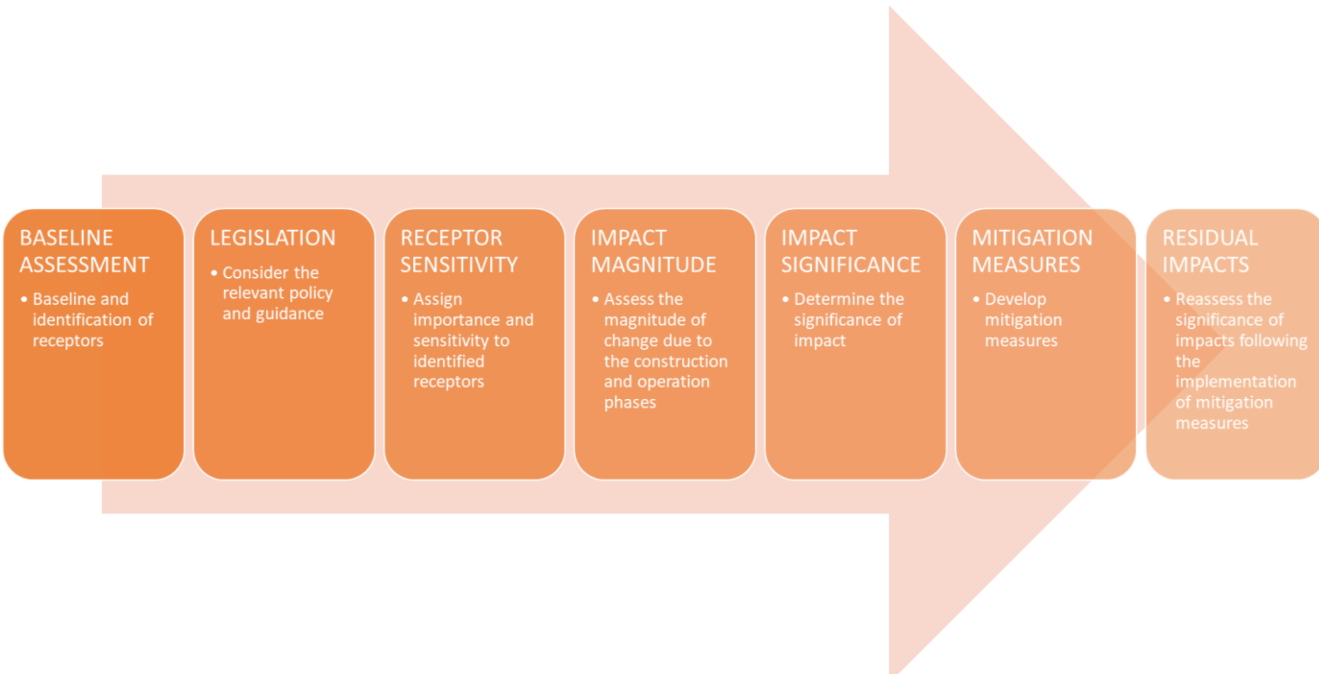


Figure 3-1: ESIA process flow chart

The assessment of the potential impacts of both the construction and operational phases of the Project will be based on a number of criteria, which are used to determine whether or not such effects are 'significant'. These significant criteria will include:

- Local, national and international legislation, regulations and standards;
- Relationship with national planning policies or drivers;
- Sensitivity of the local environment;
- Reversibility or irreversibility and duration of the impact;
- Inter-relationship, if any, between the impacts, otherwise known as cumulative impacts; and
- Outcomes of consultations with relevant stakeholders.

The significance of impacts reflects judgements as to the importance or sensitivity of the affected receptors and the nature, magnitude and duration of the predicted changes.

The approach to identifying required mitigation and management measures has also been identified to ensure that, where significant impacts are identified, these can be reduced to acceptable levels.

3.8.3. Sensitivity and Importance of Receptors

Receptors are defined as the physical resource or user group that would be impacted by a proposed development. In each technical chapter of the ESIA report, the potential sensitive receptors will be identified. The sensitivity of the receptors will be determined within each of the technical chapters using professional judgement, the consideration of existing designations and quantifiable data, where possible. Some examples are as follows:

- A proposed project site which is a protected area in accordance with IUCN criteria, international conventions such as RAMSAR, and supports species listed as Critically Endangered, Endangered or Vulnerable in the 2004 IUCN Red List of Threatened Animals and Critical habitats, would be classified as highly sensitive. In contrast, a site which includes habitats that are severely modified, damaged or degraded, or supporting a generic and common terrestrial habitat, would be classified as less sensitive; and
- Residential areas would generally be considered more sensitive to noise and poorly controlled lighting from a construction site than industrial areas.

3.8.4. Description of Impact

Impacts are defined as the physical changes to the environment as attributed to a project. In each technical chapter of the ESIA Report, the likely environmental impacts have been identified and taken into consideration in the course of the assessment.

Impacts are defined as either 'negative' or 'positive' and, depending on the discipline, either 'direct' (effects directly attributable to a project action / activity), or 'indirect' (effects that are not directly attributed to a project action / activity).

Impacts are also divided into those occurring during the construction phase of a project, and those that occur during the operational phase. Again, dependent on the discipline, the ESIA may refer to such effects as 'temporary', generally during the construction phase, and 'permanent' (generally during the operational phase).

3.8.5. Significance of Impacts

Prediction of impacts is essentially an objective exercise to determine what could potentially happen to the environment as a consequence of the Project and its associated activities. Impacts have been categorised according to their various characteristics (e.g. are they detrimental or beneficial, direct or indirect etc.). The various types of impacts that arise, and the terms used in this assessment are shown and discussed in the following tables and associated text.

When evaluating the severity of environmental impacts, the following factors are taken into consideration:

- **Impact Magnitude:** the magnitude of the change that is induced (i.e. the percentage of a resource that is lost);
- **Impact Duration:** the time period over which the impact will last;
- **Impact Extent:** the geographical extent of the induced change;
- **Likelihood:** the likelihood that the event will occur during the project lifecycle; and

- **Regulations, Standards and Guidelines**: the status of the impact in relation to regulations (e.g. discharge limits), standards (e.g. environmental quality criteria) and guidelines.

Table 3-21 to Table 3-24 below outline the impact criteria used within the assessment of the proposed Project.

Table 3-21: Definition of impact type

Impact Type	Definition
Direct Impact	Impacts that result from a direct interaction between a planned project activity and the receiving environment (e.g. between occupation of a plot of land and the habitats which are lost).
Secondary Impact	Impacts that follow on from the primary interactions between the project and its environment as a result of subsequent interactions within the environment. (e.g. loss of part of a habitat affects the viability of a species population over a wider area).
Indirect Impacts	Impacts that result from other activities that are encouraged to happen as a consequence of the project (e.g. presence of project promotes service industries in the region).
Cumulative impact	Impacts that act together with other impacts to affect the same environmental resource or receptor.
Residual Impact	Impacts that remain after mitigation measures have been designed into the intended activity.

Table 3-22: Impact assessment terminology

Impact Severity	Definition
Impact Magnitude	
Magnitude	Estimate the size of the impact (e.g. the size of the area damaged or impacted the % of a resource that is lost or affected etc.)
Impact Nature	
Negative impact	An impact that is considered to represent an adverse change from the baseline or introduces a new undesirable factor.
Positive impact	An impact that is considered to represent an improvement on the baseline or introduces a new desirable factor.
Neutral impact	An impact that is considered to represent neither an improvement nor deterioration in baseline conditions.
Impact Duration	
Temporary	Impacts are predicted to be of a short duration and intermittent / occasional in nature.
Short-term	Impacts that are predicted to last only for a limited period but will cease on completion of the activity, or as a result of mitigation / reinstatement measures and natural recovery.
Long-term	Impacts that will continue over an extended period but cease when the project stops operating. These will include impacts that may be intermittent or repeated rather than continuous if they occur over an extended period of time.
Permanent	Impacts that occur once on development of the project and cause a permanent change in the affected receptor or resources that endures substantially beyond the project lifetime.

Impact Severity	Definition
Impact Extent	
Local	Impacts are on a local scale (e.g. restricted to the vicinity of the facility etc).
Regional	Impacts are on a national scale (effects well beyond the immediate vicinity of the project and affect an entire region).
Global	Impacts are on a global scale (e.g. global warming, depletion of the ozone layer).

Table 3-23: Impact severity criteria

Impact Severity	Definition
Slight	Where the development would cause perceptible improvement or deterioration to the existing environment.
Low	Where the development would cause noticeable improvement or deterioration to the existing environment.
Medium	Where the development would cause moderate improvement or deterioration to the existing environment.
High	Where the development would cause significant improvement (or deterioration) to the existing environment.

Table 3-24: Likelihood categories

Impact Likelihood	Definition
Extremely unlikely	The event is very unlikely to occur under normal conditions but may occur in exceptional circumstances, e.g. emergency conditions.
Unlikely	The event is unlikely but may occur under normal conditions.
Low likelihood	The event is likely to occur during normal conditions.
Medium likelihood	The event is very likely to occur during normal conditions.
High likelihood	The event will certainly occur during normal conditions.

3.8.6. Evaluation of Impacts

The significance of each impact (Table 3-26) is determined by comparing the impact severity against the sensitivity of the receptor in the impact significance matrix provided below in Table 3-25.

Table 3-25: Determining the significance of impacts

Impact Severity	Sensitivity of Receptor				
	Low	Low-medium	Medium	Medium High	High
No Change	Negligible	Negligible	Negligible	Negligible	Negligible
Slight	Negligible	Negligible	Negligible	Minor	Minor
Low	Negligible	Negligible	Minor	Minor	Moderate
Medium	Negligible	Minor	Minor	Moderate	Major [1]
High	Minor	Moderate	Moderate	Major [1]	Major [1]

Table 3-26: Definition of each impact significance

Significance	Definition
Negligible	Magnitude of change comparable to natural variation.
Minor	Detectable but not significant.
Moderate	Significant; amenable to mitigation and should be mitigated where practicable.
Major	Significant; amenable to mitigation; and shall be mitigated.
Critical	Intolerable; corresponds to a major impact, but not amenable to mitigation; alternatives must be identified – Project Stopper.

The Critical Impact designation indicated in Table 3-26 above will be allocated in place of a Major Impact when mitigation for the Major Impact is not possible and the impact takes on a Critical Impact status where alternatives must then be considered.

[1] Note: Major impacts would be accorded a 'Critical' impact status if no or very limited mitigation is possible. Critical impacts would require the identification of alternatives or compensation measures.

3.8.7. Mitigation, Enhancement and Assessment of Residual Impacts

Where significant impacts are identified, from moderate levels of significance and above, mitigation and enhancement measures will be identified to prevent, reduce or remedy any potentially significant environmental impacts which cannot be avoided or effectively reduced through changes to the construction or operational methodology.

Such measures will need to be implemented during the construction phase or the operational phases or the Project by adopting the control hierarchy principles as illustrated by Figure 3-2.

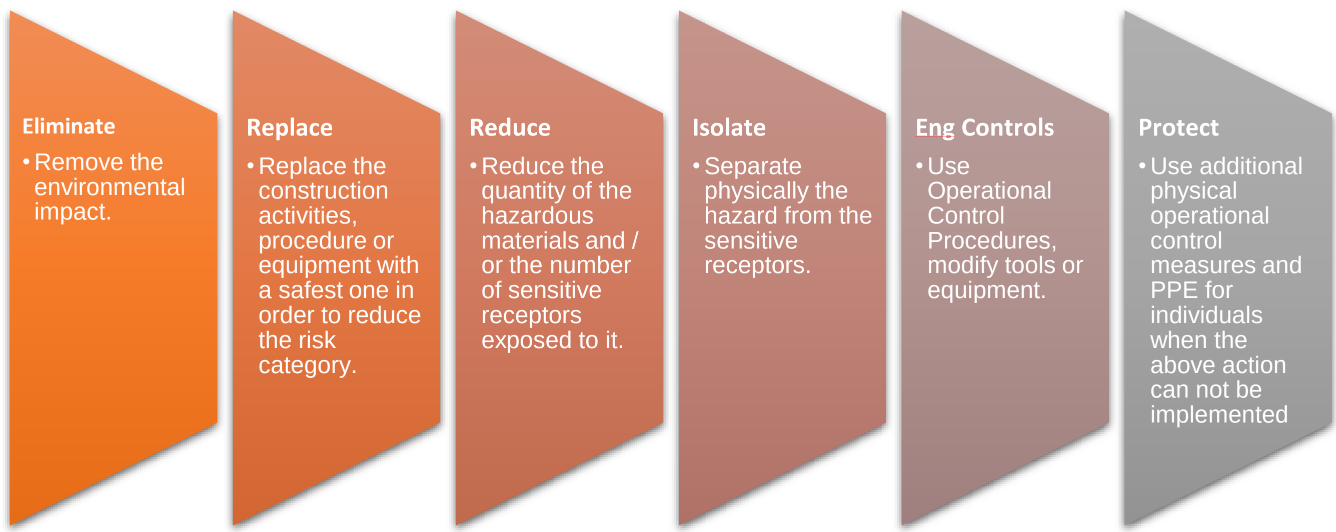


Figure 3-2: Control hierarchy principles

Each technical chapter of the ESIA report will detail the measures recommended to mitigate any identified significant effects and any measures which may provide positive environmental effects.

3.8.8. Cumulative Impacts

Cumulative impacts are those that occur in combination with other developments or impacts taking place at the same time. The potential for cumulative environmental impacts to arise will also be considered. Two types of cumulative effects have been included:

- **Type 1 Cumulative Impact**: the combined effects of different environmental factors from a single development on a particular receptor, e.g. one residential property may experience a degradation in local air quality and an increase in noise levels as a result of a single development; and
- **Type 2 Cumulative Impact**: the combined effects of all developments within the area, e.g. impacts on air quality from one development may not be significant when considered alone but may be significant in combination with other proposed developments. Type 2 cumulative impacts could occur within the Project site and interrelated facilities, which may be under construction and/or operation in conjunction with other future proposed developments, such as residential, other infrastructure.

3.8.9. Mitigation Measures

Following the impact assessment, avoidance, mitigation, compensation or enhancement measures will be identified to prevent, reduce or compensate for any potentially significant environmental impacts.

Each technical chapter of the ESIA Report will detail the measures recommended to mitigate any identified significant effects and any measures which may provide positive environmental effects. An assessment of the significance of any residual impacts remaining following the implementation of mitigation measures will then be undertaken.

3.8.10. Environment & Social Management and Monitoring

Detailed control measures have been developed as part of this ESIA, where potentially significant impacts have been identified. Based upon this, it is a requirement that a Construction Environment & Social Management Plan (CESMP) will be developed for the Project by the EPC Contractor, which will ensure the following:

- There is a clear framework for the implementation of environmental management plans;
- Responsibilities for implementation are defined;
- Clear environmental management actions are defined;
- Requirements for monitoring including methods and frequency are defined; and
- Mechanisms for feedback, management plan updates and reporting are in place to ensure that the plans remain relevant.

It is also a requirement that an Operational Environment & Social Management Plan (OESMP) will be developed for the Project by the Operator, which will include specific requirements for ongoing environmental management and monitoring in the long-term.

4. PROJECT DESCRIPTION

4.1. Statement of Need

As mentioned in **Section 2.3.2: ESIA Rationale**, the Project will support the Ministry of Energy Strategic Plan 2017 – 2021 and the UAE Energy Strategy 2050 by compensating the limitations of the existing and future solar photovoltaic projects within the UAE. Furthermore, the Project will allow the following:

- Meet the future UAE energy demand;
- Provide power flexibility;
- Provide a cost-effective power source; and
- Provide an efficient power capacity.

This ESIA present the significant impacts and proposed mitigation and monitoring measures to be implemented by the Project with regard to the following environmental aspects:

- Ambient air quality;
- Ambient noise;
- Soil, surface water and groundwater;
- Terrestrial ecology;
- Marine ecology;
- Marine water and sediment;
- Waste;
- Socio-economy; and
- Archaeology and cultural heritage.

All identified sensitive receptors in regard to the above environmental aspects are fully presented in **Section 5.2: Components Likely To-Be-Affected** following the results of the site visits. Finally, the Project activities during construction and operation are presented in **Section 4.2.2: Project Components**.

4.2. Concepts and Phases

4.2.1. Project Overview

The Project is planned as a gas powered combined cycle facility with a net power capacity of 2,400 MW located in Fujairah Emirate, adjacent to the existing Fujairah 1 (F1), with a capacity of 760 MW net, and the existing Fujairah 2 (F2), with a capacity of 2,000 MW net.

The below sections will provide details on the Project components during the different Project phases.

4.2.2. Project Components

4.2.2.1. Construction Phase

4.2.2.1.1. Construction Overview and Required Manpower

It is proposed to construct a built-up area of approximately 227,810 m^2 for the proposed Project and its associated facilities. The duration of the construction phase is planned to be around 36 months with a requirement for manpower of 6,500-7,000 workers.

4.2.2.1.2. Resource Requirements

4.2.2.1.2.1. Water Requirements

During the construction, the water requirement has been estimated as approximately of 500 – 700 m^3/day which will be supplied by public water or private water supplier as detailed in Table 4-1 below.

Table 4-1: Construction water requirements

Water Resources	Water Consumption
Domestic Purposes	100 – 200 m^3/day
Construction Purposes	300 – 500 m^3/day
Total	500 – 700 m^3/day

4.2.2.1.2.2. Power Requirements

The required power will be met through diesel generator sets or commercial electricity according to availability.

4.2.2.1.2.3. Expected Waste Generation and Disposal

The waste generated will be disposed through Fujairah Municipality approved disposal mechanisms.

Significant amounts of solid waste can be generated as a result of construction activities. The type and amount of waste generated is however dependent upon the type and scale of development, the construction techniques employed and the specific design of the development. Table 4-2 below presents the estimation of waste generation during the construction phase.

Table 4-2: Types and quantities of waste generation

-	Type of waste	Quantity of Generation (Approx.)	Management
a	Domestic solid waste	50 – 70 m^3/month	Disposed to Fujairah authorised service providers
b	Construction & demolition waste	30 – 50 Tons/month	
c	Hazardous waste (paint drums, construction chemicals, oil-soaked rags, cotton etc.)	1.0 – 2 Tons/month	Disposed to Fujairah authorised hazardous waste service providers after obtaining a Non-Objection Certificate (NOC)
d	Domestic wastewater (sewage)	70 – 120 m^3/day	Collected in the septic tank and discharged to Fujairah drainage system
e	Dredged waste from dredging activity	50,000 m^3	Disposed to Fujairah authorised service providers

4.2.2.1.3. Activities Description

4.2.2.1.3.1. Main Activities Overview

The main activities to be carried out during construction are detailed in Table 4-3 below. **Section 4.2.2.1.3.2** provides further details on the construction activities.

Table 4-3: Construction activities overview

Construction Activity	Details
Site Clearance & Demolition	This will include clearance of materials and dismantling of existing structures at the expansion site. Since there are some vegetation at the site, vegetation clearance will be required. This will allow for excavation, dewatering, compaction and grading of the expansion site.
Site Improvement	Once the site clearance and demolition work are completed, stone column or other method will be undertaken to improve the site ground.
Excavation works	Excavation works including compaction and grading will be undertaken to prepare the site for the fill required to raise the site as required. Excavation works will also be required to establish foundations. Excavation work will be carried out simultaneously with the dewatering of groundwater and discharging it into the sea.
Site enabling works	Vehicle access to the site will be required for the frequent delivery of soil and other materials during construction. To allow this, access roads and tracks must be of sufficient quality, and so the main access route on the approach to the proposed site must be appropriately developed.

Construction Activity	Details
Foundation construction	Once the site is suitably prepared, bar cage reinforcement and shuttering will be installed prior to concrete pouring. Concrete raft, piled foundations, or a combination of both will be used.
Erection of mechanical and electrical equipment	This stage mainly involves construction of the major power plant components including gas turbines, steam turbine and condenser. Concrete and steel will be the primary construction materials for this stage.

Construction of offshore intake and out fall pipelines	The main execution and installation activities are as follows:
	– Assemble and prepare GRP pipe strings;
	– Onshore works for SW Pump Station and Seal Pit;
	    – Backfilling for construction
	    – Sheet piling;
	    – Excavation;
	    – Dewatering;
	    – Backfill work in coastal areas;
	    – Structure construction;
	    – Revetment to encroaching shoreline;
	– Marine trenching and backfilling;
	– Pipeline installation;
	– Finalising installation works;
	    – Intake Pipe Head structures (Marine); and
	    – Diffuser (Marine).
	The supplier will fabricate individual pipeline sections and transported to the site. The pipe sections will be connected together at the site.
	Onshore works – Onshore works will be supported by regular earthmoving equipment and cartage. Sufficient slope will be provided to assure a stable trench. The trenches will be kept dry so groundwater extraction will be required. After installation of the different pipe strings the trench will be backfilled with trenched materials.
	Marine trenching – Marine trenching works are based on Backhoe dredger, clamshell, small Trailing Suction Hopper Dredger (TSHD) supported by split hopper barges for the disposal of dredged materials.
	Pipeline installation – The pipeline will be done by divers.
	Marine backfilling – Backfilling operations will be carried out in two different spreads of equipment:
	– The first step is backfilling with sand around the installed pipelines with a top level; and
	– The second step is the placement of rock on top of the sand layer.
	Backfilling with gravel and amour rocks will be done with a small Trailing Suction Hopper Dredger (TSHD). The mooring pontoon could be either the marine construction barge or other similar anchored pontoon. Rock is delivered by rock transport barges which will be moored alongside the main mooring barge. Rock placement is done by wheel loader(s) and/or excavators operating from the rock transport barges. During shift to the next rock cargo barge, the earth moving equipment will be parked on the main mooring barge.

Construction Activity	Details
	Various installation works – Installation works of both Intake structure and Diffuser will be done by the marine construction barge. The marine construction barge will be equipped with a typically crawler crane. Consequently, it is assumed that the ultimate weight of both Intake Head and Diffuser structures (could be modular) will be within lifting capabilities of such a crane. After positioning on the seabed, the structures will be connected to the GRP pipelines by divers.

4.2.2.1.3.2. Detailed Activities

4.2.2.1.3.2.1. Soil Investigation

Soil investigation will explore the subsurface stratigraphy of site and to obtain foundation design criteria and construction recommendations for the Project. Geotechnical investigation shall be carried out in the following requirements:

- Determination of vertical and lateral distribution and thickness of the soil and rock strata within the site of influence of the proposed construction or development;
- Determination of physical and engineering properties of subsoil/rock formation;
- Determination of potential hazardous conditions including unstable slopes, expansive soil, collapsible soil, regional seismicity, fissures & faults and so on, if exist;
- Recommendation of foundation type for shallow (include soil improvement) and/or pile foundation; and
- Determination of soil contamination.

4.2.2.1.3.2.2. Soil Improvement

If in case the allowable bearing pressure values are not sufficient to meet the design criteria, ground improvement technique, such as vibro-replacement (stone columns) can be adopted as follows:

- Vibro-replacement (Stone Column) can be used for improving with dense granular materials. The introduction of granular materials in the form of piers, not only improves the characteristics of the soil, but also leads to a faster dissipation of pore water pressure; and
- Shallow foundations (isolated footings and/or strip footings) can be used to support the structural loads on the improved area with Vibro-Replacement. It is used to produce a stone column, below the ground level by sinking the vibratory device, backfilling the induced hole by adding granular materials of various size.

4.2.2.1.3.2.3. Demolition of Existing Buildings and Structures

A detailed survey will be conducted for the identification of the existing buildings / structures such as foundations, piles, pipelines, cable trenches, etc. to determine the conditions of the eventual demolition and removal possible for these structures.

Within the Project plant site, various underground and superstructures are expected to exist such as above and below ground site installation of previous projects, foundations, piles walls, roads, wells, ducts, sewage pipelines, fences, etc. These buildings and structures will be demolished and removed before start of construction and site installation as far as possible. Any deep foundations of former plant structures such as piles which are not demolished and removed will not interfere with the foundations of new structures of the Project plant.

4.2.2.1.3.2.4. General Levelling and Grading of Site

Following demolition works, the existing grade of Project plant will be brought to be filled in, levelled and compacted to achieve a site level to allow proper storm drainage (due to the design rainfall) as well as sufficient protection against tidal levels due to Mean Higher High Water (MHHW). For the storm drainage a site level is required at 2.5m above the high tidal level (Highest Astronomical Tide (HAT)) = + 3.2m above the Admiralty Chart Datum (ACD), which corresponds to a fill level at + 5.7 m ACD.

Further, the site level needs to offer sufficient protection for tidal levels. This requires a minimum level of +5.0 m ACD, considering a water level of +3.0m ACD during the cyclone conditions (MHHW (+2.5mACD) + 0.5 m).

A Final Level of (+) 5.75 m ACD, is adopted to provide a sufficient margin for the storm drainage and tidal levels.

The works will include for importing any further suitable material that may be required and for levelling and compacting the site to acceptable standards. The final grading of the Project site will vary slightly in accordance with the requirements of each complex, the requirements of the general layout, the storm water drainage system and other external installations. The finished ground floor slab levels of buildings will be 0.3 m above ground level.

Unsuitable material and debris will be removed from the site. Pockets of soft or unstable subsoil will be excavated and replaced by compacted fill material. All filling work will be carried out accordance with the project requirement. The Project Area will be raised by 1~2 m thickness of fill from the existing grade, and the embankment work will be performed in accordance with the project specification.

4.2.2.2. Operation Phase

4.2.2.2.1. Overview

All the gas turbines and the supplementary fired Heat Recovery Steam Generators (HRSGs) operate with natural gas as the primary fuel and only in the event of natural gas interruption, natural gas non-conforming quality or for testing purposes will the plant operate on a back-up liquid fuel, which is diesel. The power generation units will comprise the following:

- **Group 1 Power Unit:**
  - two Mitsubishi Hitachi Power Systems M701JAC gas turbines;
  - two triple pressure with reheat unfired HRSGs;
  - one reheat and condensing steam turbine with combined high pressure (HP) and intermediate pressure (IP) sections and
  - two double flow type low pressure (LP) sections; and
  - three main transformers exporting power at 400 kV.
- **Group 2 Power Unit:**
  - one Mitsubishi Hitachi Power Systems M701JAC gas turbine;
  - one triple pressure with reheat HRSG with supplementary fired burners;
  - one reheat and condensing steam turbine with combined HP and IP sections and one double flow type LP section; and
  - two main transformers exporting power at 400 kV.

Each Power Group will include both Main Stacks (for combined cycle operation) and Bypass Stacks (for simple cycle operation) together with:

- Environmental control systems such as Selective Catalytic Reduction (SCR); and
- Continuous Emissions Monitoring Systems (CEMS).

Finally, an overview of the Project process flow diagram is presented in Figure 4-2 below.

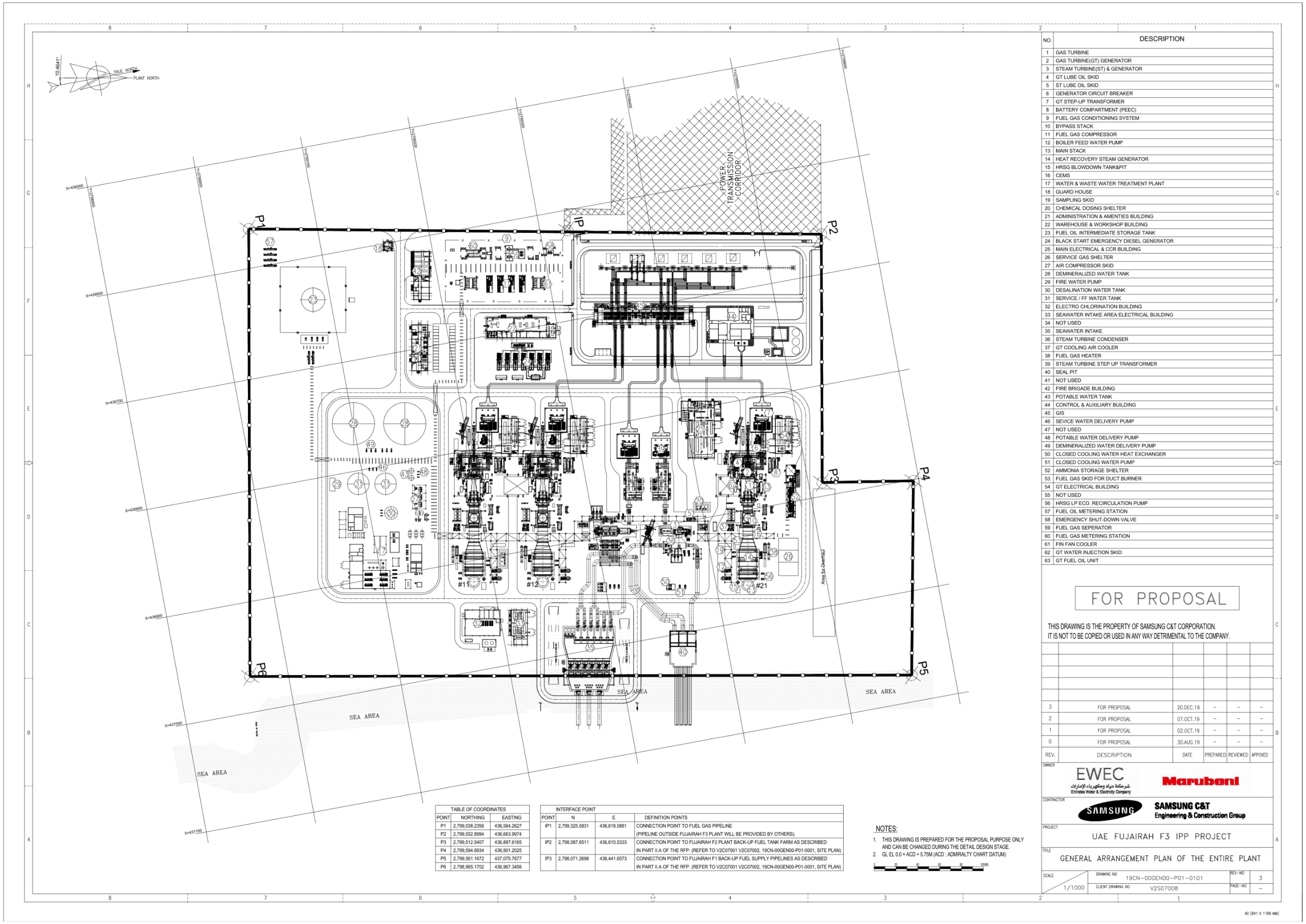


Figure 4-1: Project layout detail

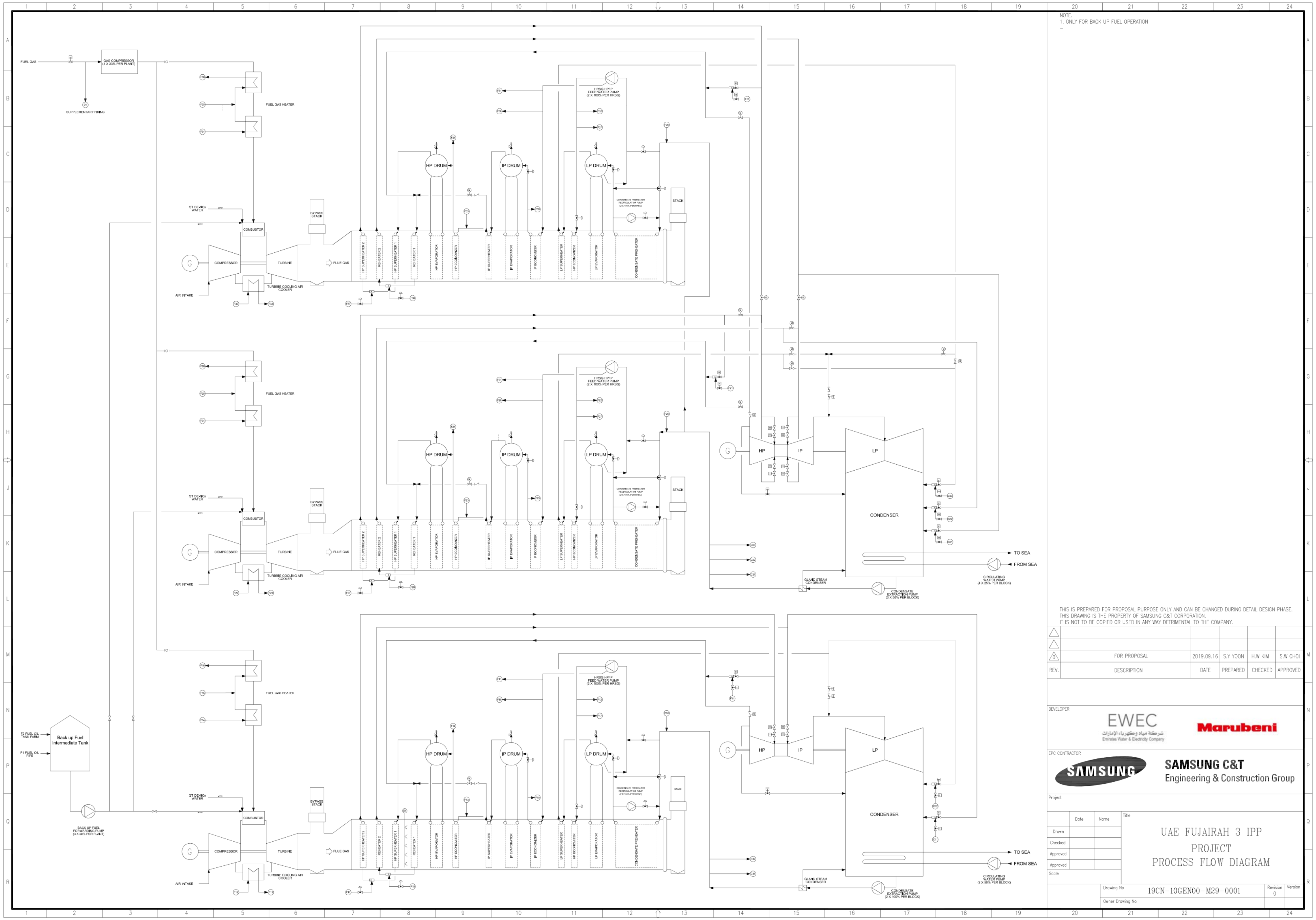


Figure 4-2: Project process flow diagram

4.2.2.2.2. Key Components

4.2.2.2.2.1. Gas Turbine

The M701JAC proposed for this project is the latest version of MHPS's proven J series Advanced Class Gas Turbine technology, which is a large utility frame machine consisting of three main highly proven components: high efficiency compressor, combustor, and high efficiency turbine.

4.2.2.2.2.2. Steam Turbine

The turbine generator unit which is installed in outdoor is two (for Block 1) / one (for Block 2) cylinders tandem-compound double-exhaust, condensing reheat turbine, which consists of a combined High Pressure-Intermediate pressure (HIP) turbine and two (for Block 1) / one (for Block 2) double flows LP turbine.

The steam turbine packages will be complete packages, including the following:

- **Block 1 steam turbine:**
  - One (1) single flow HP-IP turbine;
  - Two (2) double flow LP turbines;
  - Associated bearing pedestals and bearings;
  - One (1) set of couplings including sleeves, bolts and nuts;
  - One (1) set of shaft grounding brushes and holders;
  - Two (2) Combined HP steam stop and control valves with integrated steam strainer;
  - Two (2) Combined reheat steam stop and control valves with integrated steam strainer;
  - One (1) Combined LP steam stop and control valve (butterfly type) with separate strainer;
  - One (1) Turbine Lube Oil system;
  - One (1) Control fluid System;
  - One (1) Turning Gear;
  - One (1) Controlled Non-Return Valve (HP Turbine Outlet);
  - One (1) Vacuum breaker valve;
  - One (1) Rupture disc;
  - One (1) Gland Steam System; and
  - One (1) Turbine Drain System.
- **Block 2 steam turbine:**
  - One (1) single flow HP-IP turbine;
  - One (1) double flow LP turbine;
  - Associated bearing pedestals and bearings;
  - One (1) set of couplings including sleeves, bolts and nuts;
  - One (1) set of shaft grounding brushes and holders;
  - One (1) Combined HP steam stop and control valve with integrated steam strainer;
  - One (1) Combined reheat steam stop and control valves with integrated steam strainer;
  - One (1) Combined LP steam stop and control valve (butterfly type) with separate strainer;
  - One (1) Turbine Lube Oil system;
  - One (1) Control fluid System;
  - One (1) Turning Gear;
  - One (1) Controlled Non-Return Valve (HP Turbine Outlet);
  - One (1) Vacuum breaker valve;
  - One (1) Rupture disc;
  - One (1) Gland Steam System; and
  - One (1) Turbine Drain System.

4.2.2.2.2.3. Generator

The large hydrogen generator with a water-cooled stator winding series of generators for 50 Hz applications and/or the air-cooled generator for 50 Hz application, are designed according to both IEC and ANSI standards. The generator is a two-pole design being directly coupled to the turbine. The following components are included:

- Three (3) Generators for GTs and Two (2) Generators for STs, including:
  - Stator & Rotor;
  - Bearings;
  - Brushes and brush holders;
  - Generator monitoring system;
  - Hydrogen coolers or Air coolers;
  - Seal Oil System (only for hydrogen generators);
- Three (3) Excitation Systems, including:
  - Excitation Panel;
  - Excitation Bus Duct;
  - Excitation Transformer;
- Two (2) Static Excitation Equipment sets, including:
  - Static Frequency Converter;
  - Static Frequency Converter Transformer;
  - Start-up switchboard;
- Generator Protection, Control and Metering Equipment;
- Current Transformer; and
- Generator Neutral Grounding Equipment.

4.2.2.2.2.4. Heat Recovery Steam Generators

The triple pressure with reheater heat recovery steam generator based on the natural circulation principle is located downstream of the gas turbine for use in a combined cycle power plant. The steam produced by a heat recovery steam generator is used to drive steam turbine. The HRSG is installed outdoors and therefore all components will be designed for outdoor installation.

The HRSGs consists of following components.

- Pressure parts, including condensate preheaters, economizers, drums, evaporators, superheaters, headers, etc. for each pressure levels of the HRSG;
- Supplementary firing system (for Block 2 HRSG only);
- SCR system with ammonia storage (26% Aqueous, 5 days storage capacity) and injection system;
- Safety valves for steam drum and superheaters of LP, IP and HP circuit;
- Feedwater control valve for LP, IP and HP feedwater line of HRSG;
- Drains and vents, including collecting headers;
- Ducting system including HRSG inlet duct with insulation and lagging, expansion joint;
- HRSG casing and wall cladding;
- Condensate preheating loop system including manual valve, check valve and thermal relief valve;
- Blowdown system including flash vessel, silencer, piping, valves, and local Instrumentation such as temperature gauge, pressure gauge, level indicator, etc.;

- Thermal, personal protection insulation and lagging for HRSG inlet duct, HRSG body and Piping;
- Necessary platforms, stairways, ladders, galleries, walkways including railing for HRSG;
- N_2 blanketing connections system with piping, isolating valves, etc.; and
- HRSG main stack (60m above ground) with stack gas emission monitoring and aircraft warning light.

4.2.2.2.2.5. Seawater Intake and Outfall

Seawater will be used mainly for the cooling process as cooling water and will also be used, in a small amount for process water, service water and potable water as detailed in **Section 4.2.2.2.3.15**. Maximum treated seawater is expected to be 3,480 m^3/day.

4.2.2.2.2.5.1. Intake

Three (3) intake pipelines supply the intake basin with seawater via gravity flow. These pipelines extend into the Gulf of Oman and collect seawater at approximately 485m from the shore, as shown in Figure 4-3 below.

The intake pipelines start from the Pump Station where the bottom elevation of the pipe is (-)5.95 mACD. The intake pipelines are buried in the seabed until the chainage of 0+ 374.00 where the water depth is 10 m. After this distance, the intake pipelines will be partially buried on the seabed where the water depth is 10m or deeper.

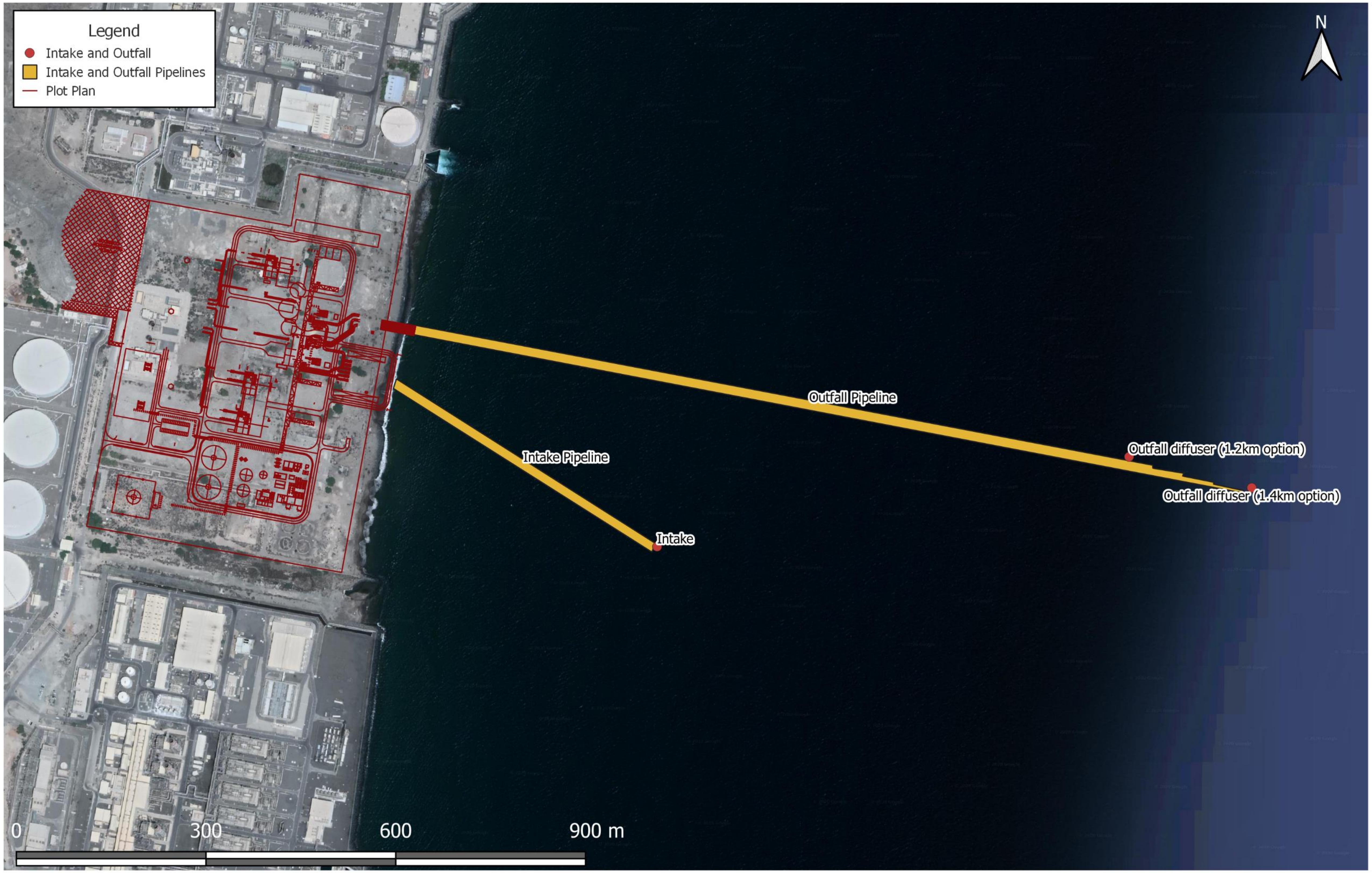
The seawater intake system filters debris from the circulating water system upstream of the circulating water pumps and auxiliary cooling water pumps. The system consists of bar screens, travelling type trash rake, center flow type travelling band screens, and stop logs to isolate the pump bays, spray wash pump, level measuring equipment. Pumps and intake facilities will be maintained by mobile crane.

4.2.2.2.2.5.2. Outfall

The proposed outfall pipeline system currently includes four parallel outfall pipes from the shore and discharge diffusers.

The discharge pipelines start from the Seal pit, where the bottom elevation of the pipe is (-)8.3 mACD. The discharge pipelines are buried in the seabed until the chainage of 0+ 380.00, where the water depth is 10 m. After this distance, the discharge pipelines will be partially buried on the seabed where the water depth is 10m or deeper.

The diffuser sections will be staggered to distribute the cooling water across the main direction of ambient flow. With the first diffuser section starting about 1.2km from the shore, this means the longest of the outfall pipes extends nearly 1.4km offshore. As with the intake, pipelines are rested or are buried in the seafloor to the discharge diffuser.



Project Number: 1116
Project Name: Fujairah F3 IPP
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Compiled By: AB

Scale: 1:7409.279
Coordinate System: Mercator
Datum: WGS 84
Units: meters
Date: 19/01/20

Figure 4-3: Project layout and intake and outfall pipeline locations

4.2.2.2.3. Systems

4.2.2.2.3.1. Bypass Stack and Diverter Damper System

The Exhaust Bypass System allows for the simple cycle operation in which the diverter damper is in the HRSG closed position, guiding the hot exhaust via the bypass stack into the atmosphere, and for the combined cycle operation in which the diverter damper is in the HRSG open (Bypass closed) position, guiding the hot exhaust into the HRSG. The Diverter damper supports also a slower heat up of the HRSG during GT running on full load.

4.2.2.2.3.2. Steam System

The main function of the steam system is to transport steam produced in the HRSG to the steam turbine. The steam system consists of high pressure steam, intermediate pressure steam and low pressure steam.

High pressure steam is piped from HRSG high pressure superheater outlet to the main steam stop and control valve of the steam turbine. Stream is equipped with flow, pressure and temperature measuring devices along with safety relief valves, automatic drains, manual free blow valves and a manual shut-off valve.

A high pressure steam bypass line equipped with a steam conditioning valve for reducing the pressure and temperature of the steam allows steam to be entered to cold reheat line during start-up and shutdown.

An intermediate pressure steam bypass line is equipped on hot reheat and after the temperature and pressure reducing, dumped to Condenser.

A low pressure steam bypass line equipped with a pressure control valve for reducing the pressure of the steam allows steam to be dumped to the condenser during start-up and shutdown.

The exhaust of the HP steam turbine is led to HRSG reheater then transferred to IP steam turbine admission. Then the LP steam mixes with IP turbine exhaust steam and flows to the LP Turbine. Exhausts from the LP turbine into the surface condenser where it condenses.

Auxiliary steam will be available from another running unit.

In case of first unit start up, the auxiliary steam system receives superheated steam either from the cold reheat steam header via Pressure Reducing and Desuperheating Station (PRDS), depending on the operation mode of the plant.

No auxiliary steam boiler will be provided.

4.2.2.2.3.3. Condensate System

The condensate system delivers condensate from the condenser hotwell to the HRSG. Condensate pumps supply condensate water through condensate preheater of the HRSG to low pressure drum. Condensate is also used for the following purposes:

- Spray water for the turbine drains (flash box) desuperheater;
- Spray water to LP Turbine exhaust hood & condenser curtain spray;
- Spray water for HRH steam bypass & LP steam bypass systems; and
- Condensate supply to the unit's various water seal consumers.

The function of the condenser is to condense the steam exhausted from the LP turbine and to maintain as high a vacuum as possible in order to increase the heat drop which can be utilised in the turbine.

Surface condenser is provided for operation with steam turbine. The condenser shall be complete with instruments and other necessary fittings and impressed current type Cathodic Protection. The condenser shall be designed and provided with the following features:

- Condenser;
- Man-ways to water boxes, hot well, and turbine exhaust hood;
- Condenser tube clearing system;
- Pressure Transmitter;
- Hot well temperature indicator;
- Hot well level gauge glass;
- Conductivity meter; and
- Vacuum breaker valve.

4.2.2.2.3.4. Condenser Air Removal System

The condenser air removal system creates and helps maintain a vacuum in the shell side of the surface condenser by removing air and non-condensable gases. The system consists of two (2) skid-mounted condenser vacuum pump packages and the connecting piping to the surface condenser for each block.

4.2.2.2.3.5. Feed Water Systems

Fixed speed type feedwater pumps at nominal operation shall be provided to suit the requirement of the HRSG. Feedwater pumps is provided with IP feed from an intermediate stage of the feedwater pump. Feed water is used as a heating source for fuel gas performance heater and returned to the condensate preheater. Otherwise feed water is also used as a cooling source for the Turbine Cooling Air (TCA) cooler and returned to between HP economisers.

4.2.2.2.3.6. Circulating Water System

The function of the circulating water system is to transfer cooling seawater from the seawater intake facility to steam surface condensers and seal water heat exchanger of vacuum pumps for each group and return it back into the sea. The circulating water system includes the following major components:

- Four (4) x 25% Circulating Water Pumps for Block 1;
- Two (2) x 50% Circulating Water Pumps for Block 2; and
- Piping, valves instruments etc.

4.2.2.2.3.7. Auxiliary Cooling Water System

The purpose of the auxiliary cooling water system is to transfer cooling seawater from the seawater intake facility to closed cooling water heat exchangers for each block and return it back into the sea through circulating water discharge pipeline. The auxiliary cooling water system includes below major components;

- Two (2) x 100% auxiliary cooling water pumps for each block; and
- Piping, valves, instruments etc.

4.2.2.2.3.8. Closed Cooling Water System

The closed cooling water system is a closed-loop system. Closed cooling water (CCW) pumps takes suction from the CCW return header and pumps the water through the CCW heat exchangers. Closed cooling water heat exchangers are provided as plate heat exchangers.

4.2.2.2.3.9. Fuel Gas Supply System

The fuel gas supply system is designed to supply the required quantity of fuel gas in proper condition to the gas turbines to satisfy unit demands during start-up, shut-down, and normal operation and fuel gas to supply HRSG supplementary firing for Block 2 from upstream of the fuel gas compressor. The fuel gas supply system includes the following major equipment:

- One (1) x 100% Emergency stop valve;
- Two (2) x 100% or three (3) x 50% Filter/separators;
- Metering system;
- Gas chromatograph;
- Four (4) x 33% Fuel gas compressors; and
- Piping, valves, instruments etc.

4.2.2.2.3.10. Fuel Oil Transfer & Forwarding System

Distillate fuel oil is to be used as a back-up fuel for the gas turbines in case of a fuel gas supply interruption. Back-up Fuel is transferred from the F2 Back-up Fuel Storage tank farm (by pumps). Transferred back up fuel is stored in intermediate back up fuel storage tank in plant without independent truck unloading system.

4.2.2.2.3.11. Water Distribution Systems

The following water distribution systems will be included:

- Demineralized Water;
- Service Water; and
- Potable Water.

4.2.2.2.3.12. Compressed Air System

The plant common air compressor package is skid mounted and consists of:

- Oil free screw type air compressors (Three (3) x 50%);
- Dual tower heatless desiccant dryers (Two (2) x 100%);
- Pre-filters / After-filters (Two (2) x 100%); and
- Air receivers (Instrument air receiver, Service air receiver).

4.2.2.2.3.13. Gas Systems

The following gas systems will be in place:

- Nitrogen – which supplies a nitrogen blanketing system is used during short unit shutdowns to protect the internal surfaces of the heat recovery steam generators;
- Hydrogen – a hydrogen storage system is provided for supplying hydrogen gas to generator to maintain the hydrogen pressure in the generators; and
- CO_2 Purge – a CO_2 purge system is provided to purge the hydrogen from the generators.

4.2.2.2.3.14. Electro Chlorination System

The purpose of Electro-chlorination system is to inject chlorine solution into the cooling water intake to inhibit the growth of biological organisms at the cooling water intake and to prevent slime deposit at the inner wall of cooling water pipes.

The Electro-chlorination package will be designed to continuously dose up to maximum 2.0 ppm chlorine and shock dose plus up to maximum 2 ppm chlorine into the seawater. The shock dosing will be done for 20 min per every 24 hours interval. Continuous dosing rate will be normally 1ppm chlorine.

Continuous dosing of hypochlorite solution will be pumped from the hypochlorite solution storage tanks to the intake riser. Shock dosing of hypochlorite solution will be pumped to the intake riser as well. Chlorination will be continuous with the rate manually set to maintain less than 0.15 ppm residual chlorine at downstream of the condenser outlet and it is in exception during shock dosing.

4.2.2.2.3.15. Water Treatment System

4.2.2.2.3.15.1. Components

A water treatment system will produce the required water of the plant by reducing the level of total dissolved solids in seawater. The water treatment system is provided for the following purposes;

- Supply of demineralized water (HRSG make-up, GT wet compression, De-NOx water and etc.);
- Supply of service water (Evaporative cooler make-up, firefighting and etc.); and
- Supply of potable water.

Seawater is desalinated by reverse osmosis process, and pre-treatment system of Dissolved Air Floatation (DAF) and Dual Media Filter (DMF) is applied to meet the feed water condition of Seawater Reverse Osmosis System (SWRO). Maximum treated seawater is expected to be 3,480 m^3/day.

Demineralized water is produced by polishing of desalinated water through Mixed Bed Exchanger (MBE). Service water is produced by re-mineralization of desalinated water and potable water is produced by disinfection of service water. The water treatment system consists of following units and process:

- **For Desalination:**
  - Two (2) x 50% DAF;
  - Three (3) x 50% DMF;
  - Three (3) x 50% SWRO;
  - Three (3) x 50% Brackish Reverse Osmosis System (BWRO);
  - Chemical dosing unit for coagulation, flocculation, scale inhibitor and reducing agent. It is composed of one (1) x 100% solution tank, two (2) x 100% or three (3) x 50% dosing pumps. Caustic dosing might be

provided according to process requirement. Caustic will be provided from caustic dosing tank of MBE, if required;
- Chemical cleaning unit for Reverse Osmosis (RO) membrane. It is composed of one (1) x 100% tank, one (1) x 100% cartridge filter and two (2) x 100% pumps;

- **For Demineralization:**
  - Three (3) x 50% MBE;
  - Regeneration unit composed of regeneration pumps and chemical dosing unit for acid and caustic). It is composed of one (1) x 100% solution tank and two (2) x 100% dosing pumps. The dosing unit is used in common for neutralization;
  - Neutralization unit composed of two (2) x 100% neutralization pumps;
  - Chemical storage unit for acid and caustic. It is composed of one (1) x 100% bulk storage tank and two (2) x 100% transfer pumps. It will be minimum seven days' storage;
  - Mixed bed mixing and neutralization mixing will be performed by DMF backwash blower in common;
- **For Re-mineralization:**
  - Lime dosing unit. It is composed of two (2) x 50% solution tanks and two (2) x 100% dosing pumps;
  - CO_2 dosing unit. It is composed of CO_2 gas bottle and rack;
  - NaOCl dosing unit for potable water. It is composed of one (1) solution tank and two (2) x 100% dosing pumps;
- **For Sludge Treatment:**
  - One (1) x 100% Dehydrator; and
  - Chemical dosing unit for dehydrator polymer. It is composed of one (1) x 100% dosing tank and two (2) x 100% dosing pumps.

4.2.2.2.3.15.2. Specifications and Capacity

The specifications and capacity for the water treatment facilities are provided below. It should be noted that the details below provide the capacity only, and it is not anticipated that the water treatment system will be utilised on a full time basis, unlike a conventional RO facility which would be operated continuously:

1. SWRO:

- 1) Feed flow: 3528 ~ 3552 m3/day/train
- 2) Permeate flow: 1392 ~ 1410 m3/day/train
- 3) Quantity: 3trains
- 4) Type: Spiral wound
- 5) Membrane Life: 3 years

2. 2. BWRO:

- 1) Feed flow L: 1390 ~ 1410m3/day/train
- 2) Permeate flow: 1200m3/day/train
- 3) Quantity: 3trains
- 4) Type: Spiral wound
- 5) Membrane Life: 3 years

3. 3. MBE:

- 1) Capacity: 960m3/day/train

- 2) Quantity: 3trains
- 3) Regen. Cycle: 24hrs

4.2.2.2.3.16. Wastewater Treatment System

Wastewater treatment system will be provided to meet the required discharge limit of the plant. After treatment the effluent will be discharged to the seal pit. Wastewater treatment system is designed to treat the chemical wastewater, oily wastewater and sanitary water.

Chemical wastes from the various processes on the power plant site will be collected and directed to the wastewater collection pond. These will include effluents from building flushing/drains, chemical dosing system drains etc. However, the GT wash water will be separately disposed by tank lorry to defined local vendor. The wastewater in the neutralization pond will be neutralized with acid or caustic soda. The pH value will be monitored.

Oily wastewater from the plant drain and rainfall will be collected by pumping or gravity in the central oily wastewater collection pond and treated by an oil separator. The treated oily wastewater will be discharged with chemical wastewater to seal pit. The skimmed oil or oil sludge will be stored in oil sludge holding pond and then disposed to plant outside by local vendor.

The sanitary water from toilet, shower will be treated by modular biological treatment package complete with all of the necessary equipment.

4.2.2.2.3.17. Chemical Dosing System

The chemical dosing system consists of the chemical dosing equipment for boiler water and condensate water. The dosing system will utilize ammonia for pH control and oxygen scavenger for oxygen removal and phosphate for boiler water conditioning.

4.2.2.2.3.18. Heating, Ventilation, Air Conditioning System

The Heating, Ventilation, Air Conditioning System (HVAC) system is designed to achieve the following purposes:

- To control environmental conditions in buildings for the comfort of operating and maintenance personnel.
- To control environmental conditions in buildings within limits for proper operation and protection of the equipment and systems;
- To provide fresh air supply to the inhabited areas;
- To remove hazardous gases and fume; and
- To design HVAC system within limits automatic and manual control.

4.2.2.2.3.19. Fire Alarm and Detection, Fire Protection and Firefighting Systems

The firefighting systems and equipment will be in accordance with the NFPA requirements and will comply with the local regulations of the UAE Ministry of Interior, Civil Defense Department.

4.2.2.2.3.19.1. Fire water storage and supply system

The fire water source will be service water from the service water tanks where 2 hours fire water storage will be dedicated for firefighting water use. Two (2) 100% firefighting water pump will be foreseen, one electric motor driven and the other with diesel engine driven. Two (2) X 100% jockey pumps will be provided to maintain pressure in fire water ring main. The fire water pumps will be installed in container housing at water storage tank area.

4.2.2.2.3.19.2. Outdoor hydrant / Indoor hydrant system

Outdoor fire hydrants will be provided throughout the plant in accordance with NFPA14 and NFPA850. Each hydrant will have two hose outlets. Hydrant spacing in power block and BOP area will be a maximum of 90m (300ft) as per NFPA850. Outdoor hose cabinet will be provided for minimum two (2) number of hydrants and will be equipped with two (2) 30m lengths of hose, two (2) jet/spray nozzles and tools required to operate the hydrant.

Class II Indoor hydrant system will be provided to buildings except electrical building.

4.2.2.2.3.19.3. Water spray system

Oil filled transformers containing 500 gal. or more of oil, lube oil tank and small diesel oil day tank will be protected by water spray system as per NFPA15.

4.2.2.2.3.19.4. Sprinkler system

Enclosed cable tunnels and cable spreading room will be protected by automatic sprinkler system as per NFPA13.

4.2.2.2.3.19.5. Foam Injection system.

Fuel oil storage tank having more than 190 m^3 will be protected by foam injection system as per NFPA11.

4.2.2.2.3.19.6. Gas extinguishing system

Switchgear room, electronic and control room will be protected by gas extinguishing system as per NFPA 2001 requirement.

4.2.2.2.3.19.7. Portable extinguisher

Portable extinguishers such as carbon-dioxide type and dray chemical powder type will be provided in hazardous area.

4.2.2.2.3.19.8. Fire Alarm & Detection System

Main/Local fire alarm control panel, smoke detector, heat detector, manual call point (with break glass), strobe light, alarm bell etc. will be installed as per NFPA requirement and local regulation.

4.2.2.2.4. Civil Works

4.2.2.2.4.1.1. Design Loads

New facilities, and other structures, including floor slabs and foundations, will be designed to resist the minimum loads defined in ASCE 7, and this section. The design will be adequate for the structure's intended use in accordance with commonly accepted engineering practice and the requirements. Design loads for buildings, foundations and structures will take account of all loads applied including dead, live, impact, thermal, vibration, wind, seismic and other loading conditions where appropriate. Temporary loads during maintenance and erection will also be considered. Key design loads will be as follow:

- **Vibration Load**
  - Where vibration is induced by equipment such as pumps, blowers, fans and compressors, supporting members will be designed in accordance with international code to prevent fatigue failure and to avoid misalignment or malfunction of machinery and equipment;
  - The primary source of vibration in superstructures is harmonic unbalanced forces generated by rotating or reciprocating equipment. The final design will be such that vibrations are neither intolerable nor troublesome to personnel, nor cause damage to the machine or structure as per the requirements of international code;
- **Wind Load**
  - Basic wind speed is 160km/h (3 sec. gust speed, 50 years return period). Wind loads will be computed and applied in accordance with ASCE7, and the recommended guidelines for open frame structures, pressure vessels, and pipe racks in ASCE's Wind Loads and Anchor Bolt Design for Petrochemical Facilities;
  - Due consideration will be given to the wind forces acting on the open structure of the HRSG, Steam Generator support structure and Utility Bridges. No shielding will be considered. Force coefficient 'Cf' will be determined from the approved design guide;
- **Seismic Load**
  - The F3 Plant site is an area equivalent to UBC Zone 2A seismicity and all plant items will be therefore designed to resist seismic loads.

4.2.2.2.4.1.2. Storm Water, Wastewater and Sanitary Drainage System

All materials and pipes used for the system will be fit for the purpose and will be adequate for the maximum flows expected. Lifting stations will be provided where necessary.

Storm Water System

Storm water from hard standings, roads and other areas will be collected into nearest catch basins and led to the nearest storm drainage system and finally be discharged to the sea via the nearest outlet channels or pipes. Down pipe and splash block will be provided for building roof drainage and it will be led to the nearest catch basin. The rainfall intensity and the capacity of the surface water drainage system will be designed based on a rainfall intensity for return period of 5 years:

- Rainfall intensity: 60 mm/h;
- Duration: 15 min.

Manholes will be provided at every change of alignment or gradient or at every 50m in straight run. UPVC and/or concrete pipes shall be used for the system. Manholes shall be provided with heavy-duty manhole covers where they are in the vicinity of the roads or where heavy external loading is expected. Medium-duty manhole covers shall be provided elsewhere.

Oily, Chemical and Other Wastewater Drainage System

Oily, chemical, or other process wastewater will be collected, conveyed via appropriate piping systems and treated in the wastewater treatment plant. The treated effluent will meet the permissible limits prior to discharge to the sea via the discharge channels as a part of the discharge of used seawater. The wastewater drainage system will consist of a piping system with manholes every 30m and at each change of direction.

Sanitary Drainage System

Sanitary wastewater drainage from the entire Project plant area will be collected, conveyed via an adequate piping system and treated in a sanitary treatment plant. The treated sanitary wastewater will meet the permissible limits prior to discharge to the sea via the outlet channels or pipes. The sanitary wastewater system will consist of a piping system with manholes every 30m and at each change of direction.

Pipe materials

Drainage pipes will be C-PVC, U-PVC, Concrete Pipe and adequate protection by sleeves or concrete protection will be provided at road crossings where soil cover cannot meet the minimum value.

4.2.2.2.4.1.3. Road and Paving

Asphalt paving shall be used for main roads, secondary roads and parking areas unless purposed and specified otherwise on drawings. The necessary improvements of existing roads (if any) and construction of new roads will take into consideration the loading capacities and clearances of existing bridges and connecting roads when carrying out transportation from the ports or from other places to the sites and vice-versa.

Roads for common and frequent use by the Project will be designed of sufficient width, turning radii and load as well with regard to the frequency of traffic as to the heavy load transportations. Adjacent to major buildings in most cases walkways will be provided.

Parking space inside the Project premises shall be provided as necessary during the operation of the plant. All roads and parking areas shall have falls to ensure free drainage under the most severe storm water conditions:

- **Parking Area:** the entire parking areas will be paved with asphaltic concrete and will receive area lighting to provide comfortable illumination and to meet safety requirements;
- **Main Roads (within the Project boundary):** Minimum 7.5m;
- **Secondary Roads:** Minimum 5m;
- **Hard Standings:** Hard standing areas around outdoor auxiliary plant including transformer areas, any other area liable to suffer from oil spillage and lay down area will be constructed of concrete.

4.2.2.2.4.1.4. Security Fencing and Gates

Permanent Boundary Fencing and Gates

The plant Area of the Project Plant will be enclosed by fence or wall similar to the existing boundary fences or walls of the potable water tank area of F1/ F2 Plant and the F2 Plant. The Project fence or walls will be maintained throughout the construction phase and at no time security of any of the plant sites will be compromised. Permanent gates for the Project Plant and the ESF will meet the local requirements.

Internal Fencing

Internal fences for the security of any particular installations within the Project plant site will be erected complete with gates. Transformers will be protected from unauthorized personnel by chain-link fence.

4.2.2.2.4.1.5. Corrosion Protection

Reinforced Concrete

All cement used in the works shall conform in all respect to the requirements of relevant international code and standard. The outer surface of the concrete will be protected with a waterproof bituminous membrane and minimum one additional corrosion protection method by using of corrosion inhibitor to be applied. Reinforced concrete structures which are exposed to atmosphere to be provided with appropriate concrete mix and cover.

Steel Structures

Steelwork in contact with water, chemical aggressive fluids and brine will be designed to acceptable international standards and will be fit for the purpose in each case to avoid accelerated corrosion. Galleries, handrails, stairs, ladders and other miscellaneous steelwork will be hot-dipped galvanized and will also be adequately painted according to safety requirements. The embedded items (anchor bolts and plates, fixing elements, etc.) for outside and inside conditions with severe exposure condition, chemical attack, etc. will be of stainless steel (type 316Ti according to AISI-Standard). The embedded items for outside conditions without severe exposure condition, chemical attack, etc. will be minimum hot-dipped galvanized and the surface exposed to atmosphere will be epoxy coated in addition.

4.2.2.2.5. Grid Connections

Transco's 400 kV network in Fujairah will be exporting power from F1, F2 and the Project is 7,500 MVA, which is of adequate capacity for the installed generating units at F1 and F2 and the planned capacity to be installed at the Project site.

4.2.2.2.6. Laboratory Equipment

A chemical laboratory equipment will include for analysis equipment, furniture and glassware etc.

4.2.2.2.7. Summary of Buildings

The below list of buildings and shelters including structural systems will be included in the Project detailed design:

- Gas Turbine (GT) electrical building;
- Steam Turbine (ST) electrical building;
- Seawater electrical building;
- Control & electrical building;
- Electro Chlorination Building;

- Fuel oil electrical building;
- Fuel oil pump shelter;
- Service gas shelter;
- Ammonia storage shelter;
- Chemical dosing shelter;
- Air compressor shelter;
- Water treatment building;
- Chemical storage shelter;
- MBP shelter;
- DAF shelter;
- Dehydrator shelter;
- WT chemical dosing shelter;
- Form skid shelter;
- PW chemical dosing shelter;
- WWT chemical dosing shelter;
- Administration & amenities building;
- Covered car parking;
- Warehouse & workshop building;
- Guard house; and
- Fire brigade building.

4.2.3. Decommissioning

The Contract between EWEC and the consortium of Marubeni and Samsung C&T is for 25 years. It is understood that once the contract is finalised, the Project asset will be transferred back to EWEC. Therefore, decommissioning may be occurring at the earliest in 25 years, in 2048, however no confirmation of the Project decommissioning date is confirmed at this stage.

4.2.4. Future Expansions

At this stage, no information on future expansions have been provided for this Project. However, due to the size location, it is not expected that the Project will require expansion.

4.3. Location, Scale & Scheduling of Activities

4.3.1. Project Site Location & Scale

As illustrated in Figure 4-4 below, the Project is located within Qidfah city in Fujairah Emirate in the United Arab Emirates. The Project will be situated on a vacant site between the existing Fujairah F1 and Fujairah F2 power and water plants which is shown in Figure 4-5 below. The Fujairah F1 Plant was commissioned in 2004 and is owned by Emirates Sembcorp Water and Power Company. The Fujairah F2 Plant was commissioned in 2011 and is owned by Fujairah Asia Power Company.

The Project site has been previously developed by FEWA for power and water generation facilities. These facilities were decommissioned and completely demolished by 2018. Most of these facilities have now been removed although a number of the former facilities remain, including:

- Some abandoned buildings previously used for operations;
- Abandoned mosque;
- Infrastructure such as roads and paved areas;
- Pipelines and cable trenches
- Military security station at Project site entrance;
- Abandoned materials and operational waste (e.g. batteries admin equipment); and
- One fuel storage tank.

Anthesis undertook a site visit of the Project site on 22nd January 2020 in order to understand current conditions within and surround the Project site. Please note, photographs were not allowed to be capture during the Project site visit undertaken by Anthesis due to security restrictions issued by the onsite military personnel. As a result, no Project site photographs have been provided within this report.

The existing conditions are illustrated in Figure 4-6 below.

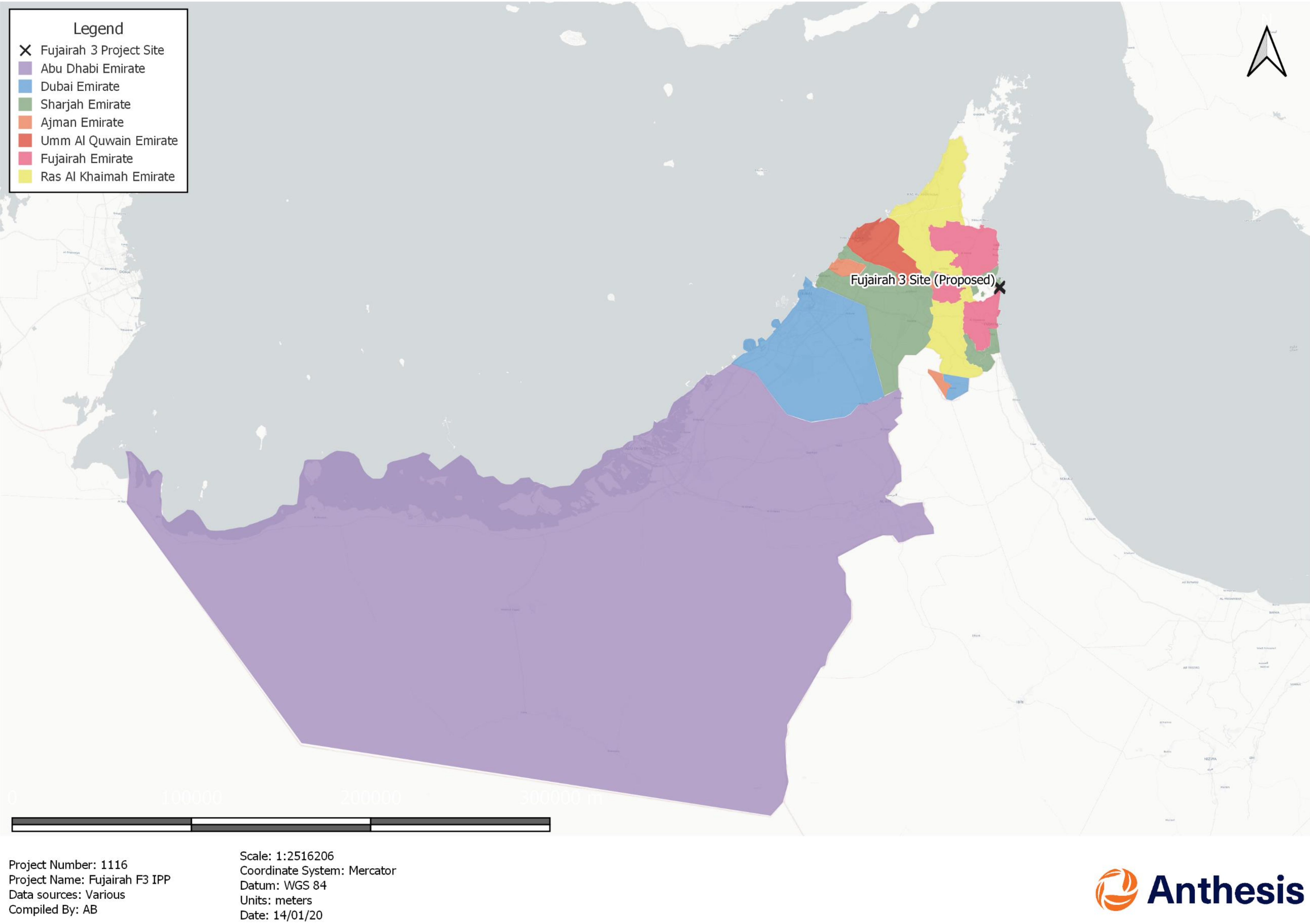

Figure 4-4: Overview of the Project site within the UAE

Project Number: 1116
Project Name: Fujairah F3 IPP
Data sources: Various
Compiled By: AB

Scale: 1:13306
Coordinate System: Mercator
Datum: WGS 84
Units: meters
Date: 19/01/20

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Figure 4-5: Project site location

Figure 4-6: Aerial view of the Project site conditions in 2019

4.3.2. Project Scheduling / Phases

The Project phases and schedule is detailed in Table 4-4 below.

Table 4-4: Project scheduling and phases

Phase / Stage	Details	Start Date	End Date
Design and Construction Phase	The design and construction schedule is expected to last 39 months. Construction is expected to start in April 2020.	30th January 2020	29th April 2023
Operation Phase:	The consortium of Marubeni and Samsung C&T agreed to	28th April 2023	29th April 2048
Early Contract Period 1:	One GT in open cycle operation: 520 MW	28th April 2022	29th April 2022
Early Contract Period 2:	Two GTs in open cycle operation: 1,040 MW	29th April 2022	30th April 2022
Early Contract Period 3:	One GT in open cycle and one on one block in combined cycle operation: 1,200 MW	30th April 2022	31st October 2022
Group 1:	Two GTs on one ST in combined cycle operation: 1,600 MW	1st March 2023	30th April 2023
Entire F3 Plant (Group 1 & Group 2):	Entire F3 Plant (Group 1 & 2) in combined cycle operation: 2,400 MW	30th April 2023	29th April 2048
Decommissioning	Decommissioning of the Project	Information not confirmed at this stage	Information not confirmed at this stage

4.4. Project Status

The Project is currently at the planning stage as the consortium Marubeni & Samsung C&T has been recently appointed by EWEC on the 30th January 2020. Therefore, design is in the process and no works have been undertaken to date.

As a result, no approvals have been requested at this stage. Table 4-5 below details the future expected approvals for the Project.

Table 4-5: Project approvals

Phase	Approval	Applicant	Authority Approval
Design Phase	Approval of the Project ESIA Scope of Work	Anthesis acting as Environmental Consultant on behalf of Marubeni and Samsung C&T	FM-EPS

Phase	Approval	Applicant	Authority Approval
	Approval of the Project ESIA	Anthesis acting as Environmental Consultant on behalf of Marubeni and Samsung C&T	FM-EPS
Construction Phase including Demolition and Enabling Works	Approval of the Project Construction Environment and Social Management Plan (CESMP) undertaken by the construction contractor, Samsung C&T, in order to receive an environmental NOC prior to the start of the Project Construction	Samsung C&T	FM-EPS
	Renewal approval of the Project CESMP	Samsung C&T	FM-EPS
	During construction, all required approvals with other authorities will be obtained	Samsung C&T	Other Authorities
Operation	Approval of the Project Operation Environment and Social Management Plan (OESMP) undertaken by the future F3 Operator, in order to receive an environmental NOC for the Project Operation	Future F3 Operator	FM-EPS
	Renewal approval of the Project OESMP	Future F3 Operator	FM-EPS
	During operation, all required approvals with other authorities will be received	Future F3 Operator	Other Authorities
Decommissioning	Approval of the decommissioning plan and other required decommissioning approvals	Future F3 Operator	FM-EPS & other authorities

4.5. Waste Streams & Emissions

4.5.1. Waste Streams

Waste streams generated during the Project construction is presented in **Section 4.2.2.1.2.3** and details of type of waste and their impacts is fully discussed in **Section 6.3.7.1**. During the Project operation, waste streams estimations are not currently available, however, details of type of waste and their impacts is fully discussed in **Section 6.3.7.2.**

4.5.2. Air Emissions

Air emissions during the Project construction and operation is fully discussed in **Section 6.3.1**.

5. DESCRIPTION OF THE ENVIRONMENT

5.1. Baseline Conditions

5.1.1. Site Description and Surrounding Areas

5.1.1.1. Site Description

As previously stated, photographs were not allowed to be capture during the Project site visit undertaken by Anthesis due to security restrictions issued by the CICPA personnel. As a result, no Project site photographs have been provided within this report. Nevertheless, a representation of the site visit findings is illustrated in Figure 5-1 below.

The Project site, as shown in Figure 4-6 above, covers an area approximately 0.24km^2 along the eastern coast of Fujairah. The Project site has been previously developed as a power plant but was subsequently decommissioned and largely demolished between 2013 and 2017, although some components remain. The Project site currently contains large amount of concrete rubble and waste, generated from the decommissioning of the previous power plant. This waste is heaped in areas around the centre of the Project site as well as flattened along the eastern section closest to the coast. Some concrete buildings remain standing, generally in the centre of the Project site which were previously used as battery storage units and administration offices based upon signage that remains on the existing buildings. A concrete underground seawater network exists within the centre of the Project site, connecting these two existing buildings as well as extending throughout large parts of the site. Additionally, an abandoned mosque remains in the centre of the Project site.

Flattened concrete rubble remains in large concentrations around the external areas of the Project site. Much of these areas support a light coverage of vegetation with vegetation in the area being composed of some exotic remnants of landscaping, ruderal weeds and limited recolonization by indigenous species in some areas. Additionally, approximately five Ghaf trees are located within the Project site, two located in the central area, east of the concrete buildings, and three located in the southern edge of the Project site, adjacent to the site entrance.

Large amounts of wooden, metal and plastic waste previously used within the operations of the Project site exist in several heaps throughout the eastern half of the Project site. This waste generally takes the form of wooden pallets, lengths of fiberglass pipe and metal rebar.

Approximately 15 sheets of asbestos concrete sheeting were located stacked near the southern perimeter of the Project site. Additionally, the eastern perimeter of the Project site contains a significant amount of coastal waste which has been deposited over time. This waste generally contains plastic and wooden debris.

The northern area of the Project site contains an oil storage facility which remains existing from the decommissioned plant as well as areas of flattened rubble.

The perimeter of the Project site is guarded with a high security which has broken gaps along the eastern, coastal side.

Project Number: 1116
Project Name: Fujairah 3
Data Sources: Various
Compiled By: AB

Scale: 1:3108
Coordinate System: World Mercator System
Datum: WGS84
Units: meters
Date: 02/02/20

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Figure 5-1: Project site overview

5.1.1.2. Surrounding Areas

As mentioned previously, the future Project is located directly adjacent to the F1 & F2 power facilities. To access the Project site, vehicles use the E99 highway, then join the Qidfa Power Station Street to The Station Street. No photos were allowed around the Fujairah plants area; however, a representation of the site visit findings is illustrated in Figure 5-10 below. The figure illustrates all land use and potential future socio-economic receptors.

Regarding other industrial sites, except F1 and F2, the Project site is also located adjacent to a number of oil storage tanks, containing approximately 26,000 m^3 of oil. These tanks are understood to be used by the adjacent F1 and F2 plants.

Other land uses surrounding the Project site include agricultural areas and residential areas. F1, F2 and the Project are located directly adjacent to a farming area which is comprised of several residential housing. Figure 5-2 below shows an example of farming areas located in the northern section of the farms. Furthermore, adjacent to the farm near F2 is located a cemetery.

The residential areas near the Project comprise the population of Mirbah and Qidfah towns which include shops (example in Figure 5-6), mosques (example in Figure 5-7), houses (example in Figure 5-8 and Figure 5-9), residential towers, parks and governmental buildings. Approximately 300m to 1km to the south of F2 are located in Mirbah city several schools and a kindergarten as illustrated in Figure 5-3 to Figure 5-5.

Figure 5-2: Farms with residential housings (refer to P1 in Figure 5-10)

Figure 5-3: Alshahad Kindergarten (refer to P2 in Figure 5-10)

Figure 5-4: Saif bin Hamad Alsharqi School (refer to P3 in Figure 5-10)

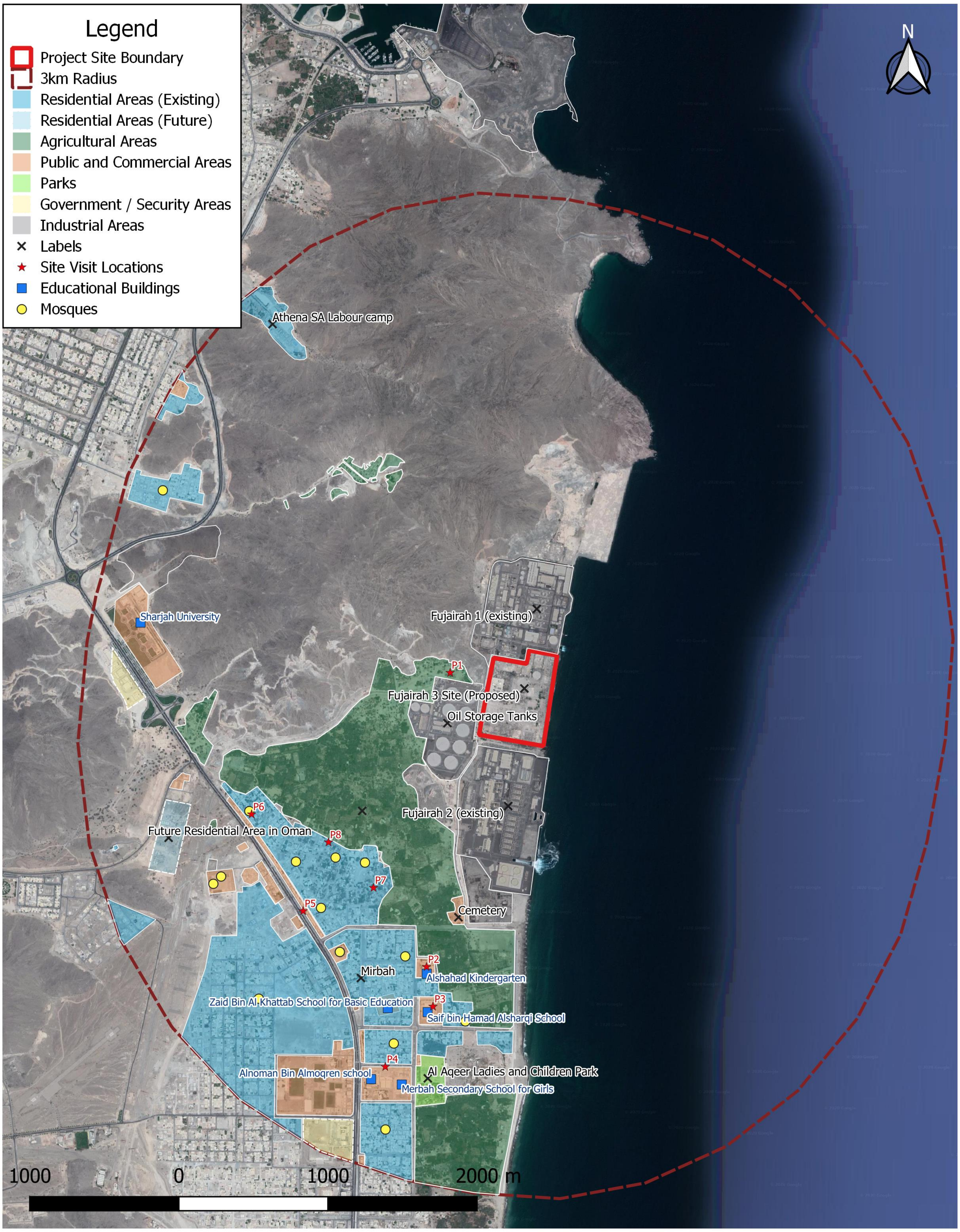
Figure 5-5: Sport Hall of Alnoman bin Almoqren School and Merbah Secondary School for Girls (refer to P4 in Figure 5-10)

Figure 5-6: Commercial areas adjacent to E99 (refer to P5 in Figure 5-10)

Figure 5-7: Example of a mosque (refer to P6 in Figure 5-10)

Figure 5-8: Example of residential houses (refer to P7 in Figure 5-10)

Figure 5-9: Example of a residential house (refer to P8 in Figure 5-10)



Project Number: 1116
Project Name: Fujairah 3
Data Sources: Various
Compiled By: AB

Scale: 1:31287
Coordinate System: World Mercator System
Datum: WGS84
Units: meters
Date: 02/02/20

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Figure 5-10: Overview of the Project surroundings

5.1.2. Ambient Air Quality & Meteorology

5.1.2.1. Baseline Methodology

Baseline data have been collected from a range of sources as follows:

- Meteorological data have been collected from the UAE National Centre of Meteorology; and
- Continuous hourly data was collected over a 5 month period at the Qidfa station (August – December 2019) and over a year (January – December 2019) at the Al Qurayyah station, which has kindly been made available by FM from their existing air quality monitoring network. The specific methods of monitoring, data capture, quality assurance and quality control were not provided with the data.

5.1.2.2. Baseline Results

5.1.2.2.1. Climate

The climate of Fujairah, along the east coast of the UAE, is typically hot and dry and is classified as BWh (hot and desert) under the Köppen Classification of global climatic zones (Figure 5-11) (8). Temperature, relative humidity, rainfall and wind speed have been recorded at the Fujairah International Airport (PIA), located about 20 km south of the Project site, for the period 1988 to 2018, by the Ministry of Presidential Affairs (MOPA): National Centre of Meteorology (NCM) (9) and is detailed in the following sections.

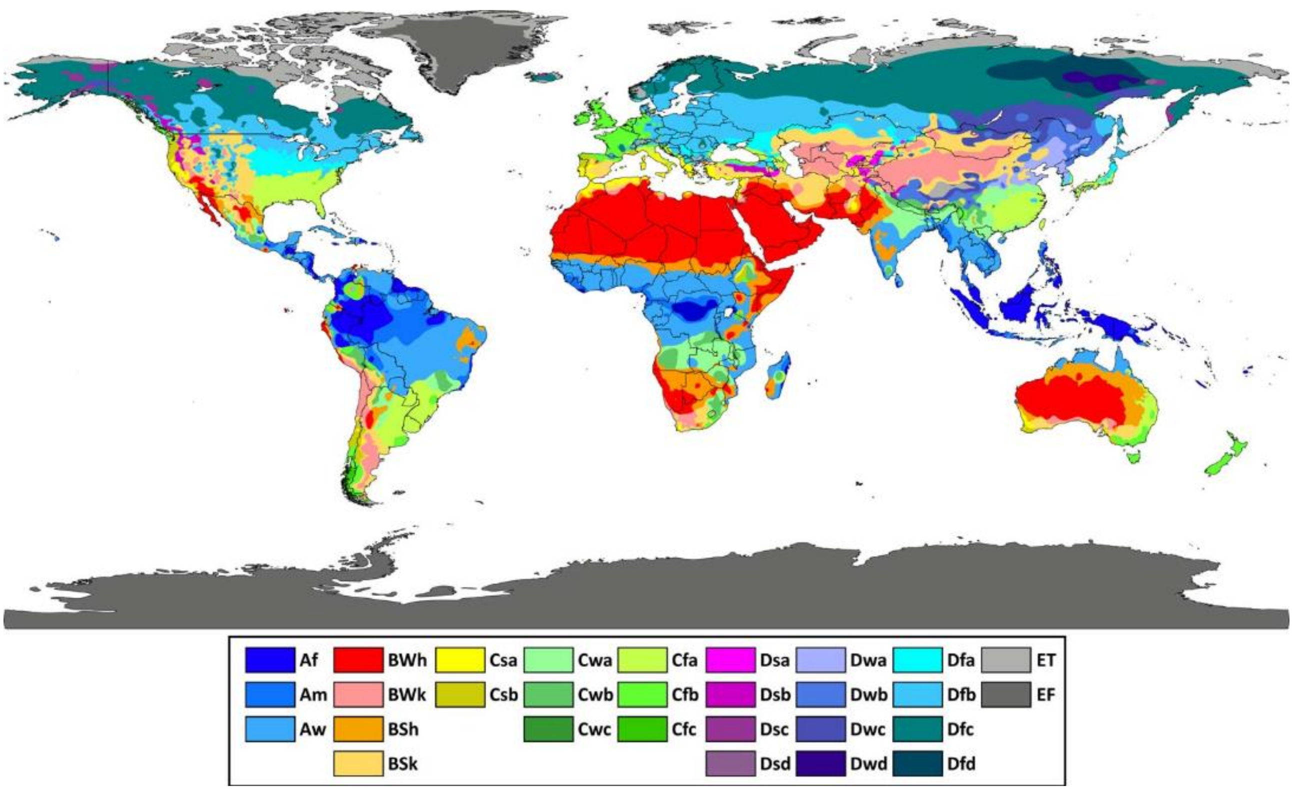


Figure 5-11: Köppen Climate Classification

5.1.2.2.1.1. Temperature

Fujairah is generally an emirate with warm conditions throughout the year, with relatively higher temperatures experienced between May and September. Emirates within the UAE generally experience hot summers with mild temperate winters. Minimum average temperatures of 10.5 – 14.8 °C were observed in December to March, with maximum average temperatures of 35.7 – 39.3°C observed during May to September. Table 5-1 and Figure 5-12 presents average monthly temperatures for the emirate.

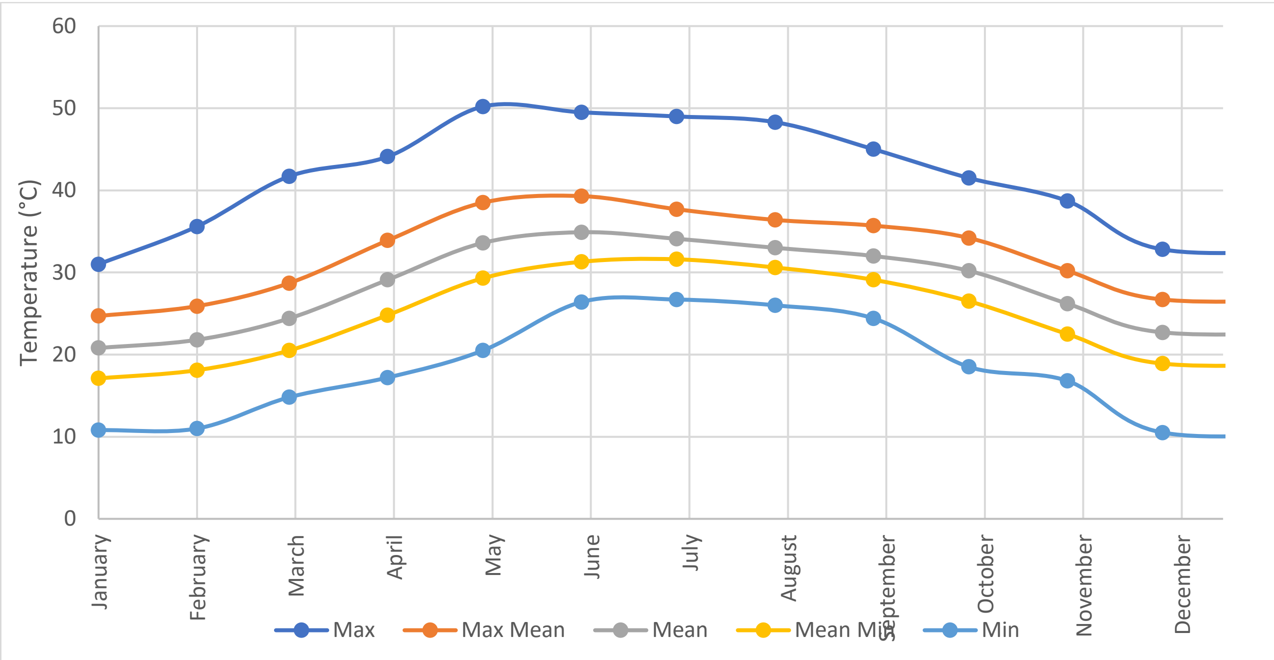


Figure 5-12: Monthly Ambient Temperature

5.1.2.2.1.2. Rainfall

Fujairah is the only emirate of the UAE that is almost completely mountainous. Most rainfall within the UAE occurs during the winter months and in early spring. Fujairah boasts a high average annual rainfall as compared to the other emirates of the UAE. This is partially due to its geographic location (allowing influence by tropical weather systems) and its mountainous character. The average rainfall in Fujairah is presented in Table 5-1 and Figure 5-13

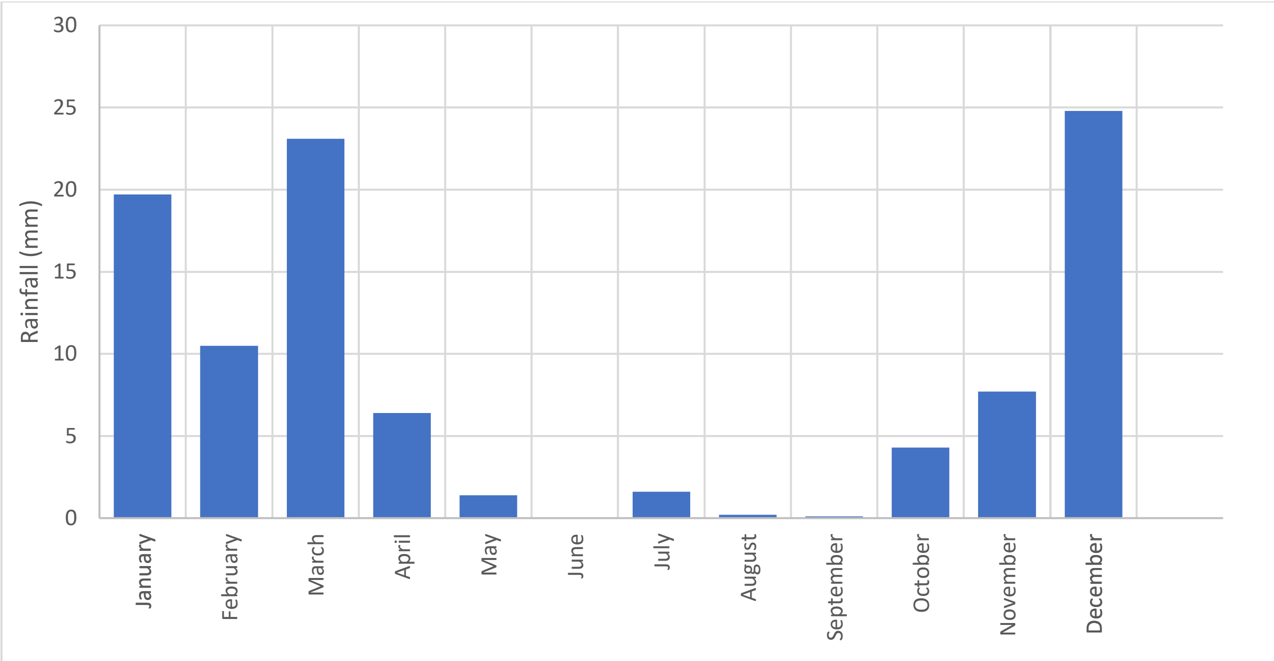


Figure 5-13: Average Monthly Rainfall

5.1.2.2.1.3. Relative Humidity

Humidity is highest along the coastal fringe of the Arabian Peninsula and decreases inland. Average humidity recorded at FIA is greater the 50%, throughout the year, with an average maximum of 72% recorded in August and minimum average of 46% in May. The average relative humidity is shown in Figure 5-14 and Table 5-1.

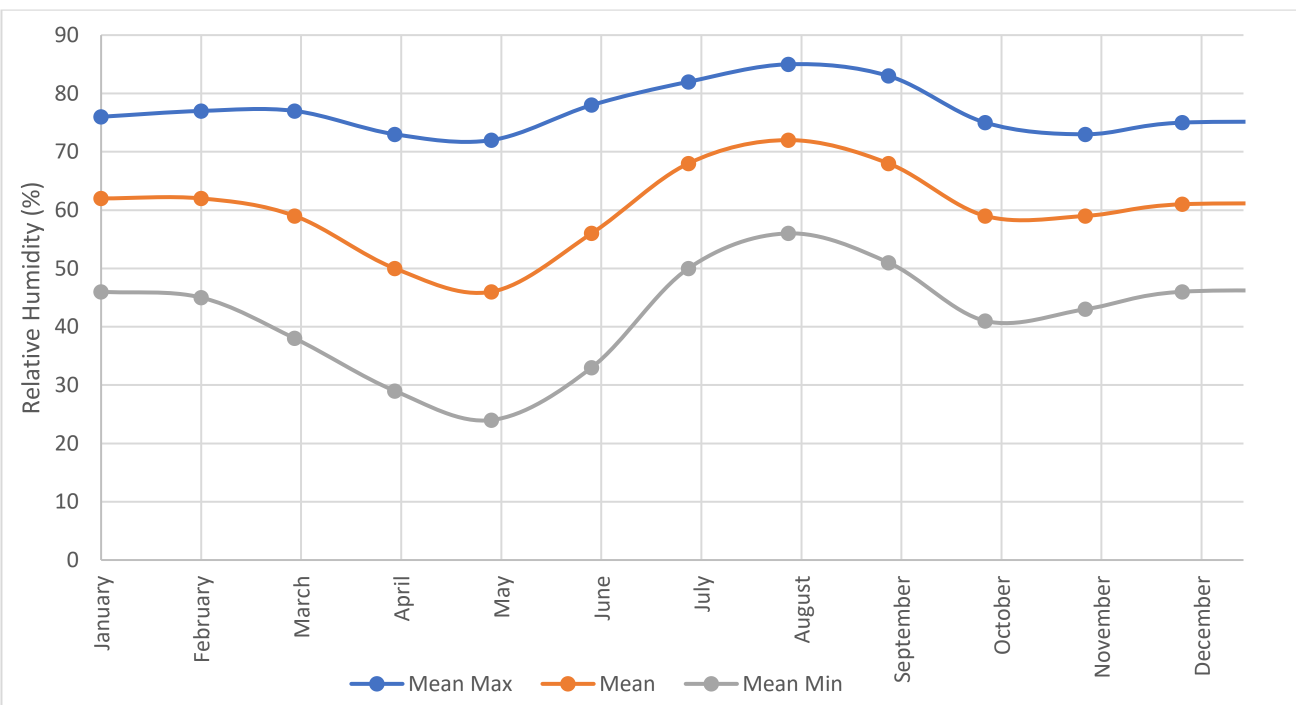


Figure 5-14: Average Monthly Relative Humidity

Table 5-1: Monthly Climate Data for FIA (9)

Month	Temperature (°C)					Relative Humidity (%)			Rainfall (mm)
	Maximum	Average Maximum	Average	Minimum	Average Minimum	Average Maximum	Average	Average Minimum	
January	31.0	24.7	20.8	17.1	10.8	76.0	62.0	46.0	19.7
February	35.6	25.9	21.8	18.1	11.0	77.0	62.0	45.0	10.5
March	41.7	28.7	24.4	20.5	14.8	77.0	59.0	38.0	23.1
April	44.1	33.9	29.1	24.8	17.2	73.0	50.0	29.0	6.4
May	50.2	38.5	33.6	29.3	20.5	72.0	46.0	24.0	1.4
June	49.5	39.3	34.9	31.3	26.4	78.0	56.0	33.0	0.0
July	49.0	37.7	34.1	31.6	26.7	82.0	68.0	50.0	1.6
August	48.3	36.4	33.0	30.6	26.0	85.0	72.0	56.0	0.2
September	45.0	35.7	32.0	29.1	24.4	83.0	68.0	51.0	0.1
October	41.5	34.2	30.2	26.5	18.5	75.0	59.0	41.0	4.3
November	38.7	30.2	26.2	22.5	16.8	73.0	59.0	43.0	7.7
December	32.8	26.7	22.7	18.9	10.5	75.0	61.0	46.0	24.8

5.1.2.2.2. Air Quality

Ambient air quality data from the Qidfa and Al Qurayyah continuous ambient air quality monitoring stations were obtained from FM. The location of both stations in relation to the Project site are provided in Figure 5-15.

Continuous hourly data was collected over a 5 month period at the Qidfa station (August – December 2019) and over a year (January – December 2019) at the Al Qurayyah station. The specific methods of monitoring, data capture, quality assurance and quality control were not provided with the data. The data was processed into averaging periods relevant to the AAQS. A summary of the monitored data, compared with the relevant standards, is presented in Table 5-2 and Table 5-3.

Table 5-2: Summary of the Qidfa Station Ambient Air Quality Baseline Data

Parameter	NO_2	NO_2	PM_{10}	CO	CO
Unit	µg/m³	µg/m³	µg/m³	mg/m³	mg/m³
Averaging Period	1 hour	24 hour	24 hour	1 hour	8 hour
Percent Data capture over the five month period (Hourly Values)	86.87	86.87	86.79	83.09	83.09
Maximum	110	46.75	203.9	8.16	1.75
Minimum	0	4.74	44.58	0.03	0.07
Long Term Average	21.22		72.88	0.662	
Ambient Standards	400	150	150	30	10
Number of Exceedances	0	0	0	0	0

Table 5-3: Summary of the Al Qurayyah Station Ambient Air Quality Baseline Data

Parameter	NO_2	NO_2	PM_{10}	CO	CO
Unit	µg/m³	µg/m³	µg/m³	mg/m³	mg/m³
Averaging Period	1 hour	24 Hour	24 hour	1 hour	8 hour
Percent Data capture over the one year period (Hourly Values)	96.38	96.38	87.92	99.47	99.47
Maximum	214	108	371	2.76	2.33
Minimum	73.30	14.99	5.56	0.39	0.43
Long Term Average	33.34		101.28	0.905	
Ambient Standards	400	150	150	30	10
Number of Exceedances	0	0	46	0	0

Based on the measured data for each of the sites, it can be concluded that the airshed would be considered "Non-Degraded" in terms of the IFC General EHS definition with regards to gaseous pollutants, where an airshed is considered as having poor air quality if nationally legislated air quality standards or WHO Air Quality Guidelines are exceeded significantly. The measured data does show elevated particulate matter concentrations which is a well-documented regional phenomenon.

One important aspect of cumulative impact assessment entails combining modelled concentrations with monitored background concentrations to determine the potential cumulative ambient air quality impacts. The use of a single uniform monitored background contribution is the simplest approach to implement since it can be applied outside of the modelling system. However, in determining a suitable background value for short-term periods it is acknowledged that use of the overall highest hourly background concentration will be overly conservative in many cases, as the maximum process contribution and maximum background concentration may be separated both temporally and spatially, so that the addition of the two "worst-case" concentrations together may not represent a likely event.

In order to be able to provide a comparison of the short-term average AAQS in conjunction with short-term average model outputs, the approach advocated by the UK Environmental Agency has been adopted. When assessing short-term effects, it is reasonable to consider the maximum short-term modelled output in an additive context with a background concentration equal to two times (double) the long-term background value (10). An average of the data from both monitoring stations was used to obtain the background concentrations used for the cumulative assessment. The Al Qurrayah station, however, did not measure $PM_{2.5}$ therefore, $PM_{2.5}$ data from the Qidfa station was used. The background concentrations considered for the cumulative assessment are presented in Table 5-4 below. Given the naturally high levels of dust and particulate matter that occur in the region, PM_{10} and $PM_{2.5}$ background concentrations have not been included in the cumulative assessment.

Table 5-4: Background Ambient Air Quality (BAAQ) for cumulative assessment

Pollutant	Background Concentration (µg/m³)	
	Long-Term Concentration (µg/m³)	Short-Term Concentration (µg/m³)
NO_2	27.29	54.57
CO	784.24	1,568.48

Figure 5-15: Location of the Ambient Air Quality Monitoring Stations

5.1.3. Ambient Noise

5.1.3.1. Baseline Methodology

Short-term and long-term baseline noise surveys were conducted from the 22nd to the 23rd of January 2020, in accordance with best practice to establish the existing noise levels at the Project fence line and surrounding areas.

Measurements were conducted using a NL-52 Rion Cirrus Type 1 sound level meter, together with an NC-75 Rion acoustic field calibrator. A one-half-inch microphone was used. The sound level meter was set at fast response and had the capability of determining the equivalent A-weighted sound level over a specified measurement period.

The analyser and calibrator had an annual calibration performed by the equipment supplier. On site calibrations were also performed before and after each measurement series and upon any significant change in recording conditions (i.e. battery change operation). The calibration frequency was 1,000 Hz. A calibration level change exceeding ± 1.0 dB required that the measurement series be repeated.

The selected sound level meter automatically logged environmental noise measurement parameters including A-weighted equivalent (L_{Aeq}), maximum (L_{Amax}), minimum (L_{Amin}), and statistical noise levels (e.g. L_{A10} and L_{A90}).

Figure 5-16 below indicates the locations of the baseline noise measurements.

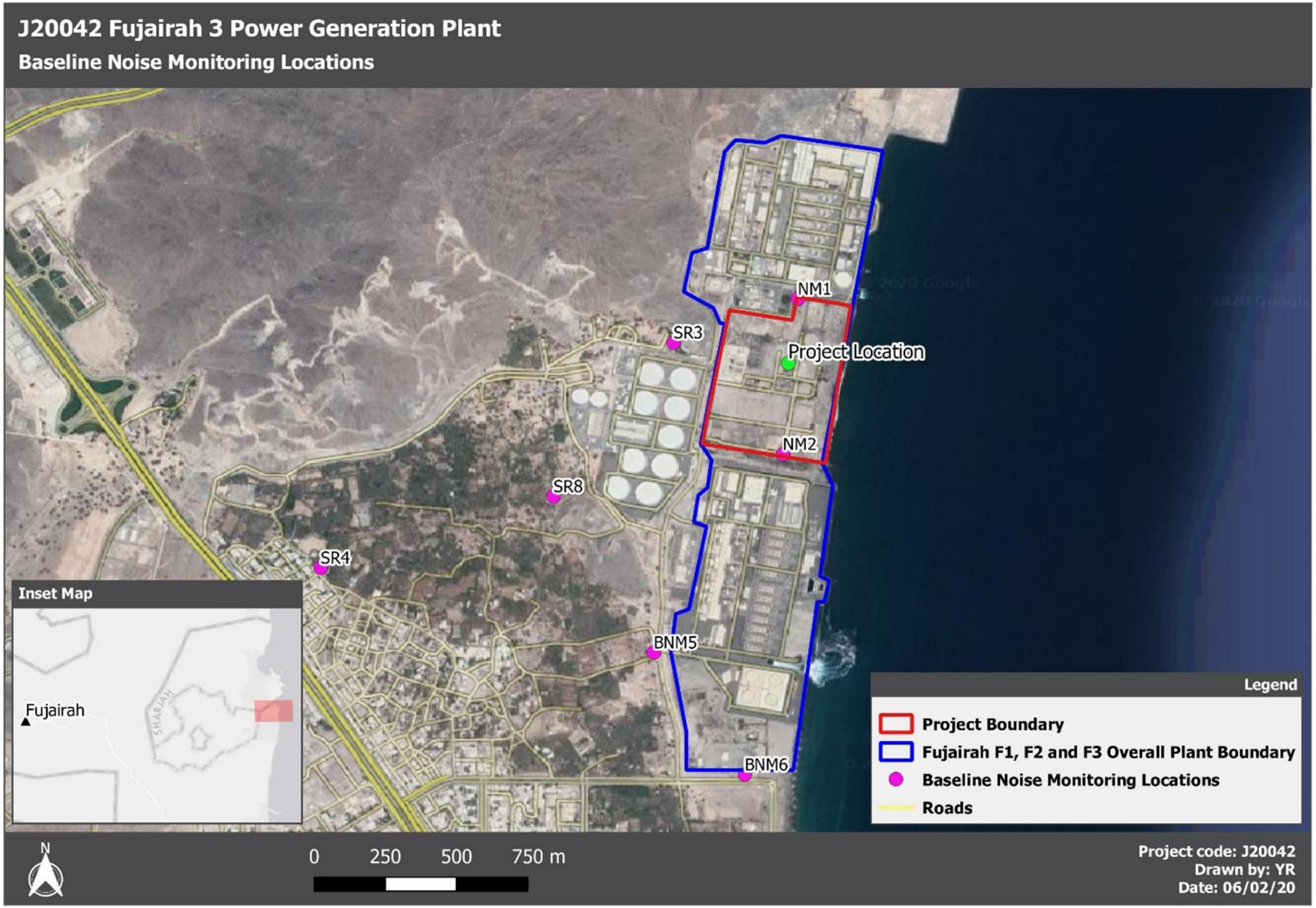


Figure 5-16: Baseline noise measurement locations

5.1.3.2. Baseline Results

The ambient noise measurements recorded at all locations are summarised below in Table 5-5 (daytime noise survey results) and Table 5-6 (night-time noise survey results).

Table 5-5: Ambient noise survey results: daytime noise levels

Receptor	Land Use Type	Most Stringent Noise Limit L_{Aeq} (dB(A))	Recorded Noise Level L_{Aeq} (dB(A))	Limit Exceeded
Short-Term Measurements (15 minutes)				
BNM5	Industrial	70 (Federal & IFC)	61.1	No
BNM6	Industrial	70 (Federal & IFC)	58.6	No
SR3	Mixed Residential	60 (Federal)	54.6	No
Long-Term Average Measurements (24 hours)				
NM1	Industrial	70 (Federal & IFC)	46.7	No
NM2	Industrial	70 (Federal & IFC)	52.5	No
SR4	Mixed Residential	60 (Federal)	49.1	No
SR8	Mixed Residential	60 (Federal)	44.8	No

Table 5-6: Ambient noise survey results: night-time noise levels

Receptor	Land Use Type	Most Stringent Noise Limit LAeq (dB(A))	Recorded Noise Level L_{Aeq} (dB(A))	Limit Exceeded
Short-Term Measurements (15 minutes)				
BNM5	Industrial	60 (Federal)	49.3	No
BNM6	Industrial	60 (Federal)	53.3	No
SR3	Mixed Residential	50 (Federal)	52.8	Yes
Long-Term Average Measurements (24 hours)				
NM1	Industrial	60 (Federal)	49.3	No
NM2	Industrial	60 (Federal)	56.3	No
SR4	Mixed Residential	50 (Federal)	46.1	No
SR8	Mixed Residential	50 (Federal)	45.4	No

When compared against the most stringent daytime limits, as defined in Table 3-8, all seven monitoring locations did not exceed the limits. In terms of the most stringent night-time limits, there is one exceedance recorded at SR3, having a level 2.8 dB(A) above the federal night-time noise limit of 50 dB(A).

The exceedance could be attributed to the close proximity of SR3 to the existing F1 and F2 Independent Water and Power Plants (IWPPs) as SR3 is located 210 m and 479 m from F1 and F2 respectively. All of the remaining survey locations (BNM5, BNM6, NM1, NM2, SR4 and SR8) have recorded noise levels below the applicable noise limits.

5.1.4. Soil, Surface Water and Groundwater

This chapter provides the methodology and baseline investigation data in relation to soil, groundwater and surface water baseline conditions within the Project site.

5.1.4.1. Baseline Methodology

5.1.4.1.1. Phase I Investigation

A Phase I non-intrusive investigation of the Project site was conducted over a number of visits by the Anthesis team to determine initial conditions in advance of detailed investigations. This comprised a visual investigation of the Project site taking site notes. The primary aim of the Phase I assessment was to establish the historical use and existing potential contamination sources on site, potential pathways and sensitive receptors as defined and illustrated in Figure 5-17 below. The assessment included the identification of:

- Potential soil and/or surface water contamination;
- Potential sources of contamination such as:
  - Storage areas or illegal dumping areas of hazardous and non-hazardous waste;
  - Storage areas of chemicals of potential concern such as fuel/oil drums, tanks etc.;
  - Utilities, industrial and/or commercial activities that can cause potential contamination; and
  - Existing buildings on-site which may contain asbestos;
- Potential pathways;
- Groundwater abstraction; and
- Overall site surroundings, in order to identify potential sensitive human and environmental receptors.

Figure 5-17: Contamination risk assessment pollution linkage

5.1.4.1.2. Soil and Groundwater Sampling

As part of the Project baseline investigations, a total of six soil and six groundwater samples have been collected from three locations within the Project site, to provide details of existing baseline geo-environmental conditions and to understand if there are any issues of contamination migrating into the Project site. The sample locations are shown in Figure 5-18 below, with coordinates listed in Table 5-7.

Table 5-7: Sample Locations

Borehole	Easting (m)	Northing (m)
BH-05	436905.11	2799046.92
BH-10	436888.21	2799477.28
BH-13	436649.33	2799198.16

5.1.4.1.2.1. Soil

Soil sampling was conducted to ascertain current baseline conditions and to highlight any areas of contamination. For each location, due to the well-drained nature of the soils (predominantly sand and gravels), it was appropriate to collect one composite surface soil sample to a maximum depth of 0.5m as well as one composite sample from a depth ranging from 50 cm to 1.0m per location. The samples were analysed by an EIAC accredited laboratory. In the absence of soil regulations within the emirate of Fujairah, it is proposed to adopt the Dutch Intervention Values (2009), which will be considered as reference values as they are not compulsory threshold standards.

5.1.4.1.2.2. Groundwater

Six groundwater samples from three existing boreholes located within the Project site were collected for analysis. The samples were analysed by an EIAC accredited laboratory. In the absence of groundwater regulations within the emirate of Fujairah, it is proposed to adopt the Dutch Intervention Values (2009), which will be considered as reference values as they are not compulsory threshold standards.

5.1.4.1.2.3. Testing Parameters

As these are no applicable Emirate or Federal limits for the limits of soil or groundwater analysis, the Dutch Intervention Value (DIV) limits have been adopted. Table 5-8 below details the soil testing parameters and Table 5-9 below details the groundwater testing parameters.

5.1.4.1.2.4. Surface Water

No (non-marine) surface water was located within the Project site.

Table 5-8: Soil testing parameters and DIV limits

No.	Parameter	Unit of Measurement	Dutch Intervention Value (2009) Limits (11)	
			Standard Value	Corrected Value
Physical Parameters				
1.	pH	-	-	
2.	Soil Texture	USDA Classification	-	
3.	Asbestos	g/10kg	-	
Heavy Metals:				
4.	Zinc	mg/kg	720 *	258
5.	Manganese	mg/kg	-	-

No.	Parameter	Unit of Measurement	Dutch Intervention Value (2009) Limits (11)	
			Standard Value	Corrected Value
6.	Iron	mg/kg	-	-
7.	Copper	mg/kg	90 *	80
8.	Selenium	mg/kg	100	-
9.	Cadmium	mg/kg	13 *	7
10.	Lead	mg/kg	530 *	313
11.	Arsenic	mg/kg	76 *	39
12.	Chromium	mg/kg	-	-
13.	Nickel	mg/kg	100 *	29
14.	Mercury	mg/kg	-	-

Note:

- Value in (*) are based on a standard soil of 10% organic matter and 25% clay. In the case of this Project, the soil value has been corrected in the 'corrected value' column
- The sign '-'significates that this is not applicable, or this parameter is not listed in the Dutch Intervention Value.

Table 5-9: Groundwater testing parameters and DIV limits

No.	Parameter	Unit of Measurement	Dutch Intervention Value (2009) limits (11)
Physical Parameters			
1.	pH	-	-
2.	Electrical Conductivity (EC)	MicroS/cm	-
3.	Total Dissolved Solids (TDS)	mg/L	-
Inorganic Parameters			
4.	Sodium	mg/L	-
5.	Potassium	mg/L	-
6.	Calcium	mg/L	-
7.	Magnesium	mg/L	-
8.	Sulphate	mg/L	-
9.	Nitrate	mg/L	-
10.	Total Nitrogen	mg/L	-
11.	Chloride	mg/L	-
12.	Arsenic	µg/L	60
13.	Cadmium	µg/L	6

No.	Parameter	Unit of Measurement	Dutch Intervention Value (2009) limits (11)
14.	Chromium	µg/L	30
15.	Copper	µg/L	75
16.	Iron	µg/L	-
17.	Lead	µg/L	75
18.	Molybdenum	µg/L	300
19.	Boron	µg/L	-
20.	Barium	µg/L	-
21.	Beryllium	µg/L	-
22.	Manganese	µg/L	-
23.	Zinc	µg/L	800
Miscellaneous Parameters			
24.	Phenols	mg/L	2
25.	Benzene	mg/L	0.03
26.	1, 2 dichloroethane	mg/L	0.4
27.	Dichloromethane	mg/L	1
Note: The sign '-'significates that this is not applicable, or this parameter is not listed in the Dutch Intervention Value.			

Project Number: 1116
Project Name: Fujairah 3
Data Sources: Various
Compiled By: Karl McMullan

Scale: 1:5146
Coordinate System: World Mercator System
Datum: WGS84
Units: meters
Date: 02/02/20

Anthesis

Figure 5-18: Location of soil and groundwater sample locations

5.1.4.2. Baseline Results

5.1.4.2.1. Regional Geology

The geology of the United Arab Emirates, and the Arabian Gulf area, has been substantially influenced by the deposition of marine sediments associated with numerous sea level changes during relatively recent geological time. With the exception of mountainous regions shared with Oman in the north- east, the country is relatively low-lying, with near-surface geology dominated by Quaternary to late Pleistocene age, mobile aeolian dune sands, and sabkha/evaporite deposits.

The geologically stable Arabian Plate is separated from the unstable Iranian Fold Belt by the Arabian Gulf. It is believed that a tilting of the entire Arabian Plate occurred during the early Permian period, resulting in uplift in southern Yemen, and depression to the north- east. Crustal deformations and igneous intrusions occurred in the north- east as a result of this movement. Subsequent tectonic movements, peripheral to the folding of the Iranian Zagros Range, during the Pliocene – Pleistocene epoch, probably contributed to the formation of both the Arabian Gulf depression, and the mountainous regions shared by the United Arab Emirates and Oman in the north-east.

Available geological literature indicates the east coast of the United Arab Emirates to form part of the Oman Mountain range, composed of basic igneous rocks, with associated wadis and outwash deposits, bordered by a sandy shoreline.

In this region the mountains almost border onto the sea, with the coastal plain being of variable width, but generally narrow. Nearer the mountains and where the coastal plain narrows towards the north, outwash deposits only are encountered, with large thicknesses of gravels, cobbles and boulders. Towards the south and away from the mountains, mixed deposits of silts, sands and gravels predominate. Beneath these superficial deposits, interbedded conglomerate, calcarenite (carbonate sandstone) and calcisiltite (carbonate siltstone) are encountered on the coast, whilst inland the bedrock consists of basic and ultrabasic igneous rocks of the peridotite and gabbro suites (12).

5.1.4.2.2. Seismicity

As per EAD Environmental Atlas (13), movements of the Arabian Plate in relation to the surrounding tectonic plates generates pressure and heat, exerting immense force on the sub-surface rocks of the region. Under such persistent and enormous stresses, sub-surface rocks may respond by breaking or ‘faulting.’ Once faults have developed, these zones of weakness may become earthquake zones. Earthquake epicentres occur mostly to the north in the Arabian Gulf and Iran.

The ongoing compression of the Zagros Range, which is illustrated in Figure 5-19, causes frequent but relatively weak earthquakes in the region. Occasional large movements along vertical linear faults, such as the north–south trending Nayband Fault in south-east Iran, are usually accompanied by powerful and devastating earthquakes that can sometimes be felt across the Gulf. Furthermore, it can be seen that in the south-west branch of this fault lies beneath Dibba, in the north-east Emirates, but appears to not extend into Abu Dhabi (13).

Figure 5-19 illustrates the tectonic plate boundaries and recent earthquakes which are expressed as magnitudes on the Richter scale. A magnitude 5.3 earthquake would be rated as a moderate earthquake, while a magnitude 6.3 would be rated as a strong earthquake. Given it is a logarithmic scale, each whole number increase in magnitude represents a ten-fold increase in earthquake amplitude or intensity (13).

Figure 5-20 and Figure 5-21 present the recent seismic activity for 1964 to 2006 and from the 19th November 2017 to 19th February 2018 respectively. It can be seen therefore that the seismicity of Fujairah is considered low to moderate.

5.1.4.2.3. Regional Groundwater

Groundwater movement in the UAE is generally from east to west, towards the Arabian Gulf. Flow times from recharge zones in the east to the sabkha discharge zones along the Gulf coastline can take up to 15,000 years. The slow groundwater movement allows for considerable dissolution of salts in the groundwater. Hyper-saline waters are found along the coastline line. As illustrated in Figure 5-22 below, salinities generally decrease with distance from the coastline with some potable water being observed deep in the southern and eastern regions of UAE (14).

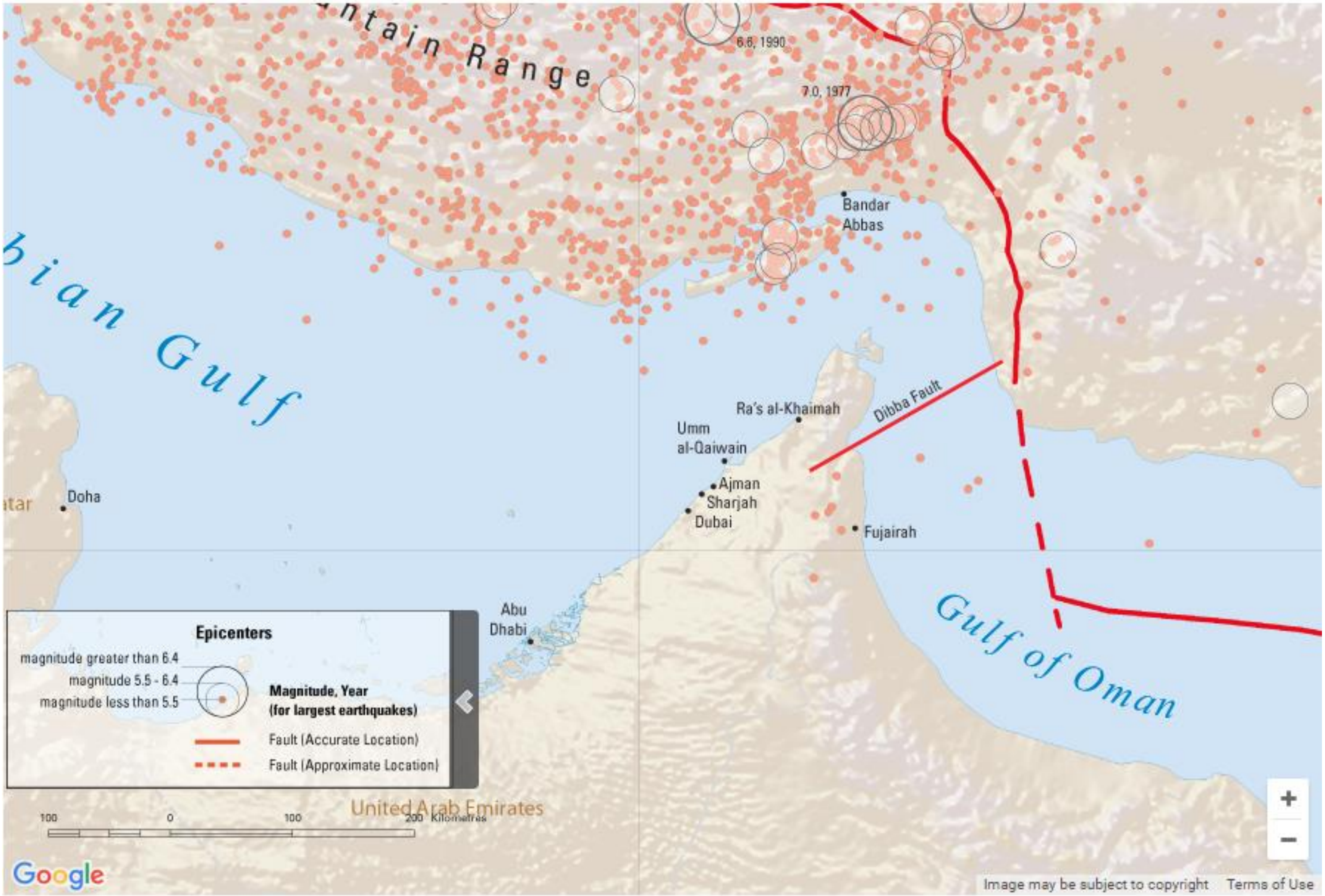
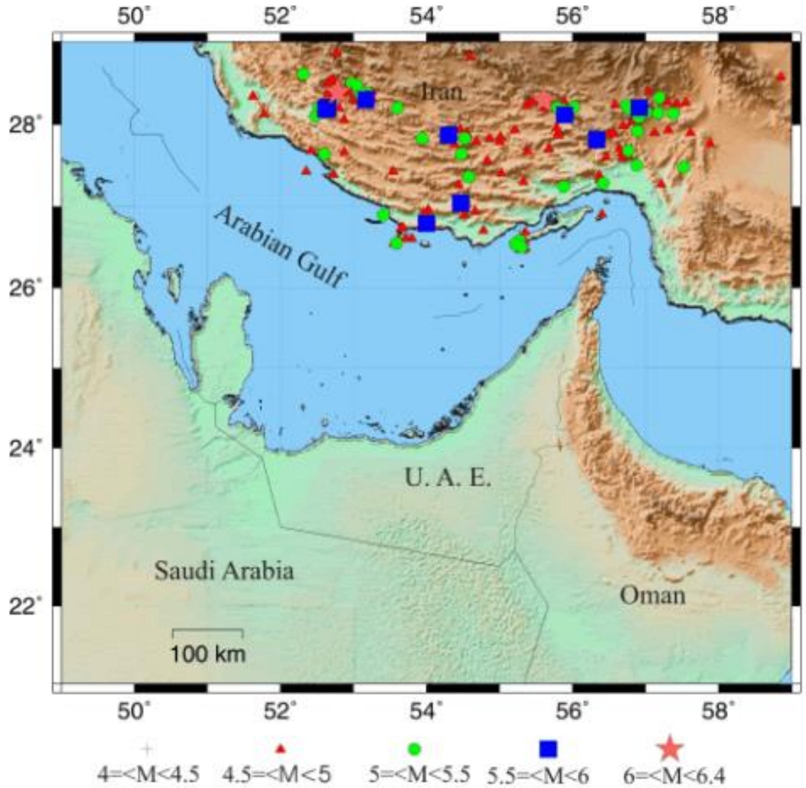
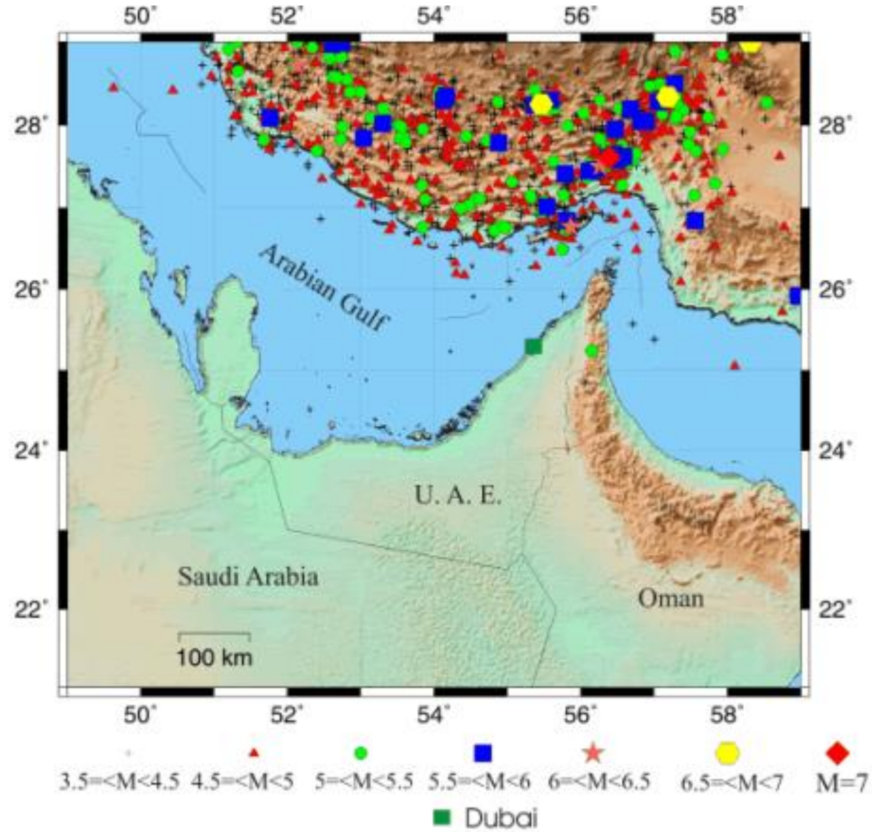


Figure 5-19: Seismic Events & Tectonic Plate Boundaries (13)



Seismicity in & around UAE during the period from 1964-1973.

(ISC Bulletin)



Seismicity in & around UAE during the period from Jan.1973-Feb. 2006

Figure 5-20: Historical of seismicity in the Middle East region from 1964 to 2006 (15)

Figure 5-21: Seismicity event from 19th November 2017 to 19th February 2018 (16)

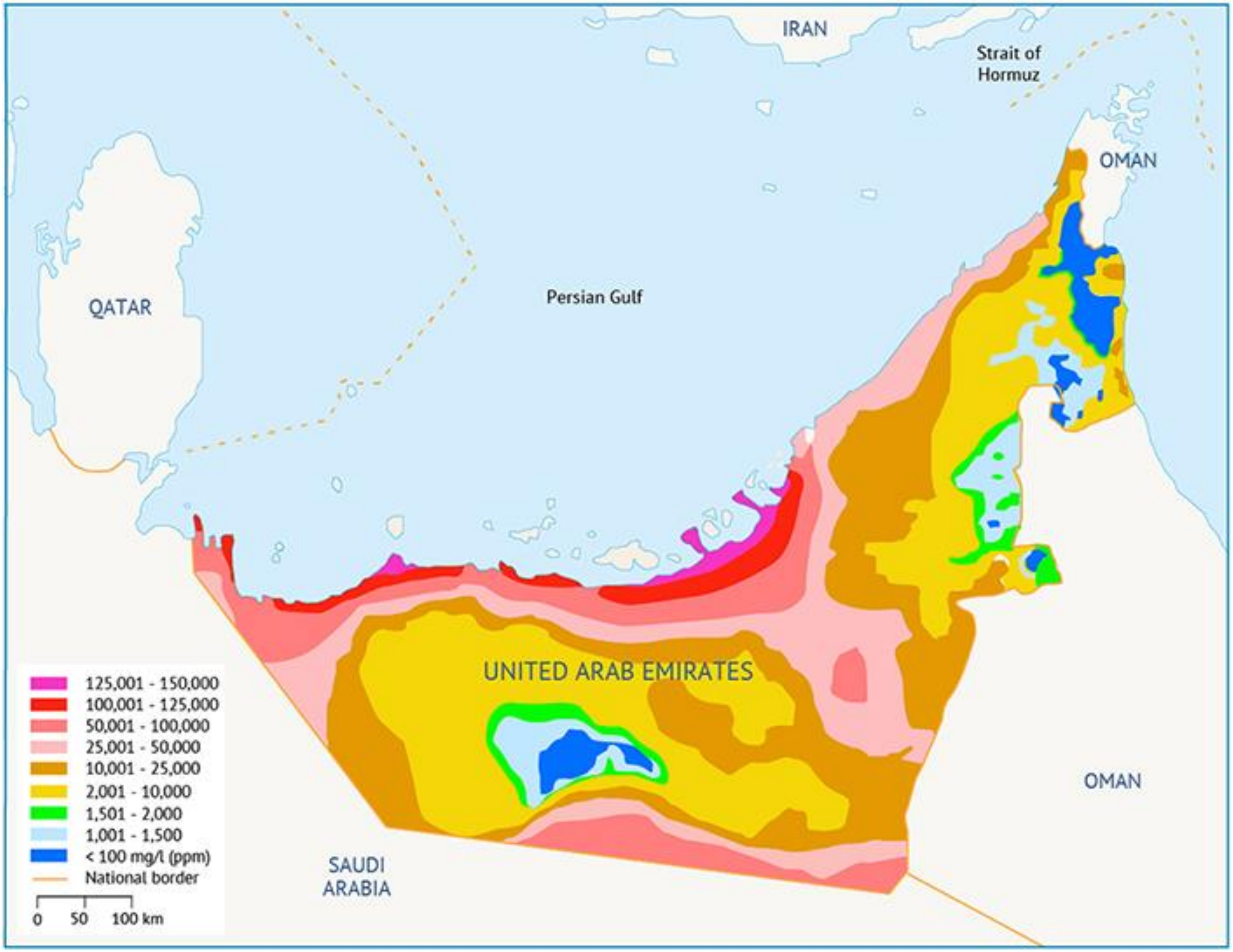


Figure 5-22: UAE Groundwater salinity (14)

5.1.4.2.4. Project Site Conditions

5.1.4.2.4.1. Soil

The Phase I investigation at the Project site did not identify any significant areas of contamination. However, the majority of the site is disturbed with demolition rubble from the previous power plant. As a result, and due to the potential for soil contamination, six soil samples were collected from three sample locations within the Project site and were analysed by an EIAC accredited laboratory with results presented in Table 5-10 and included within **Appendix 1.1**, showed that exceedances of the following parameters:

- Zinc at BH05;
- Copper at BH05; and
- Nickel at all locations.

5.1.4.2.4.2. Groundwater

Six groundwater samples were collected from three boreholes within the Project site and were analysed by an EIAC accredited laboratory. The results of this analysis are present in Table 5-11 below and included within **Appendix 1.1**, which confirm that no exceedances in the analysed parameters were detected.

5.1.4.2.4.3. Conclusion

Phase II investigations have revealed that exceedances in zinc, copper were detected in soil samples obtained from BH-05 while exceedances in nickel were detected in soil samples obtained from all locations.

No exceedances in groundwater samples were detected.

5.1.4.2.4.4. Asbestos Containing Materials

One area has been identified where existing asbestos cement sheets are present within the Project site. The location of these cement sheets does create the necessity of construction phase interaction during site cleaning or demolition. In this event, workers are likely to come into contact with disturbed asbestos fibres which presents a significant risk to health.

Table 5-10: Soil sample analysis results

No.	Parameter	Unit of Measurement	Dutch Intervention Value (2009) Limits (11)	Soil Samples Tested					
				BH-05		BH-10		BH-13	
				1	2	1	2	1	2
Physical Parameters									
1.	pH	-	-	7.7	7.6	8.3	8	8	8.1
2.	Soil Texture	USDA Classification	-						
3.	Asbestos	g/10kg	-	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.
Heavy Metals:									
4.	Zinc *	mg/kg	258	695	1040	130	199	23.1	22.7
5.	Manganese	mg/kg	-	393	420	354	346	296	281
6.	Iron	mg/kg	-	43100	48900	30800	30500	26500	24100
7.	Copper *	mg/kg	80	101	149	31.6	34.4	14.4	17.3
8.	Selenium	mg/kg	-	<3.0	<3.0	<3.0	<3.0	<3.0	<3.0
9.	Cadmium *	mg/kg	7	0.6	0.7	<0.5	<0.5	<0.5	<0.5
10.	Lead *	mg/kg	313	52.8	77.6	2.3	2.2	2.7	2.9
11.	Arsenic *	mg/kg	39	4.4	4.1	18.7	16.6	22.4	19.5
12.	Chromium *	mg/kg	-	70.7	77.8	126	108	127	111
13.	Nickel *	mg/kg	29	138	148	460	415	697	628
14.	Mercury *	mg/kg	-	<0.010	<0.010	0.012	<0.010	<0.010	<0.010

Note:
- Value in (*) were corrected based on the soil type and the organic matter content
- The sign '-'significates that this is not applicable, or this parameter is not listed in the Dutch Intervention Value
- Highlights in **RED** indicates exceedances

Table 5-11: Groundwater sample analysis results

No.	Parameter	Unit of Measurement	Dutch Intervention Value (2009) limits (11)	Groundwater Samples Tested					
				BH-05		BH-10		BH-13	
				1	2	1	2	1	2
Physical Parameters									
1.	pH	-	-	7.4	7.4	8	8.1	7.7	7.8
2.	Electrical Conductivity (EC)	MicroS/cm	-	2.6	2.5	2.8	2.9	1	1
3.	Total Dissolved Solids (TDS)	mg/L	-	1560	1440	1640	1760	548	574
Inorganic Parameters									
4.	Sodium	mg/L	-	318	301	426	436	107	109
5.	Potassium	mg/L	-	17.1	16.9	17.6	18.2	7.4	6.8
6.	Calcium	mg/L	-	31.8	25.3	35.2	40.3	31.6	29.9
7.	Magnesium	mg/L	-	146	138	61.1	69.4	41.6	38.7
8.	Sulphate	mg/L	-	54	61	296	288	30	33
9.	Nitrate	mg/L	-	0.04	<0.04	12	18.1	1.28	0.44
10.	Total Nitrogen	mg/L	-	0.27	0.08	0.16	0.12	0.36	0.45
11.	Chloride	mg/L	-	372	337	638	638	128	120
12.	Arsenic	µg/L	60	<0.01	0.02	<0.01	<0.01	<0.01	<0.01
13.	Cadmium	µg/L	6	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
14.	Chromium	µg/L	30	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
15.	Copper	µg/L	75	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
16.	Iron	µg/L	-	0.21	0.06	0.02	0.1	0.2	0.18
17.	Lead	µg/L	75	<0.01	0.01	0.03	0.01	<0.01	<0.01
18.	Molybdenum	µg/L	300	0.051	0.035	0.015	0.016	0.007	0.006
19.	Boron	µg/L	-	3.75	3.79	2.24	2.35	0.78	0.74
20.	Barium	µg/L	-	0.14	0.11	0.01	0.01	<0.01	<0.01
21.	Beryllium	µg/L	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
22.	Manganese	µg/L	-	0.13	0.09	<0.01	<0.01	<0.01	0.02
23.	Zinc	µg/L	800	0.02	0.01	0.02	<0.01	<0.01	<0.01
Miscellaneous Parameters									
24.	Phenols	mg/L	2						
25.	Benzene	mg/L	0.03	<10	<10	<10	<10	<10	<10
26.	1, 2 dichloroethane	mg/L	0.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
27.	Dichloromethane	mg/L	1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Note:
The sign '-'significates that this is not applicable, or this parameter is not listed in the Dutch Intervention Value.

5.1.5. Terrestrial Ecology

5.1.5.1. Baseline Methodology

5.1.5.1.1. Literature Review

A literature review was conducted as per the IFC Performance Standard 6, the results of which are presented in the literature review results below. References used in order to inform the literature review include, but are not limited to:

- Al Dhaheri, S. et al., 2017. Abu Dhabi Emirate Habitat Classification and Protection Guideline. Abu-Dhabi. : Environment Agency Abu-Dhabi.
- Aspinall, S., 2010. Breeding Birds of the United Arab Emirates. 2nd ed. Abu Dhabi: Abu Dhabi: Emirates Printing Press.
- Boer, B., 1997. An introduction to the climate of the United Arab Emirates. Journal of Arid Environments, Volume 35, pp. 3-16.
- Brown, G. & Boer, B., 2004. Interpretation Manual of Major terrestrial natural and semi-natural Habitat types of Abu Dhabi Emirate., s.l.: ERWDA Internal Research Report.
- Brown, M. A., Clarkson, B. D., Barton, B. J. & Joshi, C., 2013. Implementing ecological compensation in New Zealand: Stakeholder perspectives and a way forward. Journal of the Royal Society of New Zealand, 44(1), p. 34–47.
- Business and Biodiversity Offsets Programme, 2009. Biodiversity offset design handbook. Washington, D.C: BBOP.. [Online] Available at: www.forest-trends.org/documents/files/doc_3126.pdf [Accessed 17 January 2020].
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- Cunningham, P., 2004. Checklist of the terrestrial mammals from the United Arab Emirates. Zoology in the Middle East, Volume 33, pp. 7-20.
- Environment Agency-Abu Dhabi, 2016. Abu Dhabi Habitat Mapping, Abu Dhabi: Environment Agency-Abu Dhabi.
- Evans, M., 1994. Important Bird Areas in the Middle East. Birdlife Conservation Series No 2. Cambridge, U.K..
- Hornby, R., 1996. A Red List of Mammals for the UAE. Tribulus, Volume 6.1, pp. 13-14.
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- Treweek, J., 1999. Ecological impact assessment. 1st ed. Oxford: Blackwell Science.
- USDA, 1999. Soil taxonomy. A basic system of soil classification for making and interpreting soil surveys , s.l.: USDA Agriculture Handbook No. 436. U.S. Government Print Office, Washington, DC.
- Western, A. R., 1989. The flora of the United Arab Emirates: An introduction. 1st ed. United Arab Emirates: United Arab Emirates University.
- World Wildlife Fund, 2001. Arabian Peninsula: Oman and United Arab Emirates, s.l.: National Geographic Society.
- Zohary, M., 1973. Geobotanical Foundations of the Middle East.. 1st ed. Stuttgart, 2 Vols: Gustav Fisher Verlag.

5.1.5.1.2. Field survey

Due to the very degraded nature of the study area a single site visit was conducted on the 23rd of January 2020. Due to the security issues on site no cameras are allowed in site and the survey was limited to a walkover site survey during which cognisance was taken of the following:

- General ecological status of the site;
- Plant species presence;
- Avifauna species presence;
- Mammal species presence; and
- Reptile species presence.

5.1.5.2. Baseline Results

5.1.5.2.1. Introduction

The study area comprises approximately 26 ha directly on the coast, within the Fujairah urban edge. The area has been extensively impacted through present and historic anthropogenic activities. Much of the surface area has been previously developed, with the buildings only being removed over the last 10 years. Less than 5.5ha of the study area was not covered by buildings, but even these areas have been historically cleared and probably originally landscaped. With this area falling into disuse the majority of the plants in the area are ruderal weeds and remnants of landscaping.

5.1.5.2.2. Regional ecoregion

The study area falls within the Arabian Peninsula: Oman and United Arab Emirates Ecoregion (Scientific code AT1306) that in turn falls within the Deserts and Xeric Shrublands habitat type, based on the latest World Wildlife Fund (WWF) classifications (17). This ecoregion falls within the Afrotropical Ecoregion category, it covers an area of approximately 62,420km^2 and is considered by the WWF as a Critical/Endangered ecoregion (17).

5.1.5.2.2.1. Location and General Description

Situated at the north east tip of the Arabian Peninsula, this ecoregion lies predominantly in Oman with a portion extending into the United Arab Emirates (UAE). To the west lies the Persian Gulf and Qatar; to the north the Strait of Hormuz and Iran; to the east the Gulf of Oman and Arabian Sea, and to the southwest the Rub'al-Khali (Empty Quarter) desert of Arabia. Several small islands in the Persian Gulf are UAE territories, the majority of which are close to the mainland, but a few are located further offshore (17).

Satchell (18) describes the UAE as having two distinct regions: an eastern mountain region with a sub-montane zone of outwash plains where the dominant tree species is usually *Vachellia tortilis*, and a western desert region divided into a coastal belt and inland desert and scrub where the dominant tree species is usually Ghaf trees (*Prosopis cineraria*).

The UAE's four major habitat types support a range of plants that, according to Western (19) and following further surveys, may number between 450-500 indigenous and naturalized species. Many plants show interesting adaptations to high salt levels, high temperatures and low rainfall. Along the coast, mangrove is represented by a single species, *Avicennia marina*. Common indigenous tree species are *Zizyphus spina-christi*, *Prosopis cineraria* and *Vachellia tortilis*. Common trees of the Hajar mountains are *Moringa peregrina, Ficus cordata salicifolia, F. johannis, V. tortilis* and *Prunus arabica* (19).

5.1.5.2.2.2. Biodiversity Features

Recorded bird species in the ecoregion number 420, of which 10 species are considered threatened (20). The Arabian Peninsula serves as a staging post between Africa and Asia for migratory species, and the many lagoons, mud flats, khors and mangrove stands found along the Arabian Gulf and the Gulf of Oman provide ideal nesting and feeding sites. An inventory of Important Bird Areas (IBAs) in the Middle East (21) showed this ecoregion to contain 11 out of 20 areas in the UAE.

The UAE, as part of this ecoregion, hosts 49 terrestrial mammal species, including 8 threatened species. Critically endangered species such as the Arabian leopard (*Panthera pardus* ssp. *Nimr*) still exists in the Hajar mountains but in very low numbers, certainly no more than 20 and probably far less than this figure (22). This leopard is listed as critically endangered in UAE's National Red List of threatened animals (23) and on the IUCN Red List (24). The Arabian tahr (*Hemitragus jayakari*), a type of wild goat, was photographed in the UAE Hajar mountains in 1995, constituting the first recent evidence that this ungulate survives in the UAE (22). Since 1995 more sightings and photographic evidence of this species have been recorded, including near Hatta in Dubai and Jebel Hafeet in Abu Dhabi, but numbers are precariously low, and the animal is relentlessly hunted.

Most of the species either fall within the Least concern category of the IUCN Red List. The classifications according to the UAE mammals Red List of 1996 (23), are shown in Table 5-12. The classification (by Hornby) was based on a consensus of opinions of members of the UAE Biodiversity Conservation Committee rather than on systematic survey data and was therefore updated by Cunningham (25).

Table 5-12: Endangered mammal species of the UAE

Category	Abbreviation	IUCN Red Data List (2017)	UAE Red Data List
Extinct	EX	0	0
Extinct in the Wild	EW	0	4
Critically Endangered	CR	0	5
Endangered	EN	1	3
Vulnerable	VU	6	5
Near Threatened	NT	1	3
Least Concern	LC	41	18
Data Deficient	DD	0	11
Not Listed	NL	0	0

There are 62 species of terrestrial herpetofauna (including Anurans) that are known to occur in UAE. These exist in 12 Families within 2 Orders (Squamata and Anura). The common names of many of the species have multiple synonyms and should not be used when referring to a species. In some cases, over the last 10 years, the scientific names have changed (for example *Agama flavimaculata* has become *Trapelus flavimaculatus*). The IUCN status as well as the UAE Red List status for herpetofauna are given in Table 5-13.

Table 5-13: Endangered herpetofauna species of the UAE

Category	Abbreviation	IUCN Red Data List (2017)	UAE Red Data List
Extinct	EX	0	0
Extinct in the Wild	EW	0	0
Critically Endangered	CR	1	3
Endangered	EN	0	0
Vulnerable	VU	0	6
Near Threatened	NT	0	1
Least Concern	LC	49	45
Data Deficient	DD	1	4
Not Listed	NL	11	3

5.1.5.2.2.3. Types and Severity of Threats

The whole of UAE's sand dune system is subject to extensive grazing by camels and goats. Hunting and trapping, of large mammal species, has resulted in very low population levels of *Panthera pardus* ssp. *Nimr* and *Hemitragus jayakari* (22). Oil spills are a threat to the entire coastline of this ecoregion, and 4-wheel drive vehicles cause damage to bird and turtle nesting sites. Off-road driving inland causes much damage to the vegetation, which is slow to recover due to the limited annual rainfall (17).

5.1.5.2.2.4. Justification of Ecoregion Delineation

This ecoregion boundary was formed using Zohary's (26) geobotanical map of the Middle East. It corresponds to Zohary's classified regions of *Acacia tortilis* subsp. *Sub-sudanica* in the Palearctic realm.

5.1.5.2.3. Climate

The climate of the UAE is characterised by high temperatures (up to 49 ° C in July), high humidity and low rainfall, typical of this ecoregion. Generally, annual average rainfall in the mountain region (140-200 mm) and along the east coast (100-140 mm) is higher in comparison to the gravel plains (100-120 mm), with the west coast receiving the lowest average of less than 60mm (27). The area of northern fans and pediment, located farther from the sea, are less humid.

5.1.5.2.4. Soils and Geology

Soils of the Emirate (28) can be broadly categorized as sandy and sandy calcareous, gypsiferous, saline, saline-gypsiferous, and hard pan soils etc. These soils have been classified into three soil orders (Aridisols, Entisols and Inceptisols) of the Soil Taxonomy (29). Entisols are the most commonly occurring soils, followed by Aridisols to a relatively lesser extent, and Inceptisols are the least common in the Emirate. Soil classification is described in which detailed descriptions of soil masses and their discontinuities are made in test soil pits and soil profiles and is also supported by laboratory soil data (17). These soils are described in the context of their formation, temperature and moisture regimes, properties and occurrence in the Emirate. Surface deposits of sandy soils are described from erosion and transport mechanism point of view (29).

5.1.5.2.5. Local study area

As mentioned, the local study area can be described as a transformed habitat. Historical satellite imagery was used in order to determine land use. As far back as 2009 (the oldest usable satellite imagery for the site), the area, the area has been covered by buildings with approximately 20% cleared and landscaped. These buildings were demolished between 2013 and 2017 and since then the area has been cleared and unused.

Vegetation in the area is composed of some exotic remnants of landscaping, ruderal weeds and limited recolonization by indigenous species in some areas.

5.1.5.2.5.1. Flora

During the walkover survey species recorded included *Ochradenus aucheri, Cassia italica, Blepharis ciliaris, averniera spartaea, Crotolaria aegyptiac and Pulicaria glutinosa. Rhazya stricta* occurs in limited amounts and exotic weeds of the genera *Datura*, *Sysimbrifolium* are numerous. Grass species recorded included A*eluropus massauensis* and *Cynodon dactylon*. Tree species were dominated by *Prosopis juliflora* (an exotic) although one small *Vachelllia tortillis* and a few *Prosopis cineraria* were recorded, likely to be remnants of trees planted during landscaping.

5.1.5.2.5.2. Fauna

Fauna species were very sparse due to the fact that no natural vegetation occurs in the area, birds were the most numerous with two species *Acridotheres tristis* and *Streptopelia turtur* dominating the avian demography. One species of reptile *Trachylepis tessellate* was recorded in some leftover rubble and no species of mammal were recorded in the study area.

5.1.5.2.5.3. Ecologically sensitive areas

The study area is surrounded on three sides by industrial areas and on the fourth by the sea, and no ecologically sensitive areas occur adjacent to the study area or in the vicinity.

5.1.6. Marine Water & Sediment

5.1.6.1. Baseline Methodology

Water and sediment sampling was conducted at five sample locations across the Project site at mid-column, as shown in Figure 5-23 below.

5.1.6.1.1. Marine Water Quality

5.1.6.1.1.1. In Situ Seawater Quality

Physical parameters were measured in situ through the use of a calibrated Aquaread AP-5000 multi-parameter water quality probe. The following physical water quality parameters were measured in situ:

- Conductivity (µS/cm);
- Dissolved oxygen (mg/L and %);
- pH;
- Salinity (PSU);
- Total Dissolved Solids (mg/L);
- Turbidity (NTU);
- Temperature (°C);
- Redox Potential (mV); and
- Clarity via Secchi Disc.

5.1.6.1.1.2. Ex Situ Seawater Quality

Samples for ex situ laboratory analysis were collected using a horizontal 2.2 litre Van Dorn water sampler with messenger release mechanism. The samples were transferred directly into the laboratory sample receptacles, sealed and cold stored before transit to an EAD accredited laboratory.

The results of the water quality analysis were compared against the standards which apply within Abu Dhabi, as requested by Fujairah Municipality, which include the EAD's Recommended Ambient Marine Water Quality Objectives (EAD AWQS) and the Abu Dhabi Specification (ADS) for Ambient Marine Water and Sediments Specifications, which are provided in full in **Section 3.2.3.1.3**. Dubai Municipality's Ambient Water Quality Objectives (DM AWQO) have also been referred to where relevant, which are presented in **Section 3.2.3.1.4**.

5.1.6.1.2. Marine Sediment Quality

A total of five sediment samples were collected at the same locations as water quality, as indicated in Figure 5-23. Sediment quality samples were collected by using a 0.025m^3 Van Veen grab deployed from the survey vessel and collection techniques were undertaken utilising best practice (MOOPAM) sediment sampling procedures. Due to the degeneration rates of certain parameters being tested, samples were cold stored immediately after collection to maintain sample integrity. Sediment samples were sent to an accredited laboratory for analysis. Parameters analysed were compared against the standards specified within the ADS for Ambient Marine Water and Sediments Specifications, which are provided in full in **Section 3.2.3.1.3**.

Figure 5-23: Water and sediment sample locations

5.1.6.2. Baseline Results

5.1.6.2.1. Marine Water Quality

5.1.6.2.1.1. In Situ Seawater Quality

Results from the survey were qualified against the EAD AWQS and DM AWQO where applicable. In situ water quality measurements are provided in Table 5-14 below.

Temperature was consistent over the sampling area ranging from 25.8°C to 26°C. Oxidation-Reduction Potential (ORP) was highest at WQ3 with 168.9 mV and lowest at the deepest WQ1 at 138.7 V. Readings of pH were similar for the three shallow stations (WQ 3-5) ranging from 7.16 – 7.18 but slightly increased at the deeper stations (WQ1 and 2) with readings of 7.24 and 7.23 respectively.

Dissolved Oxygen (DO) was also similar across the sampling site ranging from 6.82 – 6.9 mg/L.

Conductivity was similar for stations WQ 2 – 4 ranging from 53.06 to 53.37 µS/cm, while WQ1 was lower with a reading of 51.21 µS/cm. Total Dissolved Solids (TDS) ranged from 33.28 g/L to 34.69 g/L over the study site. WQ1 the deeper station had lower salinity (33.63 ppt) and Seawater Specific Gravity (23 δt) compared to the rest of the sampling station that ranged from 35 to 35.21 ppt salinity and 24 – 24.2 δt Seawater Specific Gravity (SSG).

5.1.6.2.1.2. Ex Situ Seawater Quality

Parameters were compared to the EAD AWQS and DM AWQO. Ex situ water quality results obtained exceedances in one parameter (Enterococci) when compared to the referenced standards (Table 5-14).

Average concentration for Total Organic Carbon (TOC) was 1.22 mg/L, with measurable levels (above the Minimum Detection Level (MDL)) across all sampling stations, but not in exceedance of the referenced standards. Biochemical Oxygen Demand (BOD) was below the MDL (<2 mg/L) in all samples. BOD indicates the amount of organic material present in the water liable to decay and therefore a low BOD indicates good water quality. Chemical Oxygen Demand (COD) were also below MDL (<5 mg/L) across all samples. COD indicates the amount of oxygen available to be used by chemical reactions in the water, with a low COD indicating there is little organic load/pollutants in the waters. Nitrate levels were below MDL across all samples.

Only one (1) of the trace metals tested was recorded above MDL. Concentrations of Arsenic were detected in all samples but none in exceedance of the referenced standards.

Hydrocarbons, and PCB’s were below MDL for all sample points throughout the survey. The low values of these organic substances suggest that the marine water within the Project area generally has limited to no contamination from hydrocarbons.

Enterococci was detected in two samples WQ2 and WQ4. WQ2 recorded; one sample was in exceedance of the QCC standards with a concentration of 50 CFU/100mL, which exceeds the QCC standards. WQ4 had a measurable level of 20 CFU/100mL, which is not in exceedance of any referenced standards. The presence of Enterococci indicates sewage is present likely from a nearby treated sewage outfall or from ships.

The accredited laboratory is only able to test to a predetermined MDL for each parameter. Therefore, some parameters tested below MDL may be present but in minute quantities.

Table 5-14: In situ seawater characteristics

Site	Temperature	Redox Potential	pH	Dissolved Oxygen	Conductivity	TDS	Salinity	SSG	Depth
EAD AWQO	±3	-	6.5 – 8.5	4	-	-	<5% change from background		
Unit	ºC	mV	pH	mg/L	μS/cm	g/L	ppt	(δt)	m
WQ1	25.9	138.7	7.24	6.87	51.21	33.28	33.63	23.0	15.16
WQ2	25.8	142.2	7.23	6.82	53.37	34.69	35.21	24.2	10.02
WQ3	25.9	168.9	7.16	6.83	53.06	34.49	35.00	24.0	3.12
WQ4	25.9	163.2	7.18	6.98	53.18	34.57	35.08	24.1	2.10
WQ5	26.0	157.3	7.17	6.9	53.19	34.57	35.09	24.1	5.08

Table 5-15: Ex situ water quality results

Parameters	Units	MDL	ADS	DM AWQO	EAD AWQS	WQ1	WQ2	WQ3	WQ4	WQ5
Physico-chemical										
Nitrate	mg/L	0.04	-	-	0.095	< 0.04	< 0.04	< 0.04	< 0.04	< 0.04
Orthophosphate	mg/L	0.06	-	-	-	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Biochemical Oxygen Demand	mg/L	2	-	20	20	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Chemical Oxygen Demand	mg/L	5	-	-	5	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Organic Carbon	mg/L	1	-	-	2.5	1.2	1.3	1.2	1.2	1.2
Residual Chlorine	mg/L	0.02	-	0.01	-	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Ammonia	mg/L	0.06	-	-	-	< 0.06	< 0.06	< 0.06	< 0.06	< 0.06
Ammonium	mg/L	0.064	-	-	-	< 0.064	< 0.064	< 0.064	< 0.064	< 0.064
Nitrogen (Ammonia)	mg/L	0.05	-	0.1	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Dissolved & Emulsified Oil	mg/L	10	-	-	-	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
Free Oil	% vol./vol.	0.01	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Total Suspended Solids	mg/L	5	-	-	<33	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulphide	mg/L	0.005	-	-	0.004	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Turbidity	NTU	0.1	-	10 mean 25 max	-	0.2	0.2	0.2	0.3	0.2

Parameters	Units	MDL	ADS	DM AWQO	EAD AWQS	WQ1	WQ2	WQ3	WQ4	WQ5
Hydrocarbons										
EPH C10-C40	µg/L	10	-	-	-	< 10.0	< 10.0	< 10.0	< 10.0	< 10.0
VPH C5-C10	µg/L	7	-	-	-	< 7.0	< 7.0	< 7.0	< 7.0	< 7.0
Metals										
Chromium (VI)	mg/L	0.05	-	-	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Aluminium (Al)	mg/L	0.005	-	0.2	-	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Arsenic (As)	mg/L	0.0005	-	0.01	0.005	0.002	0.0017	0.0017	0.001	0.0016
Cadmium (Cd)	mg/L	0.0001	0.0007	0.003	0.001	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Chromium (Cr)	mg/L	0.0001	0.0002	0.01	-	< 0.0001	< 0.0001	< 0.0001	< 0.0001	< 0.0001
Copper (Cu)	mg/L	0.0003	0.003	0.005	0.01	< 0.0003	< 0.0003	< 0.0003	< 0.0003	< 0.0003
Iron (Fe)	mg/L	0.02	-	0.2	0.3	< 0.02	< 0.02	< 0.02	< 0.02	< 0.02
Lead (Pb)	mg/L	0.0002	0.0022	-	0.01	< 0.002	< 0.002	< 0.002	0.001	< 0.002
Manganese (Mn)	mg/L	0.001	-	-	-	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Mercury (Hg)	mg/L	0.0001	0.0001	0.001	0.001	< 0.001	< 0.001	< 0.001	< 0.001	< 0.001
Nickel (Ni)	mg/L	0.0001	0.007	-	-	< 0.001	0.0005	< 0.001	< 0.001	< 0.001
Zinc (Zn)	mg/L	0.002	0.015	0.02	0.02	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Microbiology										
Enterococci	CFU/100mL	10	35	-	-	ND	50	ND	20	ND
PCB's										
2,2',3,3',4,4' - Hexachlorobiphenyl (PCB 128)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2',3,3',4,4',5 - Heptachlorobiphenyl (PCB 170)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2',3,3',4,4',5,5',6,6' - Decachlorobiphenyl	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2',3,3',4,4',5,5',6- Nonachlorobiphenyl (PCB 206)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2',3,3',4,4',5,6 - Octachlorobiphenyl (PCB 195)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2',3,4',5,5',6 - Heptachlorobiphenyl (PCB 187)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Parameters	Units	MDL	ADS	DM AWQO	EAD AWQS	WQ1	WQ2	WQ3	WQ4	WQ5
2,2',3,4,4',5' - Hexachlorobiphenyl (PCB 138)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2',3,4,4',5,5' - Heptachlorobiphenyl (PCB 180)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2',3,5' - Tetrachlorobiphenyl (PCB 44)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2',4,4',5,5' - Hexachlorobiphenyl (PCB 153)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2',4,5,5' - Pentachlorobiphenyl (PCB 101)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2',5,5' - Tetrachlorobiphenyl (PCB 52)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2`,5 - Trichlorobiphenyl (PCB 18)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,3',4,4' - Tetrachlorobiphenyl (PCB 66)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,3',4,4',5 - Pentachlorobiphenyl (PCB 118)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,3,3',4,4' - Pentachlorobiphenyl (PCB 105)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4' - Dichlorobiphenyl (PCB 8)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4,4' - Trichlorobiphenyl (PCB 28)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
3,3',4,4' - Tetrachlorobiphenyl (PCB 77)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
3,3',4,4',5 - Pentachlorobiphenyl (PCB 126)	µg/L	0.01	0.03	-	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenols										
2,3,4,6-Tetrachlorophenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,3,5,6-Tetrachlorophenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4,5-Trichlorophenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4,6-Trichlorophenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dichlorophenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,4-Dimethylphenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2,6-Dichlorophenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Parameters	Units	MDL	ADS	DM AWQO	EAD AWQS	WQ1	WQ2	WQ3	WQ4	WQ5
2-Chlorophenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Methylphenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
2-Nitrophenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
3-Methylphenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Chloro-3-methylphenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Methylphenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
4-Nitrophenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Pentachlorophenol	µg/L	1	-	-	-	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Phenol	µg/L	0.5	-	-	0.001	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Note: Values highlighted in **RED** are in exceedance when compared to referenced standards. Values in BLUE indicates quantities measured above MDL.										

5.1.6.2.2. Marine Sediment Quality

Sediment samples were collected on the 16th December 2019 and sent to an accredited laboratory for analysis. Particle size analysis was conducted and summarised in Table 5-16. The results obtained from the laboratory sediment analysis are presented in Table 5-17 and have been compared to the standards provided within the ADS for Ambient Marine Water and Sediments Specifications. Three parameters were found to be in exceedance of the referenced standards (Arsenic, Chromium and Nickel).

Analysis of the sediment samples for particle size distribution show that sand was the dominant particle fraction throughout the Project site. All samples had ≥50% sand sized particles. The area with the finest sediment was WQ1 with 25% clay and silt sized particles. 1% of gravel was measured at WQ3. The results show that grain size was larger at shallower sites and decreased in size towards the deeper sampling stations.

Table 5-16: Sediment particle size analysis results

Site	Particle Size (mm)				Description
	Clay	Silt	Sand	Gravel	
	<0.002	0.002- 0.074	0.075-2.00	>2.00	
WQ1	5%	20%	75%	0%	Sand, silty
WQ2	2%	6%	92%	0%	Sand, slightly silty
WQ3	3%	5%	91%	1%	Sand, slightly silty
WQ4	1%	0%	99%	0%	Sand
WQ5	3%	0%	97%	0%	Sand

Total Organic Carbon (TOC) was recorded above MDL across all samples with an average of 0.24 % and highest at WQ1 0.4%. The results show measurable levels (above MDL) of Total Nitrogen (TN) across all samples with a wide range; the lowest concentration was 134 mg/kg at WQ4, and the highest concentration was 269 mg/kg at WQ1.

Concentration levels for Oil and Grease were recorded above MDL in two samples at WQ1 and WQ2. Hydrocarbons, PAH's or PCB's were below MDL for all sample sites.

Of the ten trace metals analysed; three were recorded in exceedance of the ADS standards and six were recorded above the MDL. Arsenic, Chromium and Nickel were in exceedance of reference standards across all samples with the following trend of the lowest concentrations at WQ1 and the highest concentrations at WQ5. Aluminium, Cadmium, Copper, Iron, Lead and Zinc were all measured above MDL. Mercury was below MDL for all stations indicating this was only present in trace amounts.

Table 5-17: Sediment quality laboratory results

Parameter Name	Unit	MDL	ADS Standard	WQ1	WQ2	WQ3	WQ4	WQ5
Inorganic Parameters								
Oil and Grease	%	0.01	-	0.03	0.02	< 0.01	< 0.01	< 0.01
Total Nitrogen	mg/kg	5	-	269	244	230	134	162
Anions								
Orthophosphate	mg/kg	0.3	-	0.6	< 0.3	0.5	< 0.3	< 0.3
Chemical Analysis								
Total Organic Carbon	%	0.1	-	0.4	0.2	0.2	0.2	0.2
Hydrocarbons								
EPH C10-C40	mg/kg	50	-	< 50	< 50	< 50	< 50	< 50
VPH C5-C10	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Metals								
Mercury (Hg)	mg/kg	0.01	0.2	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Aluminium (Al)	mg/kg	130	-	6980	12700	10200	7940	10700
Arsenic (As)	mg/kg	1	7	9.8	24.5	22	25.3	29
Cadmium (Cd)	mg/kg	0.5	0.7	0.5	0.6	0.6	0.6	0.7
Chromium (Cr)	mg/kg	1	52	65	149	150	157	164
Copper (Cu)	mg/kg	3	20	10	18.7	11.1	10.7	19.9
Iron (Fe)	mg/kg	70	-	21100	36300	34300	35500	39900
Lead (Pb)	mg/kg	1	30	3.5	3.3	3.5	2.9	2.8
Nickel (Ni)	mg/kg	1	16	291	936	918	1010	1100
Zinc (Zn)	mg/kg	3	125	21.1	31.7	32.3	32.6	30.5
PAH's								
Acenaphthene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Acenaphthylene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Anthracene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)anthracene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(a)pyrene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Parameter Name	Unit	MDL	ADS Standard	WQ1	WQ2	WQ3	WQ4	WQ5
Benzo(b)fluoranthene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(g,h,i)perylene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzo(k)fluoranthene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chrysene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibenzo(a,h)anthracene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluoranthene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Fluorene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Naphthalene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Phenanthrene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Pyrene	mg/kg	0.01	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PCB's								
2',3,4,4',5 - Pentachlorobiphenyl (BZ # 123)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,3',4,4',5 - Pentachlorobiphenyl (BZ # 118)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,3',4,4',5,5' - hexachlorobiphenyl (BZ # 167)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,3,3',4,4' - Pentachlorobiphenyl (BZ # 105)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,3,3',4,4',5 - hexachlorobiphenyl (BZ # 156)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,3,3',4,4',5' - hexachlorobiphenyl (BZ # 157)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,3,3',4,4',5,5' - heptachlorobiphenyl (BZ # 189)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
2,3,4,4',5 - Pentachlorobiphenyl (BZ # 114)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
3,3',4,4' - Tetrachlorobiphenyl (BZ # 77)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
3,3',4,4',5 - Pentachlorobiphenyl (BZ # 126)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
3,3',4,4',5,5' - hexachlorobiphenyl (BZ # 169)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
3,4,4',5 - Tetrachlorobiphenyl (BZ # 81)	mg/kg	0.05	-	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Notes: Values in RED indicate exceedance from the relevant standard. Values in BLUE indicates quantities measured above MDL.								

5.1.7. Marine Ecology

5.1.7.1. Baseline Methodology

Surveying of the marine ecology at the Project site was undertaken primarily through the use of Drop-Down Video (DDV) supplemented with diver surveys, infauna analysis and incidental sightings.

5.1.7.1.1. Drop Down Video – Rapid ecological assessment

A rapid ecological assessment of benthic habitats occurring at the study site was conducted with 20 drift towed DDVs spread over the study site as illustrated in Figure 5-24 below. At each location a geo-referenced DDV is deployed at the predetermined location and the vessel drifts from water currents and wind. Footage is recorded for a minimum of 5 minutes at each location allowing for identification of habitat type, general condition, flora and fauna.

5.1.7.1.2. Drop Down Video – Transects of proposed pipelines

DDV transects were conducted to assess the habitats present within the proposed intake and outfall pipeline corridors. Three towed transects were conducted for each pipeline corridor, a total of 6 tows as illustrated in Figure 5-25 below. The DDV was deployed at the start of the transect and towed at low speed using the boat to direct the transect along the proposed corridor. The location of the start and end of each transect was marked with a Garmin GPS. Footage from the DDV was continuously monitored during the deployment and later analysed to identify habitat types, fauna and flora recorded.

5.1.7.1.3. Diver-based Survey

A total of 6 transect dives were conducted to assess the most common habitat type identified during the DDV's as illustrated in Figure 5-26 below. The dived transects were also conducted in shallow areas as these areas are more likely to provide habitat to sensitive species like corals and seagrass. At each transect a 50m line was marked with a tape measure perpendicular to the shoreline extending seawards. The 50m transect was recorded and a 1mx1m quadrat was photographed at each 10m interval including the beginning and end of the transect (6 quadrats/transect). Species recorded along the transect or during the dive but not present in any quadrats were noted. Quadrat data was analysed to indicate diversity and abundance of benthic species.

5.1.7.1.4. Incidentals

Incidental sightings and observations of marine mammals and reptiles were recorded throughout the duration of the marine ecology baseline survey. On any sighting occurrence, the GPS location and time of the sighting were recorded along with an identification and photographs, if possible. Due to the transitory nature of marine mammal species, this method is considered sufficient for the purposes of this assessment.

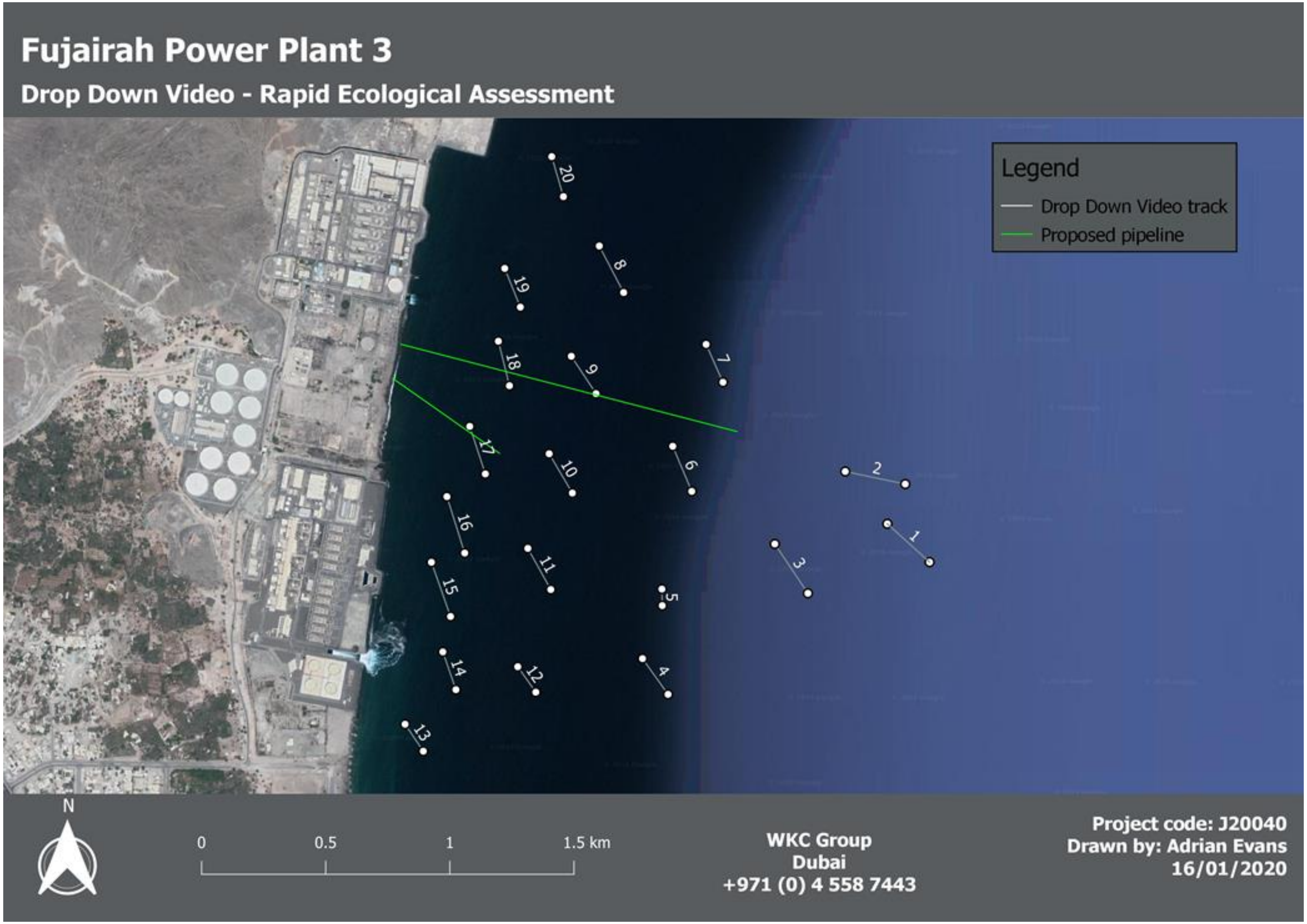


Figure 5-24: Drop Down Video – Rapid Ecological Assessment location map

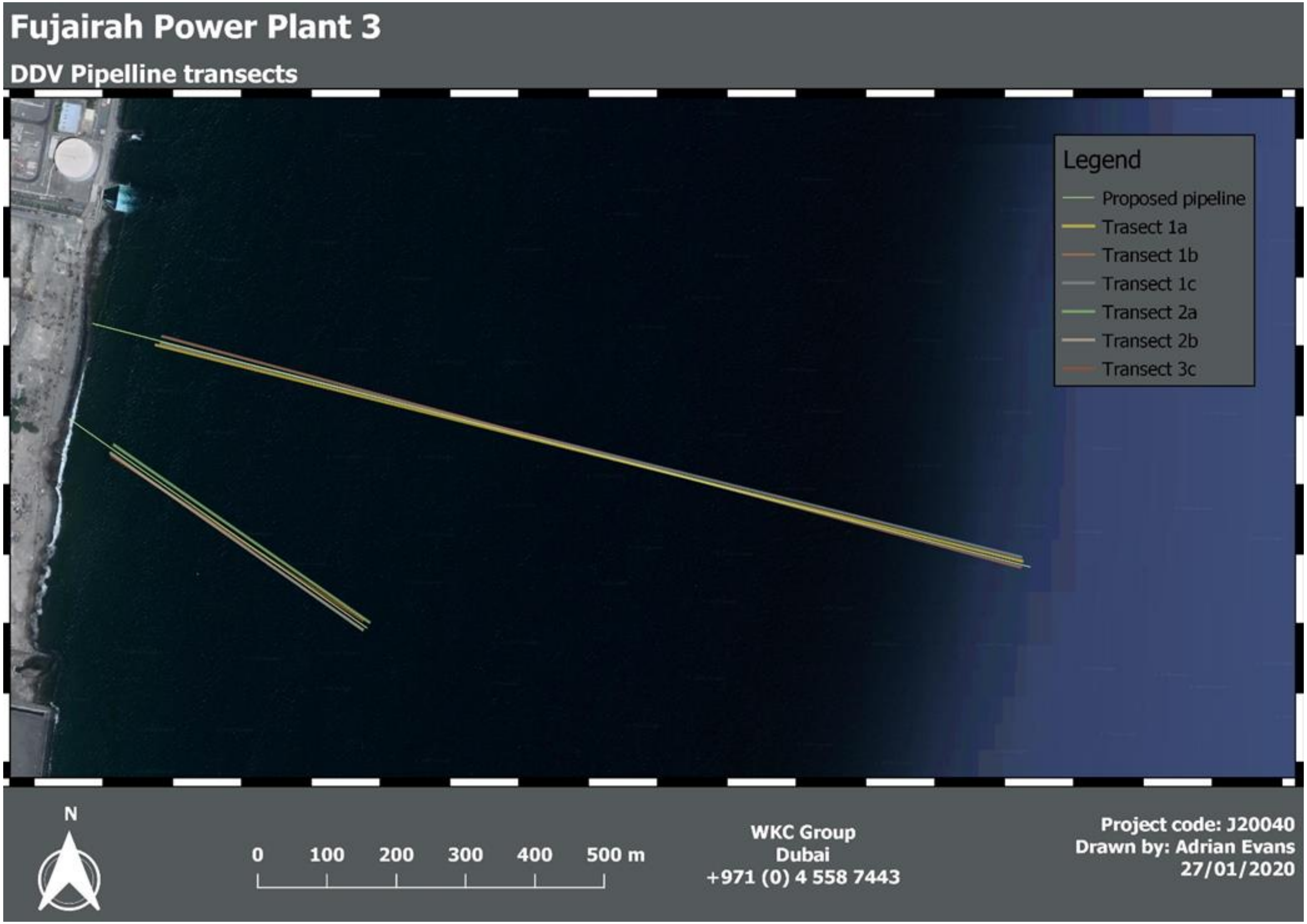


Figure 5-25: Drop Down Video – Transects of proposed pipelines

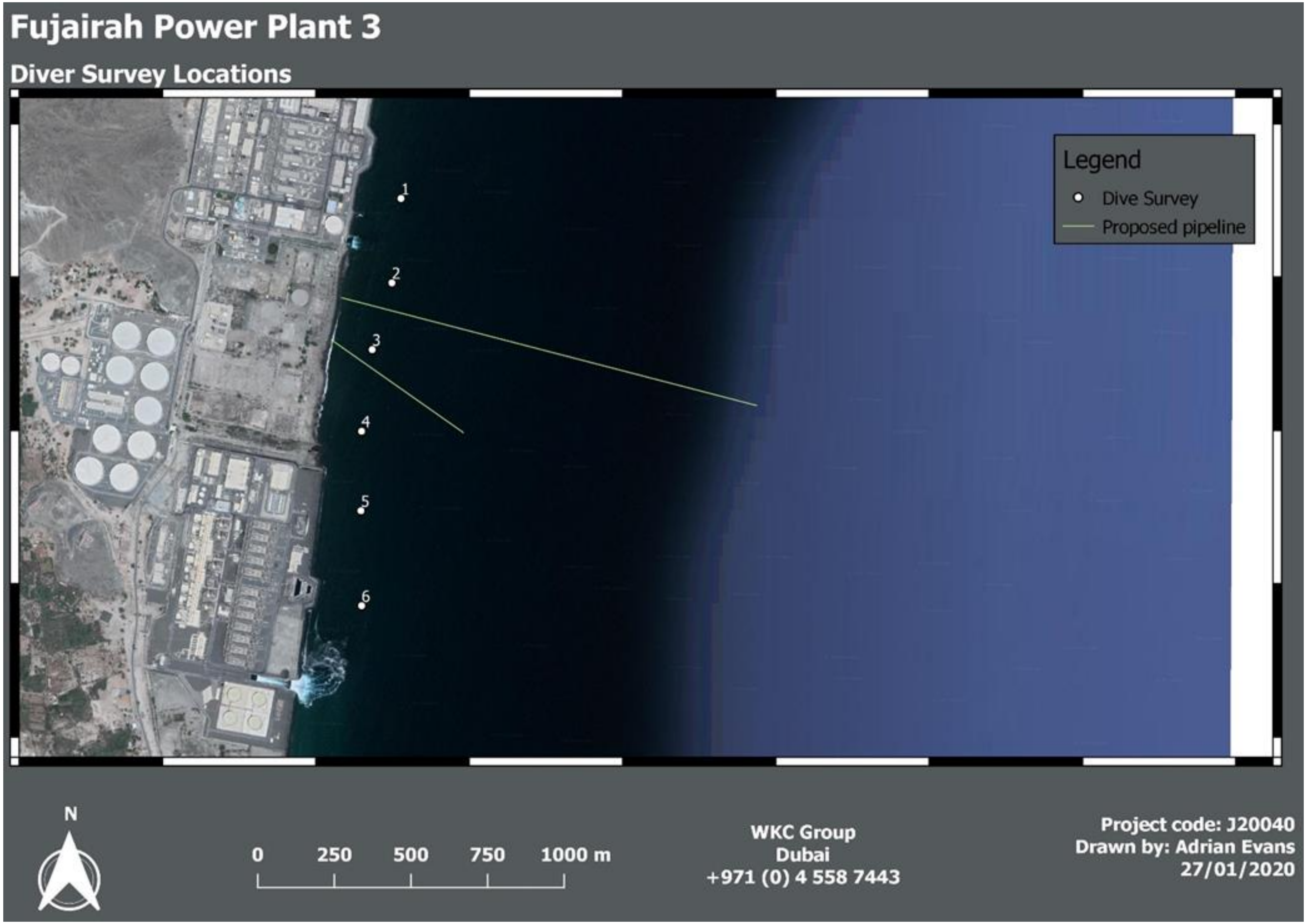


Figure 5-26: Diver-based survey locations

5.1.7.2. Baseline Results

The results of the various survey methods are presented in the sections below. The dominant habitat type over the entire sampling location consisted of unconsolidated sediments with the grain size decreasing with increased depth. Unconsolidated bottom habitat can support biological communities that are different from hard substrates. Although consisting of unconsolidated material this habitat can be relatively stable supporting both infaunal and benthic species.

Numerous signs of mollusc and polychaete burrows were observed in the sediments. Patches of the seagrass *Halophila ovalis* (Paddle weed) were recorded in all assessment types. The gastropod Conus textile was very numerous on the flat sandy/muddy substrate. Sea pens, sea fans and sponges were observed towards the deeper side of the study area. Some small patches of coral rubble were also observed as well as a berm and some construction rubble. Coral species were observed on the hard substrates and diversity of benthic species and fish was considerably higher in the areas of hard substrate despite only occurring in small patches over the sampling site.

5.1.7.2.1. Drop Down Video – Rapid Ecological assessment

5.1.7.2.1.1. Benthic Habitats

The Drop-Down video (DDV) for rapid ecological assessment was conducted on the 15th and 16th of December 2019. The 20-drift towed DDVs spread over the study location showed unconsolidated sediments to be the dominant habitat type. The soft-substrate sediments showed numerous polychaete and mollusc burrows as well as evidence of skates and rays feeding. Some of the shallower sites had patches of the seagrass *Halophila ovalis* (Paddle weed) growing in the sand. A few patches of coral rubble and artificial rocks were observed but this was never the dominant habitat type for any transect. A summary of the predominant habitat type observed on each DDV tow is provided in Table 5-18 below.

Table 5-18: Summary of habitat identified from DDV drift tow

DDV	Habitat description	Figure
1, 2, 3, 5, 7, 8, 9, 10, 11, 13, 17, 18. 20	Silt / muddy substrate; polychaete and mollusc burrows	Figure 5-27
14, 15	Sandy substrate; patches of seagrass	Figure 5-28
4, 6, 12, 16	Sand/silt with patches of coral rubble or artificial rocks	Figure 5-29
19	Silt substrate with algal mat	Figure 5-30

Figure 5-27: Unconsolidated sediment

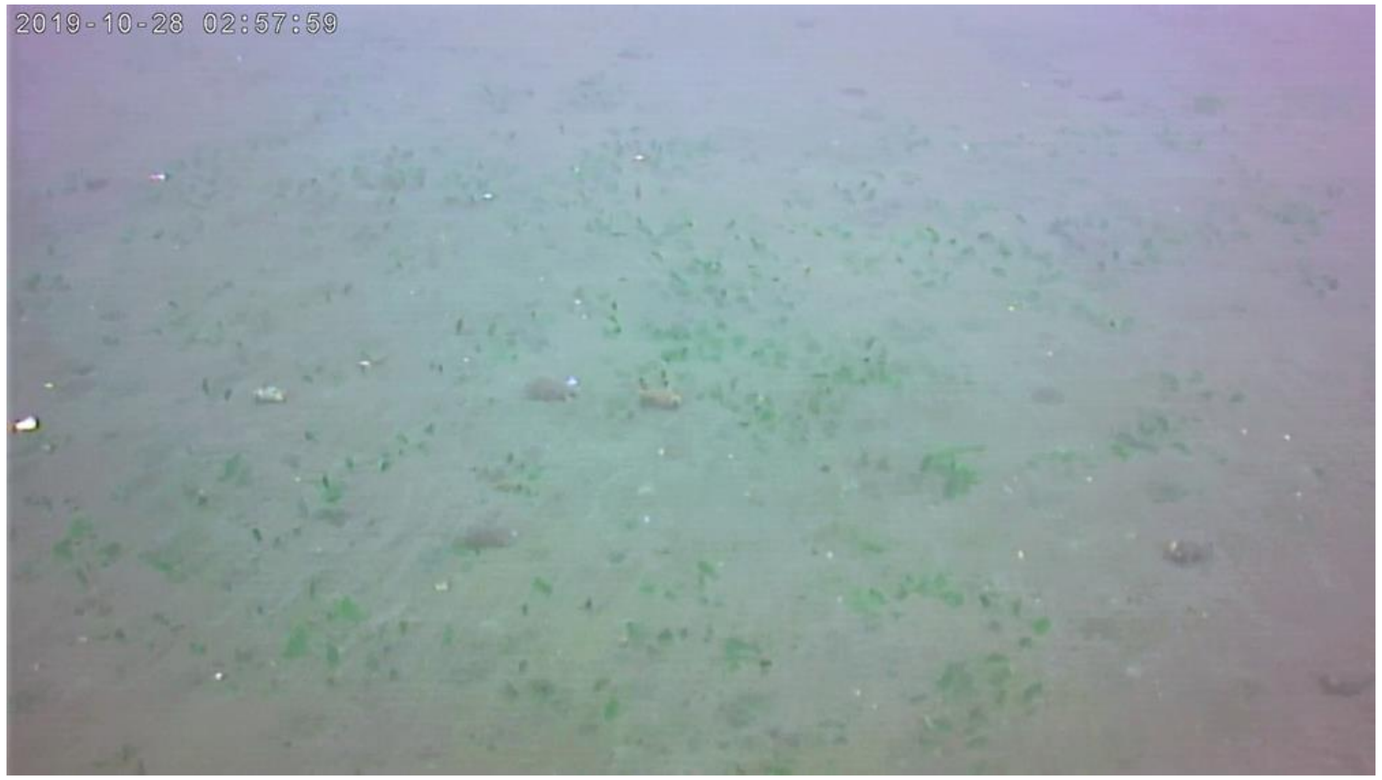


Figure 5-28: Sandy Substrate with patches of Seagrass

Figure 5-29: Sandy / Silty substrate with patches of coral rubble or artificial rocks

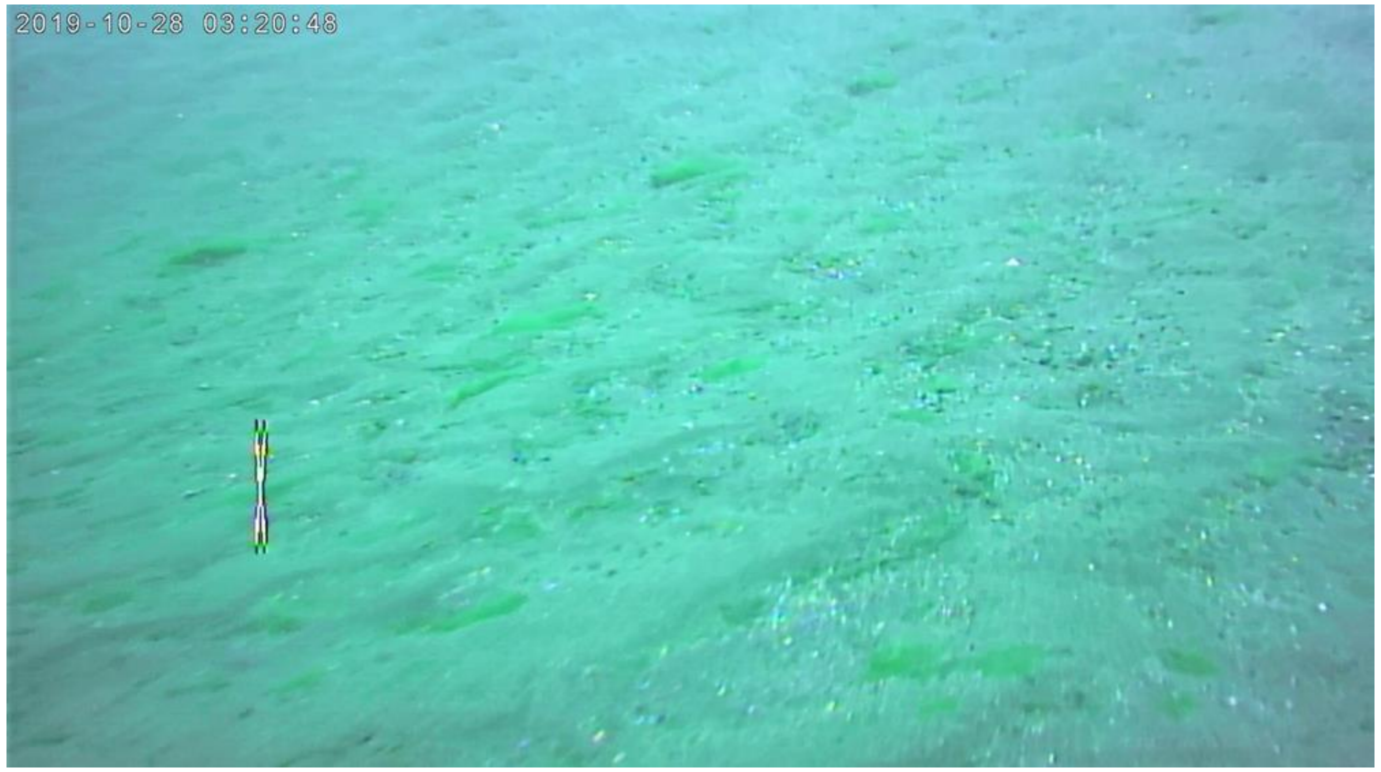


Figure 5-30: Silt Substrate with Algal mats

5.1.7.2.1.2. Species

All species observed on the DDV drift tows were noted and identified (to species level where possible). DDV tows that had the presence of hard substrate (DDV 4, 6, 12 and 16), either coral rubble or artificial rubble / berms, contained higher numbers of species, especially benthic invertebrates and fish. The gastropod *Conus textile* (Textile cone shell) was the most common benthic species being recorded in 12 of the DDV transects.

Table 5-19: Summary of species recorded from DDV drift tow

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Pennatulacea spp. (Sea Pen)	√	√	√	√		√														
Porifera spp. (Ball sponge)	√	√			√			√												
Porifera sp. (Grey sponge)																√				
Hydrozoa sp. (Hydroid)	√	√				√														
Platygyra daedalea (Coral)																√				
Porites cf. harrisoni (Coral)																√				
Favia favus (Coral)																√				
Actiiaria sp. (Burrowing anemone)													√							
Conus textile (Cone Shell)				√	√		√	√		√	√	√	√	√		√	√	√		
Dardanus tinctor (Hermit crab)													√							
Portunus pelagicus (Blue swimming crab)													√							
Asteroidea sp1. (Starfish)						√														
Asteroidea sp2. (Starfish)						√														
Diadema setosum (Long spined urchin)															√	√				
Pearsonothuria graeffei (Blackspotted seacucumber)				√												√				
Holothuria atra (Black sea cucumber)				√	√							√								
Pastinachus sephen (Cow-tail stingray)																			√	
Sphyraena sp. (Barracuda)								√												
Odonus niger (Red-toothed triggerfish)				√		√														
Scolopsis vosmeri (White-cheek monocle bream)				√																
Scolopsis taeniatus (Black-streaked monocle bream)								√												
Heniochus acuminatus (Long-fin bannerfish)						√														
Parupeneus rubscens (Rosy Goatfish)						√														
Parupeneus margaritatus (Pearly goatfish)															√	√				
cf. Tetrosomus gibbosus (Thorn-back trunkfish)						√														
Epinephelus stoliczkae (Epaulet grouper)												√				√				
Carangoides bajad (Orange-spotted trevally)												√								

Species	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Acanthopagrus bifasciatus (Two-bar sea bream)															√					
Abudefduf vaigiensis (Sergeant damselfish)																√				
Chaetodon nigropunctatus (Black-spotted butterflyfish)																√				
Tetraodontidaae sp. (Puffer fish)																√				
cf. *Pomacanthus maculosus* (Yellowbar angelfish)																√				
Cheilodipterus sp. (Cardinal fish)																√				
Cryptocentrus sp. (Goby)																				√
Pomacentrus chrysurus (Whitetail damsel)																√				
Lutjanus ehrenbergii (Black-spot snapper)															√					
Halophila ovalis (Seagrass)														√	√	√				
Algal mats																			√	

5.1.7.2.2. Drop Down Video – Transects of proposed pipelines

Drop down videos for the proposed pipeline corridors were conducted on the 16th and 24th December 2019. The DDV transects of the proposed pipeline corridors did not reveal any additional habitats to the habitats described in **Section 5.1.7.2.1** by the rapid ecological assessment with unconsolidated sediments being the dominant habitat type. Both proposed pipeline corridors were comprised of sandy substrate (Figure 5-31) in the shallower section becoming more muddy / silty (Figure 5-32) towards the deeper section. Some scattered rocks / coral rubble was observed (Figure 5-33) on the eastern (deeper) end of Transect 1 (Outfall) pipeline corridor. In the corridor for the Transect 2 (inlet), patches of the seagrass *Halophila ovalis* (Figure 5-33) were observed in the shallower western side. Species observed during the DDV tows are recorded in Table 5-20.

Table 5-20: Species observed during the towed transects

Scientific name	Common name	1a	1b	1c	2a	2b	2c
Holothuria atra	Black sea cucumber			√			
Scomberoides lysan	Double-spotted queenfish	√					
Conus textile	Cone shell	√		√	√	√	√
Aetobatus narinari	Spotted eagle ray	√					
Clupeiformes sp.	Baitfish	√					
Porifera spp.	Ball sponges	√					
Canthigaster sp.	Toby/pufferfish	√	√				
Sphyraena sp.	Barracuda	√					
Pteroeides spp.	Sea pens	√	√				
Odonus niger	Red-toothed triggerfish		√	√			
Scolopsis taeniatus	Black-streaked monocle bream		√				
Hydrozoa sp.	Hydroids white		√	√			
cf. Cephalopholis hemistiktos	Yellow-fin hind		√				
Echeneis naucrates	Remora				√		
Halophila ovalis	Paddle weed (Seagrass)					√	√

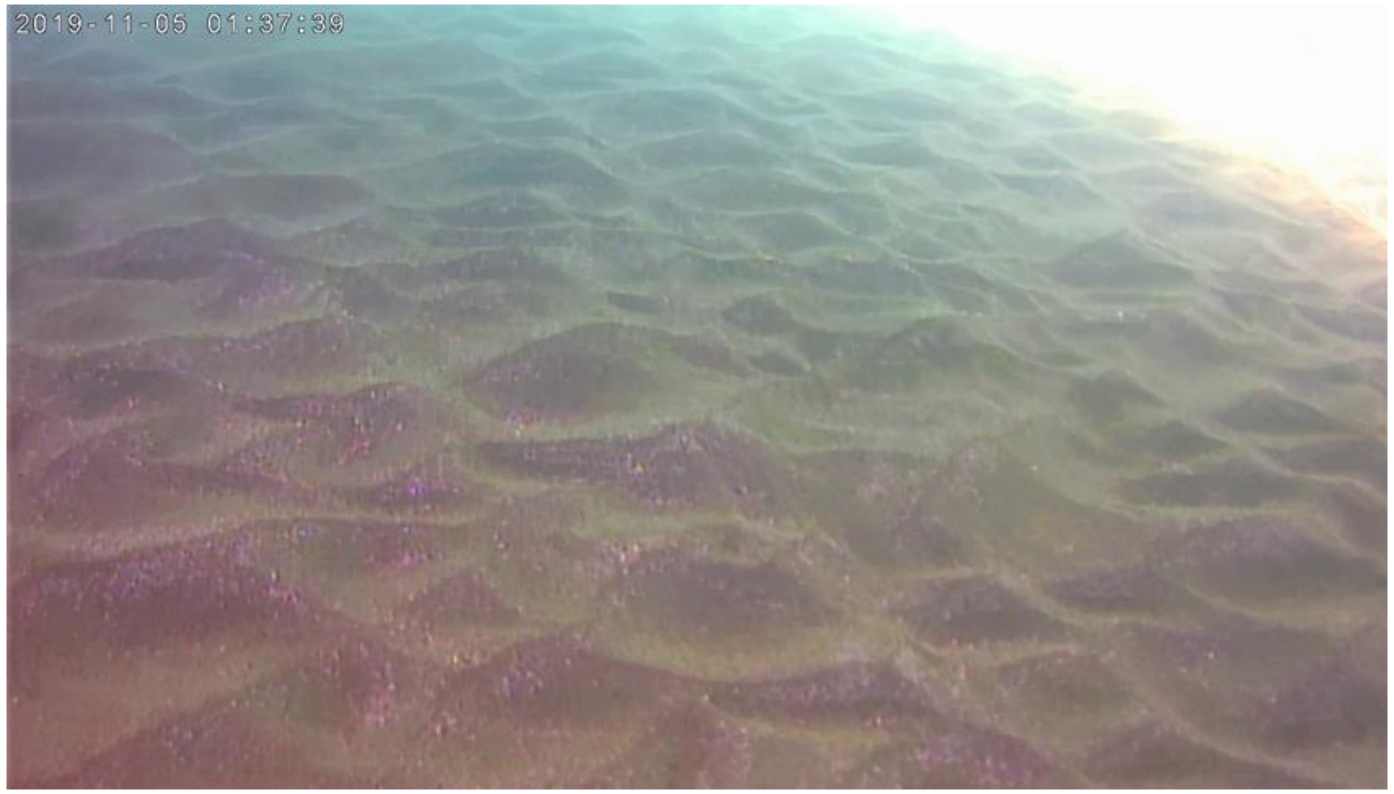


Figure 5-31: Unconsolidated sandy substrate

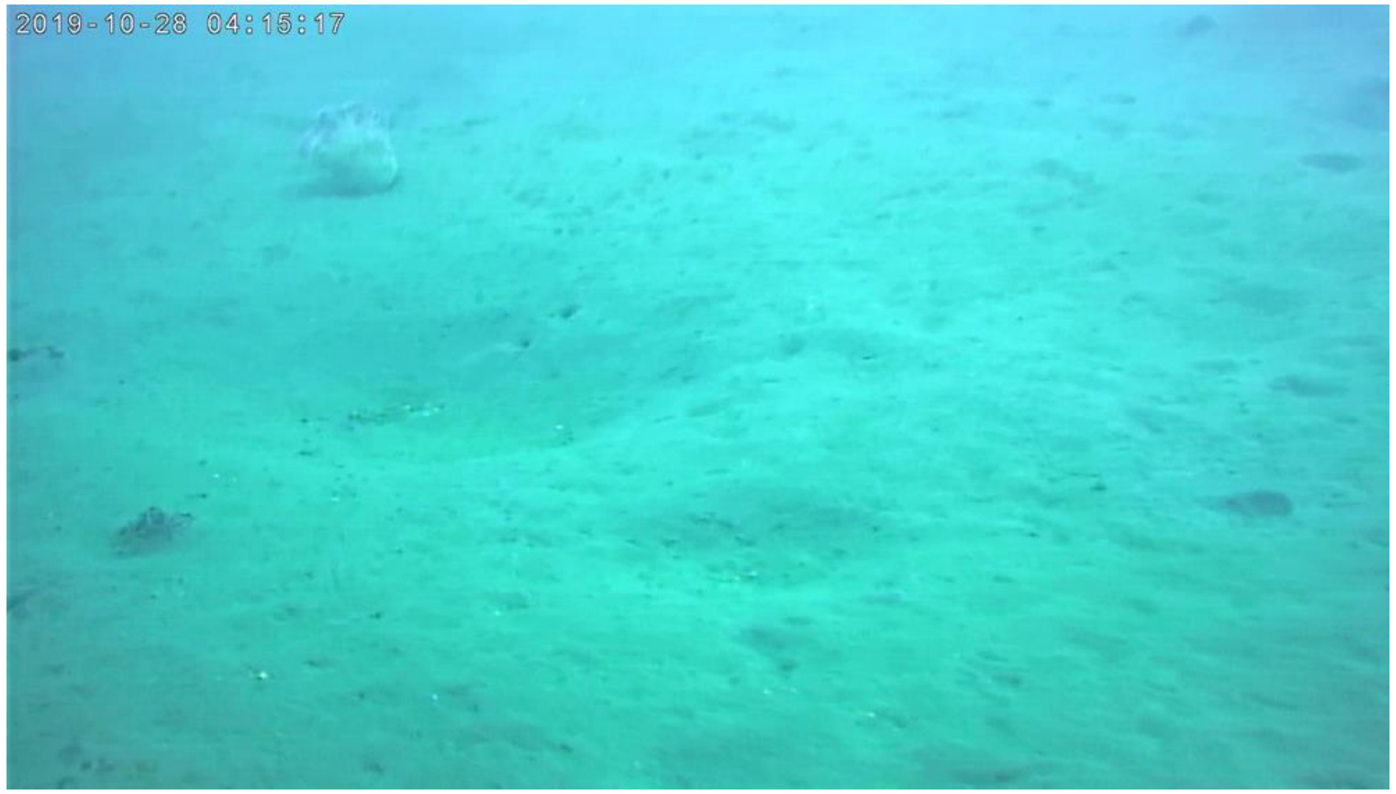


Figure 5-32: Unconsolidated Silt / Muddy substrate

Figure 5-33: Patches of Rock / coral rubble towards end of Transect 1

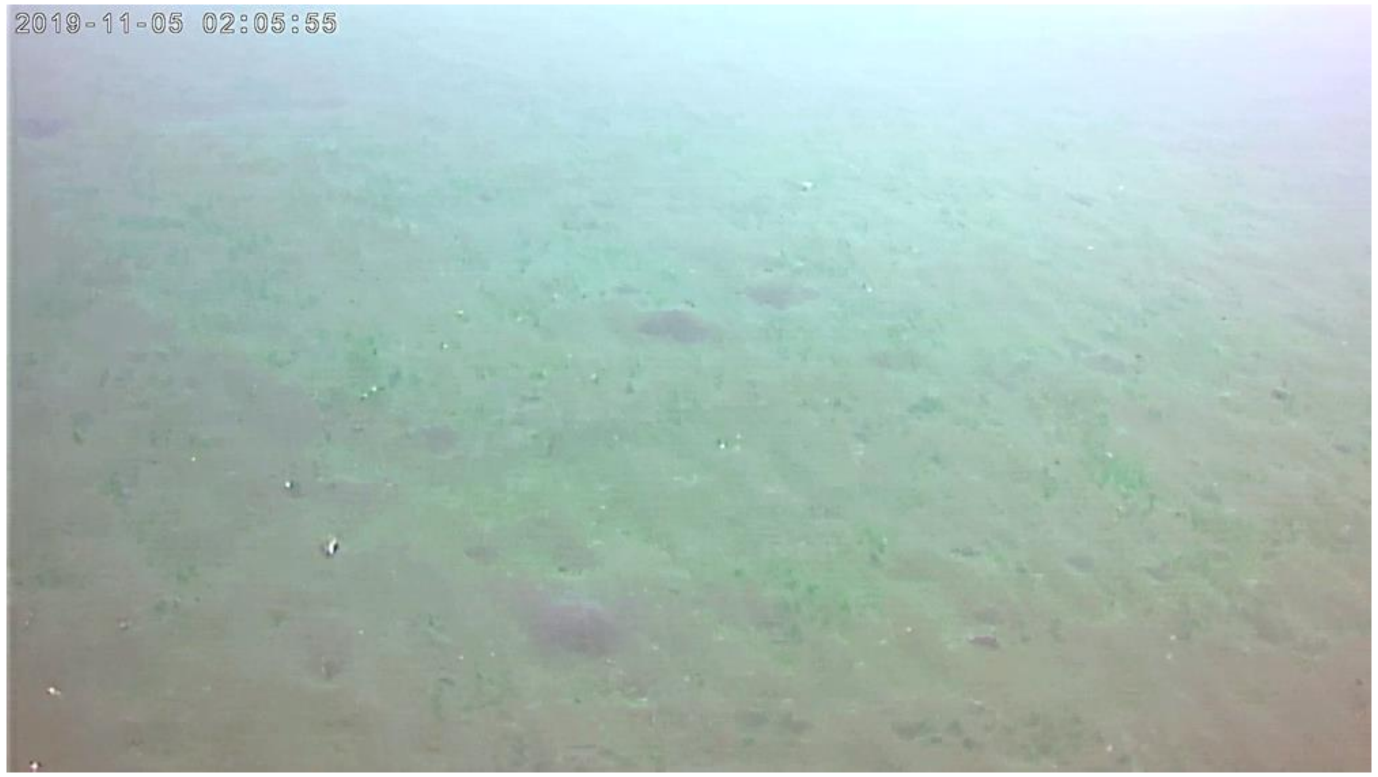


Figure 5-34: Seagrass Halophila ovalis towards the shore side of Transect 2

5.1.7.2.3. Diver-based survey

Diver based surveys were conducted on the 24th December 2019. The diver based transects and quadrats recorded the dominant habitat type to be unconsolidated substrate changing from sandy to muddy as depth increased (Figure 5-35). Unconsolidated sediment was the highest recorded cover with an average of 93% cover per quadrat for all quadrats. Only one quadrat (Transect 1, Quadrat 6) of the total of 36 quadrats recorded had hard substrate with coral rubble having a cover of 68% (Figure 5-36). No other hard substrate was recorded along any of the other transects but a patch of rocks was found after the end of Transect 6.

A total of 10 benthic species were recorded in the quadrats (including polychaete and mollusc burrows) at an average of 2.7 species/quadrat with Quadrat 6 on Transect 1 having the highest species richness with 8 species recorded. The higher species richness in Quadrat 6 Transect 1 was due to the presence of hard substrate of coral rubble. The most common recorded species was polychaete burrows which was recorded in 32 of the quadrats followed by *Halophila ovalis* (seagrass) and *Conus textile* (cone shell) recorded in 23 and 19 quadrats respectively (Figure 5-37). Percentage cover for all quadrats is provided in Table 5-21.

Hard substrate (coral rubble and rocks) were present within Transect 1 and Transect 6 (Figure 5-38 and Figure 5-39). A rapid reef survey was conducted of these areas by the divers and all species not recorded in the transects identified. Small to medium colonies of corals were observed in both locations. The rocks at Transect 6 provided habitat for a number of fish species. The list of species identified is provided in Table 5-22.

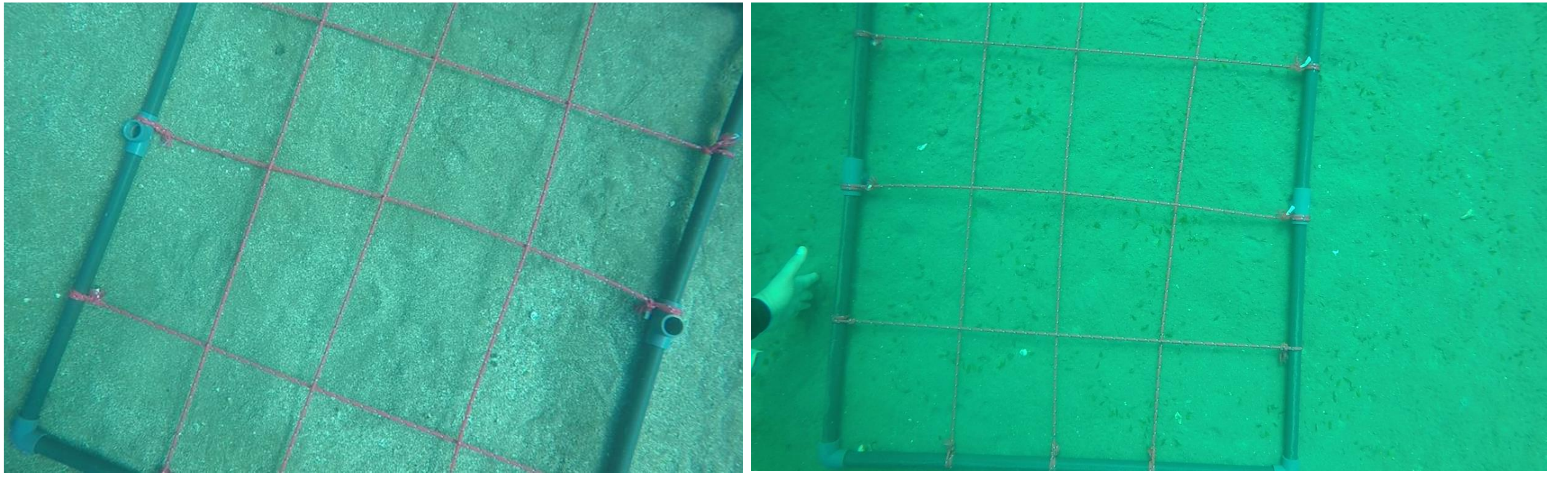


Figure 5-35: Representative photographs of a sandy (i) and muddy (ii) quadrat

Figure 5-36: Quadrat 6 on transect 1 showing the coral rubble

Figure 5-37: Picture showing the seagrass Halophila ovalis and cone shell Conus textile along the transect line

Table 5-21: Summary of percentage cover of quadrats.

Note: Code indicates the transect first followed by quadrat number

Code	Sediment	Coral rubble	*Halophila ovalis*	cf. *Haliclona* sp. (Grey turret sponge)	Black encrusting sponge	cf. *Clathria* sp. (White knobbly sponge)	*Favia favus*	*Pinctada radiata*	*Conus textile*	Polychaete burrow	Mollusc burrow	*Dardanus tinctor* (Hermit crab)
1 1	96	0	3	0	0	0	0	0	0.5	0.5	0	0
1 2	97.5	0	1	0	0	0	0	0	0.5	0.5	0.5	0
1 3	98.5	0	0	0	0	0	0	0	0.5	0.5	0.5	0
1 4	94.5	0	4	0	0	0	0	0	0.5	0.5	0.5	0
1 5	89.5	0	0	0	0	0	0	0	0	0.5	10	0
1 6	19.5	68	0	1	5	1	1	3	0	0.5	0.5	0.5
2 1	93.5	0	6	0	0	0	0	0	0	0.5	0	0
2 2	93	0	6	0	0	0	0	0	0	0.5	0.5	0
2 3	91	0	8	0	0	0	0	0	0	0.5	0.5	0
2 4	94.5	0	3	0	0	0	0	0	2	0.5	0	0
2 5	90.5	0	4	0	0	0	0	0	2	0.5	3	0
2 6	89.5	0	9	0	0	0	0	0	1	0.5	0	0
3 1	98.5	0	1	0	0	0	0	0	0	0.5	0	0
3 2	99	0	0	0	0	0	0	0	0.5	0.5	0	0
3 3	99.5	0	0	0	0	0	0	0	0	0.5	0	0
3 4	98	0	1	0	0	0	0	0	0	0.5	0.5	0
3 5	99.5	0	0	0	0	0	0	0	0	0.5	0	0
3 6	96.5	0	0	0	0	0	0	0	0	0.5	3	0
4 1	93.5	0	5	0	0	0	0	0	0.5	0.5	0.5	0
4 2	93.5	0	6	0	0	0	0	0	0	0.5	0	0
4 3	95	0	4	0	0	0	0	0	0	0.5	0.5	0
4 4	89.5	0	10	0	0	0	0	0	0	0.5	0	0
4 5	92.5	0	7	0	0	0	0	0	0	0	0.5	0
4 6	92	0	7	0	0	0	0	0	0.5	0.5	0	0
5 1	99	0	0.5	0	0	0	0	0	0	0.5	0	0
5 2	99	0	0	0	0	0	0	0	0	0.5	0.5	0
5 3	98.5	0	0	0	0	0	0	0	0	0.5	1	0
5 4	99	0	0	0	0	0	0	0	0.5	0.5	0	0
5 5	99	0	0	0	0	0	0	0	0.5	0	0.5	0
5 6	99	0	0	0	0	0	0	0	0.5	0.5	0	0
6 1	95.5	0	4	0	0	0	0	0	0.5	0	0	0
6 2	87.5	0	11	0	0	0	0	0	1	0	0	0.5
6 3	86	0	13	0	0	0	0	0	0.5	0.5	0	0
6 4	98	0	1	0	0	0	0	0	0.5	0.5	0	0
6 5	98	0	1	0	0	0	0	0	0.5	0.5	0	0
6 6	98.5	0	0	0	0	0	0	0	0.5	0.5	0.5	0

Figure 5-38: Coral rubble at end of Transect 1 with some coral colonies

Figure 5-39: Rocks at end of Transect 6 providing hard substrate with some coral colonies and *Diadema setosum* (Long-spined urchin)

Table 5-22: Species observed in the coral rubble at the end of Transect 1 and Transect 6 but not included in the quadrat assessment

Scientific name	Common name
Transect 1	
Echinometra mathaei	Short-spined urchin
Platygyra daedalea	Valley coral
Porites cf. *harrisoni*	Finger coral
Cypraea cf. *nebrites*	False margined cowrie
Pinna muricata	Pen shell
Diadema setosum	Long spined urchin
Coscinaraea monile	Wrinkle coral
Sabellidae sp.	Fan Worms
Transect 6	
Platygyra daedalea	Valley coral
Porites cf. *harrisoni*	Finger coral
Diadema setosum	Long spined urchin
Coscinaraea monile	Wrinkle coral
cf. *Callyspongia sp.*	Purple branching sponge
Ophiuroidea	Brittle stars
Cheilodipterus quinquelineatus	Five-lined cardinalfish
Carangoides ferdau	Blue trevally
Plectorhinchus sordidus	Sordid rubberlips
Pinctada margaritifera	Black-lip pearl oyster
Epinephelus stoliczkae	Epaulet grouper
cf. *Cephalopholis hemistiktos*	Yellow-fin hind
Chaetodon nigropunctatus	Black-spotted butterflyfish
Pearsonothuria graeffei	Black-spoted sea cucumber
Pomacentrus chrysurus	Whitetail damsel
Parupeneus margaritatus	Pearly goatfish
Abudefduf vaigiensis	Sergeant damselfish
Favia favus	Head coral

5.1.7.2.4. Incidentals

During sampling on the 15th December, a pod of *Stenella longirostris* (Spinner dolphins) was observed in the study area (Figure 5-40). The pod was estimated to consist of approximately 30 individuals and were displaying foraging behaviour.

Figure 5-40: Images of *Stenella longirostris* Spinner Dolphins observed during sampling

5.1.8. Waste

5.1.8.1. Baseline Methodology

A desk-based data collection exercise has been undertaken in the first instance to identify the current waste management framework within the Emirates of Fujairah, Ras Al Khaimah and Sharjah to identify current waste management opportunities and constraints, based upon publicly available information. This desk-based research has been supplemented by site visits undertaken in January 2020 to gain an overall understanding of any existing waste management issues at the Project site.

5.1.8.2. Baseline Results

5.1.8.2.1. Waste Generation & Facilities

The Federal Competitiveness and Statistics Authority (FCSA) provides detailed information regarding quantity and type of waste as well as number of waste treatment sites for each Emirate (45), which has been used to develop a description of the waste generation rates and existing waste management facilities.

5.1.8.2.1.1. Waste Collector & Type of Waste

In 2017, the quantity of collected wastes in the UAE was approximately 39 million tons, about 99% of it was not hazardous. The waste collected in Dubai contributed around 59% of the total waste collected followed by Abu Dhabi, contributing about 25%, Sharjah 8% and the rest of Emirates around 8% of the total wastes. Furthermore, as detailed in Table 5-23 below, 89% of the collected waste was collected by private companies. Table 5-23 also details the quantity and percentage of collected wastes in 2016 by emirate, waste collector and type.

5.1.8.2.1.2. Non-Hazardous Waste Composition & Disposal Method

As shown in Table 94, construction and demolition activities in 2017 produced approximately 67% of the collected non-hazardous waste, which is around 28 million tons. 17% of total produced waste is municipal waste, 10% is from non-hazardous industrial waste and 3% are from agricultural waste. Table 94 below details the quantity and percentage of non-hazardous wastes collected and managed in waste treatment facilities by Emirate, source and method of disposing.

5.1.8.2.1.3. Hazardous Waste Composition & Disposal Method

Hazardous wastes comprise approximately 1% of the total collected wastes in 2017 which is therefore minimal in comparison with the non-hazardous waste generation. Abu Dhabi contributes with the highest percent of the hazardous wastes in the UAE with 53% of the total hazardous waste collected. Dubai, Fujairah and Sharjah Emirates comprise for 13.5%, 10.4% and 18.2% respectively of the total hazardous wastes produced in the UAE. Table 95 below details the quantity and percentage of hazardous wastes collected and managed in waste treatment facilities by emirate, source and method of disposing.

5.1.8.2.1.4. Waste Treatment Sites

As shown in Table 96, the number of waste treatment facilities recorded in 2017 in the UAE is 81 which includes 35 landfill sites and 46 other waste facilities (including recovery and recycling facilities). 43% of these sites are within Abu Dhabi. Sharjah, Fujairah, Dubai and Ras Al Khaimah Emirates include a total of 34 waste facilities which include 19 landfill sites and 15 other waste facilities (including recovery and recycling facilities).

Table 5-23: Quantity of collected wastes by emirate

Note: Data from 2017 (Ton)

Emirate	Waste Collector [1]	Percentage Waste	Total	Hazardous Waste	Non-Hazardous Waste
Dubai Emirate	Municipality	6.6	1,517,625.0	13.0	1,517,612.0
	Private Company	93.4	21,416,041.0	47,887.0	21,368,154.0
	Other	0.0	1,768.0	1,768.0	0.0
	Total	**100.0**	**22,935,434.0**	**49,668**	**22,885,766.0**
Sharjah Emirate	Municipality	22.9	687,427.1	16,977.9	670,449.2
	Private Company	76.8	2,302,258.6	49,571.2	2,252,687.5
	Other	0.3	7,501.2	115.7	7,385.5
	Total	**100.0**	**2,997,187.0**	**66,664.8**	**2,930,522.2**
Fujairah Emirate	Municipality	57.3	293,711.8	924.8	292,787.0
	Private Company	42.5	217,804.0	37,377.0	180,427.0
	Others	0.2	1,209.1	0.0	1,209.1
	Total	**100.0**	**512,725.0**	**38,301.9**	**474,423.1**
Ras Al Khaimah Emirate	Municipality	41.06	445,049.1	3,062.0	441,987.1
	Private Company	58.94	638,839.0	3,779.0	635,060.0
	Total	**100.0**	**1,083,887.7**	**6,841.0**	**1,077,046.7**
Abu Dhabi	Municipality	14.2	1,372,140.1	0.0	1,372,140.1
	Private Company	85.8	8,300,652.5	195,756.0	8,104,896.5
	Total	**100.0**	**9,672,792.7**	195,756.0	**9,477,036.7**
Umm Al - Quwain [2]	Municipality	22.33	92,025.0	0.0	92,025.0
	Private Company	77.67	320,156.4	156.4	320,000.0
	Total	**100.0**	**412,181.4**	**156.4**	**412,025.0**
Ajman	Municipality	6.62	104,293.5	357.5	103,936.0
	Private Company	93.38	1,470,389.2	8,812.2	1,461,577.0
	Other	0.0	0.0	0.0	0.0
	Total	**100.0**	**1,574,682.7**	**9,169.7**	**1,565,513.0**
UAE Total [3]	**Municipality**	**11.51**	4,512,271.6	21,335.2	4,490,936.4
	Private Company	**88.46**	34,666,140.8	343,338.8	34,322,802.0
	Other	**0.02**	9,269.2	1,883.7	8594.7
	Total	**100.00**	39,188,890.4	366,557.7	38,822,332.8

Source: Collected Wastes Survey 2017
1- Municipality: Include the municipalities and the other governmental agents like the centre of waste management-Abu Dhabi)
2- Estimated
3- Total may not add up due to independent rounding.

Table 5-24: Quantity of non-hazardous wastes collected and managed in waste treatment facilities

Note: Data from 2017 (Ton)

Emirate	Source of Waste	Percentage of Waste	Total	Method of Disposal or Recovery					
				Disposal			Recovery		
				Other Method of Disposing	Burning	Dumping [2]	Other Method of Recovery [1]	Composting	Recycling
Dubai	Construction Wastes	82.4	18,870,968.0	0	0.0	18,870,968.0	0	0.0	0.0
	Municipality Waste	15.6	3,570,072.0	0	0.0	2,692,528.0	0	0.0	877,544.0
	Industrial General Wastes (non-hazardous) [3]	0.3	79,147.0	0	0.0	79,147.0	0	0.0	0.0
	Agriculture Wastes	0.6	139,938.0	0	0.0	109,059.0	0	30,879.0	0.0
	Sludge of wastewater	1.0	225,641.0	0	0.0	225,641.0	0	0.0	0.0
	Total	**100.0**	**22,889,034.0**	**0**	**0.0**	**21,977,343.0**	**0**	**30,879.0**	**877,544.0**
Sharjah	Constructions Wastes	21.7	635797.4	0.0	0.0	216,272.0	0.0	0.0	419,525.4
	Municipality Waste	24.8	726344.2	0.0	0.0	268,586.7	443,127.7	14,523.9	105.9
	Industrial General Wastes (non-hazardous)	16.7	490554.9	0.0	0.0	387,530.5	98,320.9	478.6	4,224.
	Agriculture Wastes	3.5	103153.6	0.0	0.0	78,388.0	24,765.6	0.0	0.0
	Sludge of wastewater	1.9	55,853.9	13,576.8	0.0	0.0	1,754.7	40,522.3	0.0
	Others	31.4	918,818.2	8,125.1	0.0	910,693.2	0.0	0.0	0.0
	Total	**100.0**	**2,930,522.2**	**21,701.9**	**0.0**	**1,861,470.4**	**567,968.9**	**55,524.8**	**423,856.2**
Fujairah	Constructions Wastes	60.7	288,102.0	123,294.0	0.0	164,808.0	0.0	0.0	0.0
	Municipality Waste	29.9	142,007.9	280.7	0.0	126,045.7	3,184.4	10,563.8	1,933.2
	Industrial General Wastes (non-hazardous)	3.7	17746.2	0.0	0.0	12,425.9	0.0	0.0	5,320.3
	Agriculture Wastes	2.5	11720.9	0.0	0.0	1,209.1	10,511.7	0.0	0.0
	Sludge of wastewater	3.1	14546.1	7126.6	0.0	7,419.4	0.0	0.0	0.0
	Others	0.1	300.1	0.0	0.0	300.1	0.0	0.0	0.0
	Total	**100.0**	**474,423.1**	**123,574.7**	**0.0**	**312,208.3**	**13,696.1**	**10,563.8**	**7,253.5**
Ras Al-Khaimah	Constructions Wastes	62.3	670981.7	0.0	0.0	669,054.7	0.0	0.0	1,927.0
	Municipality Waste	18.9	203319.2	0.0	0.0	181,005.4	0.0	104.0	22,209.9
	Industrial General Wastes (non-hazardous)	13.3	142904.0	0.0	0.0	142,904.0	0.0	0.0	0.0
	Agriculture Wastes	2.5	26971.8	0.0	0.0	26,971.8	0.0	0.0	0.0
	Sludge of wastewater	0.8	8556.0	0.0	0.0	8,556.0	0.0	0.0	0.0
	Others	2.3	24314.0	0.0	0.0	24,314.0	0.0	0.0	0.0
	Total	**100.0**	**1,077,046.7**	**0.0**	**0.0**	**1,052,805.9**	**0.0**	**104.0**	**24,136.9**
Abu Dhabi	Constructions Wastes	41.8	3,959,318.8	0.0	0.0	1,369,658.7	41,761.3	0.0	2,547,898.8
	Municipality Waste	14.5	1,372,141.0	0.0	0.0	957,166.0	0.0	148,866.0	266,109.0
	Industrial General Wastes (non-hazardous) 3	33.9	3,212,073.3	0.0	0.0	3,037,066.5	0.0	0.0	175,006.8
	Agriculture Wastes	9.9	933,505.0	0.0	7,514.5	883,323.0	0.0	42,667.5	0.0
	Total	**100.0**	**9,477,038.1**	**0.0**	**7,514.5**	**6,247,214.2**	**41,761.3**	**191,533.5**	**2,989,014.6**

Emirate	Source of Waste	Percentage of Waste	Total	Method of Disposal or Recovery					
				Disposal			Recovery		
				Other Method of Disposing	Burning	Dumping [2]	Other Method of Recovery [1]	Composting	Recycling
Umm Al Quwain [4]	Construction Wastes	77.7	320,000.0	0.0	0.0	320,000.0	0.0	0.0	0.0
	Municipality Waste	12.2	50,400.0	0.0	0.0	50,400.0	0.0	0.0	0.0
	Agriculture Wastes	3.4	14,000.0	0.0	0.0	14,000.0	0.0	0.0	0.0
	Sludge of wastewater	6.7	27,625.5	0.0	0.0	27,625.5	0.0	0.0	0.0
	Total	**100.0**	**412,025.5**	**0.0**	**0.0**	**384,400.0**	**0.0**	**0.0**	**0.0**
Ajman	Constructions Wastes	69.8	1,092,348.9	0.0	0.0	1,092,348.9	0.0	0.0	0.0
	Municipality Waste	22.2	346868.3	0.0	0.0	339,820.0	0.0	199.0	6,849.3
	Industrial General Wastes (non-hazardous)	1.7	26782.4	0.0	0.0	26,782.4	0.0	0.0	0.0
	Agriculture Wastes	0.5	7220.2	0.0	0.0	7,220.2	0.0	0.0	0.0
	Sludge of wastewater	0.4	6738.0	0.0	0.0	6,738.0	0.0	0.0	0.0
	Other	5.5	85555.0	0.0	0.0	85,555.0	0.0	0.0	0.0
	Total	**100.0**	**1,565,512.7**	**0.0**	**0.0**	**1,558,464.5**	**0.0**	**199.0**	**6,849.3**
Total [6]	Constructions Wastes	66.5	25,837,516.8	123,294.0	0.0	22,703,110.3	41,761.3	0.0	2,969,351.2
	Municipality Waste	16.5	6,411,152.5	280.7	0.0	4,615,551.8	446,312.1	174,256.7	1,174,751.2
	Industrial General Wastes (non-hazardous)	10.2	3,969,207.8	0.0	0.0	3,685,856.3	98,320.9	478.6	184,551.9
	Agriculture Wastes	3.2	1,236,509.4	0.0	7,514.5	1,120,171.1	35,277.4	73,546.5	0.0
	Sludge of wastewater [5]	0.9	338,960.4	20,703.4	0.0	275,979.9	1,754.7	40,522.3	0.0
	Others	2.7	1,028,987.4	8,125.1	0.0	1,020,862.3	0.0	0.0	0.0
	Total	**100.0**	**38,825,602.3**	**145,276.6**	**7,514.5**	**33,393,906.3**	**623,426.3**	**288,804.2**	**4,328,654.3**

Table 5-25: Quantity of collected hazardous wastes collected and managed in waste treatment facilities

Note: Data from 2017 (Ton)

Emirate	Source of Waste	Percentage of Waste	Total	Method of Disposal or Recovery							
				Disposal					Recovery		
				Other Method of Disposing	Export	Special Treatment in the General Dump and then dumping	Companies for final disposing	Incineration of medical waste and waste-to-energy	Hazardous Waste Facilities	Selling for companies for recycling	Recycling in hazardous facility
Dubai	Industrial	93.1	46,245.0	2,300.0	0.0	0.0	0.0	0.0	43,945.0	0.0	0.0
	Medical	6.9	3,423.0	0.0	0.0	0.0	0.0	2,893.0	530.0	0.0	0.0
	Total	**100.0**	**49,668.0**	**2,300.0**	**0.0**	**0.0**	**0.0**	**2,893.0**	**44,475.0**	**0.0**	**0.0**
Sharjah	Industrial	97.6	65,059.1	0.0	0.0	65,054.9	4.2	0.0	0.0	0.0	0.0
	Medical	2.4	1,605.6	0.0	0.0	0.0	0.0	0.0	1,605.6	0.0	0.0
	Total	**100.0**	**66,664.8**	**0.0**	**0.0**	**65,054.9**	**4.2**	**0.0**	**1,605.6**	**0.0**	**0.0**
Fujairah[1]	Industrial	83.9	32,148.0	0.0	0.0	352.0	0.0	5,204.9	0.0	26,591.6	0.0
	Medical	1.0	371.6	0.0	0.0	0.0	271.7	100.0	0.0	0.0	0.0
	other	15.1	5,782.3	0.0	0.0	594.8	4,300.8	0.0	0.0	886.6	0.0
	Total	**100.0**	**38,301.9**	**0.0**	**0.0**	**946.8**	**4,572.5**	**5,304.8**	**0.0**	**27,478.2**	**0.0**
Ras Al-Khaimah	Industrial	91.2	6,237.0	0.0	0.0	6,211.0	0.0	0.0	0.0	0.0	26.0
	Medical	8.8	604.0	0.0	0.0	8.1	201.0	395.3	0.0	0.0	0.0
	Total	**100.0**	**6,841.0**	**0.0**	**0.0**	**6,219.1**	**201.0**	**395.3**	**0.0**	**0.0**	26.0
Abu Dhabi	Industrial	18.0	35,174.0	14,083.3	0.0	0.0	0.0	130.3	9,911.0	0.0	11,049.8
	Medical	3.3	6,374.0	0.0	0.0	0.0	0.0	2,078.9	4,294.9	0.0	0.0
	Other	78.8	154,208.0	0.0	97,707.0	0.0	0.0	0.0	56,501.0	0.0	0.0
	Total	**100.0**	**195,756.0**	**14,083.3**	**97,707.0**	**0.0**	**0.0**	**2,209.2**	**70,706.9**	**0.0**	**11,049.8**
Umm Al Quwain	Medical	100.0	156.3	0.0	0.0	0.0	156.3	0.0	0.0	0.0	0.0
	Total	**100.0**	**156.3**	**0.0**	**0.0**	**0.0**	**156.3**	**0.0**	**0.0**	**0.0**	**0.0**
Ajman	Industrial	96.1	8,812.2	1,764.2	0.0	0.0	7,048.0	0.0	0.0	0.0	0.0
	Medical	3.9	357.4	0.0	0.0	0.0	0.0	357.4	0.0	0.0	0.0
	Total	**100.0**	**9,169.6**	**1,764.2**	**0.0**	**0.0**	**7,048.0**	**357.4**	**0.0**	**0.0**	**0.0**
Total[2]	**Industrial**	**52.8**	**193,675.3**	**18,147.4**	**0.0**	**71,617.9**	**7,052.2**	**5,335.2**	**53,856.0**	**26,591.6**	**11,075.8**
	Medical	**3.5**	**12,892.0**	**0.0**	**0.0**	**8.1**	**629.0**	**5,824.6**	**6,430.5**	**0.0**	**0.0**
	other	**43.6**	**159,990.3**	**0.0**	**97,707.0**	**594.8**	**4,300.8**	**0.0**	**56,501.0**	**886.6**	**0.0**
	Total	**100.0**	**366,557.5**	**18,147.4**	**97,707.0**	**72,220.8**	**11,982.0**	**11,159.8**	**116,787.5**	**27,478.2**	**11,075.8**

Source: Collected by Federal Competitiveness and Statistics Authority

6- *Medical wastes from Fujairah municipality that collected from private sector hospitals.*

2- Total may not add up due to independent rounding.

Table 5-26: Number of wastes treatment sites by Emirate and type

Note: Data from 2017 (Ton)

Emirate	Total			Mixed	Hazardous	Non-Hazardous	
	Total	Facility	Dumpsite (landfill)	Dumpsite (landfill)	Facility	Facility[1]	Dumpsite (landfill)
Dubai	8	3	5	0	2	1	5
Sharjah	13	7	6	1	2	2	5
Fujairah	9	3	6	1	1	2	5
Ras Al Khaimah	4	2	2	1	0	2	1
Abu Dhabi	35	24	11	0	4	20[2]	11
Umm Al Quwain	2	0	2	2	0	0	0
Ajman	10	7	3	0	3	4	3
Total	**81**	**46**	**35**	**5**	**12**	**34**	**30**

Source: Collected by Federal Competitiveness and Statistics Authority.

5.1.8.2.2. Site Specific

The Project site currently contains large amounts of concrete rubble and waste, generated from the decommissioning of the previous power plant. This waste is heaped in areas around the centre of the Project site as well as large concentrations of flattened concrete rubble along the eastern section closest to the coast. Some concrete buildings remain standing, generally in the centre of the Project site which were previously used as battery storage units and administration offices based upon signage that remains on the existing buildings.

There are large amounts of left-over operational waste, such as wood, metal and plastic in the form of wooden pallets, lengths of fiberglass pipe and metal rebar. Approximately 15 sheets of asbestos concrete sheeting were located stacked near the southern perimeter of the Project site. Additionally, the eastern perimeter of the Project site contains a significant amount of coastal waste which has been deposited over time. This waste generally contains plastic and wooden debris.

The northern area of the Project site contains an oil storage facility which remains existing from the decommissioned plant as well as areas of flattened rubble.

5.1.9. Socio-Economy

5.1.9.1. Baseline Methodology

5.1.9.1.1. Desktop Study & Site Visits

In order to inform the desktop study a variety of sources have been referred to, including government statistics, satellite imagery and online information. In addition, in-depth site visits have been undertaken from 30th January 2020 to understand the existing conditions and existing socio-economic receptors. No direct interactions, interviews or discussions have been held with any of the local communities.

These studies and in-depth site visits have enabled the gathering of information relating to population, demographics, land use, the livelihoods of the local community and a range of other aspects of the socio-economic conditions present throughout the length of the alignment as follows:

- Land use;
- Economy;
- Employment;
- Education;
- Communities, residential areas including mosques, schools, medical facilities and recreational areas;
- Current and planned infrastructure;
- Population and demographics; and
- Traffic congestion.

The assessment then focuses on the potential for impacts upon social and economic receptors within the area during the construction and operational phases, both positive and negative. Where necessary, appropriate mitigation measures are identified.

5.1.9.1.2. Socio-Economic Receptors Sensitivity

The primary data collection exercise has identified different land uses and their sensitivity within the Project Study Area. Each of the areas are assessed in Table 5-27 below.

Table 5-27: Socio-economic receptors sensitivity

Land Use	Key features	Sensitivity
Residential Areas	Includes area dominated by houses, residential buildings and/or hotels. These areas often include schools, mosques, clinics, hospitals, shops etc.	High
Agricultural Areas (farmland & plantations)	Includes farmland, plantations and houses for workers.	Moderate to High
Agricultural Areas (livestock)	Includes goat, camel, cattle farms etc. which are commonly not settled in legal areas.	Low
Public & Commercial Areas	Areas dominated by commercial or public buildings such as shops, commercial centres, governmental buildings, schools / nurseries, parks, cemeteries, hospitals, clinics, mosques etc.	Moderate to High
Industrial Areas	Areas dominated by industrial and utilities buildings.	Low

5.1.9.1.3. Stake Holder Engagement

The IFC's Performance Standard 1 (Assessment and Management of Environmental and Social Risks and Impacts) '*underscores the importance of managing environmental and social performance of a project*'. A key tenet of this standard is with regards to stakeholder engagement.

There are two local communities in proximity of the Project site area consisting of Mirbah and Qidfah. There is already extensive industrial developments in the surrounding areas and an industrial legacy on the Project site itself. However, it's likely the magnitude of the impacts on the local communities will be high due to the proximity to the closest farm with residential housing. Due to the confidential nature of this government project, low cultural value of the project site, low conservation value and the lack of residents on site needing relocation and compensation for lands acquired, a programme of local engagement has not been deemed necessary in this instance.

However, the Environmental Management Plan (to incorporate both a Construction Environmental Management Plan and Operation Environmental Management Plan) which is to be delivered in due course (and is normally the responsibility of the project EPC contractor) must have a clear and defined 'grievance' process and complaints response system that allows residents to address complaints to the Project proponent and that dictates that all necessary action is undertaken.

5.1.9.2. Baseline Results

5.1.9.2.1. UAE Economy

The UAE is considered as an open economy with a high per capita income and a sizable annual trade surplus (30). The GDP (Gross Domestic Product) per capita in 2017 was $68,200 (30). Following successful efforts at economic diversification, the portion of GDP from the oil and gas sector has reduced to 30%.

Since the discovery of oil in the UAE nearly 60 years ago, the UAE has undergone a profound transformation from an impoverished region of small desert principalities to a modern state with a high standard of living. The government has increased spending on job creation and infrastructure expansion and is opening up utilities to greater private sector involvement (30). The country's free trade zones are also good incentives to attract foreign investors.

The UAE's dependence on oil is a significant long-term challenge. Low oil prices have prompted the UAE to cut expenditures, including on some social programs, but the UAE has sufficient assets in its sovereign investment funds to cover its deficits (30). The government reduced fuel subsidies in August 2015 and has implemented value-added taxes (VAT) since January 1, 2018, which will support further Government spending.

The UAE's strategic plan for the next few years focuses on economic diversification, promoting the UAE as a global trade and tourism hub, developing industry, and creating more job opportunities for nationals (also referred as 'Emiratization') through improved education and increased private sector employment (30). The UAE offers government and private education to all male and female citizens and non-citizens across all levels, from nursery through to university. Public schooling within the UAE is under the jurisdiction of the Ministry of Education.

Breakdown of the contribution of broad sectors to GDP is as follows (30):

- 0.9% of the GDP from the agricultural sector. The main agricultural products from the UAE include dates, vegetables, watermelons, poultry, eggs, dairy products, and fish;
- 49.8% of the GDP from the industry sector. The main industries in the UAE include petroleum and petrochemicals, fishing, aluminium, cement, fertilizers, commercial ship repair, construction materials, handicrafts and textiles; and
- 49.2% of the GDP from the services sector.

5.1.9.2.2. UAE Population and Demographics

The UAE and its seven Emirates are extremely diverse in their population structure both in terms of ethnic group representation and age structures. For example, it is estimated that Emiratis comprise of approximately 11.6 % of the population, with the remaining 88% being expatriates (31).

5.1.9.2.3. Fujairah Emirate

5.1.9.2.3.1. Land Use

The land-use and sensitive receptors are detailed in **Section 5.1.2.2.**

5.1.9.2.3.2. Economy

A large portion of Fujairah's economy is comprised of agriculture and fishing, with the fertile lands being irrigated by rainwater running off from the Hajar Mountains (32). In addition, the geographical position of the Emirate of Fujairah is such that it is the sole point of the country with access to the Indian Ocean and therefore features a port facility enabling access to major global shipping routes (32). Fujairah port features significant livestock shipping companies.

The Abu Dhabi Crude Oil Pipeline (ADCOP) was inaugurated in 2012, which originates at onshore oilfields in Abu Dhabi terminates in Fujairah where there are export facilities and a planned refinery (33). This enables the Straits of Hormuz to be bypassed.

Adjacent to Fujairah Port is Fujairah Free Zone which enables foreign banking and trade investments, bolstering the Emirates GDP to AED 14,093 million during 2014 (32).

In addition, a variety of other industries such as mining and stone crushing are thriving due to the continued increase in construction particularly in Abu Dhabi and Dubai.

Fujairah Plan 2040 was launched by the Government in 2015 which includes provisions for the further development of Fujairah port with new terminals proposed for a range of services and expansion of the airport and the improved positioning of the cargo airport and associated terminal (32).

5.1.9.2.3.3. Employment

Overall estimates for the working and non-working population within Fujairah are not currently available online, however it is understood that the Fujairah Statistics Centre is the responsible government department for publishing the Annual Statistical Book, which began 15 years ago. These books contain detailed information relating to Fujairah and its population, economy and numerous other indicators.

Employment within the local government departments have grown considerably since 1995 when only 442 employees were working across the various departments. That figure has risen to 1,384 as of 2016, illustrating the significant growth of the government and constituent departments over the past few decades as Fujairah has diversified and grown (34).

5.1.9.2.3.4. Education

As identified within **Section 5.1.9.2.1: UAE Economy**, the UAE offers government and private education to all male and female citizens and non-citizens across all levels, from nursery through to university (35).

Educational institutions within Fujairah are understood to operate under the jurisdiction of the MoE and as such does not have a specific education authority. Fujairah Emirate has range of both public and private K-12 schools and academic institutions, in addition to universities and preschools (35).

5.1.9.2.3.5. Population and demographics

The most recent information relating to demographics for the Emirate of Fujairah dates back to 2011. During 2011, it was estimated that the total population was 167,399 including 56,829 females and 110,570 males. Of these 65,291 were Emiratis and 102,108 were expatriates. The total number of households in Fujairah was estimated to be 22,259 in 2011 (36).

The most recent population estimate for Fujairah dated 2019 is 0.25 million, or 250,000 people (32).

5.1.9.2.3.6. Fisheries

The Fujairah Emirates has a coastline only on the Gulf of Oman. Small scale commercial fishing activities are present off the coast of Fujairah with a total number of 5,066 fisherman as of 2018, 783 Emirati fishermen and 4,283 non-Emirati. The total number of fish caught in 2018 was estimated at 12,616 tons. There is also a smaller number. Recreational fishing is also done in Fujairah and serves as an important attraction for local and international tourists (31). There is no evidence to suggest that the surrounding area of the Project site is used for commercial or recreational activities.

5.1.9.2.3.7. Healthcare

Fujairah contains a variety of health facilities including provisions for both private and public treatment, including the following facilities:

- Government Hospitals, including Fujairah Hospital, Maternity Hospital, Dibba Hospital and Masafi Hospital;
- Government medical centres and clinics, including Al Quria, Badia, Al Taween, Dhedna, Masafi, Marbah, Al Madina, Qidfaa, Wadi Sedr, Al Mereshed and Al Hallah;
- Private hospitals, including GMC Hospital – Fujairah and Al Sharq International Hospital;

- Private medical centres and clinics, including Fujairah Port Clinic, Fujairah Medical Centre, Aster Medical Centre, International Medical Centre, Al Eman Medical Centre, Dr. Rawhi M Faleh's Clinic, Fujairah National Medical Centre, Hyath Medical Clinic, Dr. Eid Specialised Medical Clinic, Faleh Gynae Clinic, Merashid Pvt Clinic and Al Noor Medical Centre; and
- Dental clinics, including Al Anaya Dental Clinic, Al Ebtisama Dental Clinic, Al Riqah Dental Clinic and El Eman Dental Clinic (37).

5.1.9.2.4. Sharjah Emirate

5.1.9.2.4.1. Land use

The land-use and sensitive receptors are detailed in **Section 5.1.2.2.**

5.1.9.2.4.2. Economy

The economy in Sharjah is regulated and overseen by the Sharjah Economic Development Department (SEDD) which was established in 1999 by H.H. Dr. Sheikh Sultan bin Muhammed Al Qassimi, Member of the Supreme Council and the Ruler of the Emirate of Sharjah (38). The SEDD is responsible for the implementation and planning of all economic development projects within the Emirate, in addition to the drafting of regulations and laws, plans and commercial service and industrial license issuance (38).

Sharjah's economy is diverse with a focus on small and medium companies trading in real estate, gas, tourism, education, healthcare, manufacturing, logistics and business services (31). In addition, Sharjah is home to 19 large industrial areas, which are understood to provide 48% of the UAE's gross industrial output (31).

The economy is greatly bolstered by the two Free Zone areas present within the Emirate as follows:

- Sharjah International Airport Free Zone; and
- Hamriyah Free Zone.

Sharjah Healthcare City (SHCC) is currently under development and will also operate as Free Zone area. Three ports of 49,588,000 square metres are also located within the Emirate of Sharjah (31).

In addition, Sharjah also features one of the most popular and significant trade exhibition venues, Expo Centre Sharjah (31).

5.1.9.2.4.3. Employment

The Sharjah Census 2015 identifies that of the residents over 15 years of age, 76% are employed (39). 6% are unemployed, unable to work, retired, undertake domestic work or are self-supporting and 5% are full time students. The total working population of Sharjah Emirate was calculated in 2015 as being 855,709 of which 95.1% are employees, 2.1% are business owners and 1.5% are self-employed (39).

It is stated that of the working population present within Sharjah Emirate, 82%, or 575,610 people are employed within the private sector. 4% or 29,673 people are employed by the Federal Government, and 6% or 45,434 people are employed by the local Government. Finally, semi-Government bodies employ 3%, or 17,688 people. Diplomatic jobs and foreign sector positions employ less than 1% of the population and domestic roles employ 5% of the working population (39).

5.1.9.2.4.4. Education

Within Sharjah, private education will shortly be under the jurisdiction of the newly formed Sharjah Private Education Authority (SPEA). In November 2018, Emiri Decree No. 45 of 2018 was issued by the Government of Sharjah to initiate SPEA. No further details are currently available, but it is understood that this education authority will be affiliated to the Sharjah Government (40)

The Sharjah Census 2015 identifies that there are 253,105 individuals, both male and female, from 4 years old and above enrolled within an educational facility within the Emirate of Sharjah (39).

5.1.9.2.4.5. Population and demographics

The Sharjah Department of Statistics and Community Development (DSCD) undertook the latest census in 2015 (39). The Sharjah Census 2015 identifies that the total population of the Emirate of Sharjah was 1.4 million in 2015. The vast majority (91%) of the total population lives within the city of Sharjah (39). More recent estimates for the overall population of Sharjah Emirate report a population of 1.571 million as of 2018 (41).

175,432 Emiratis reside in the Emirate of Sharjah which equates to 12% of the total population. The Emirati population is evenly divided between females and males, with 51% of the Emirati population being female and 49% being male. 29,728 or 51% of Emirati females are married and 30,424 or 56% of Emirati males are married. 49% of females and 44% of males are divorced, widowed, single or abandoned (39).

1,230,417 are expatriates which equates to 88% of the total population. The expatriate population is predominantly male which is largely due to the large influx of male migrant workers. It was estimated that as of 2015 there were 834,542 male expatriates in Sharjah and only 89,098 expatriate females (39).

The population of the Emirate of Sharjah is young, with 79% being under the age of 30. The total estimated workforce comprises 61% of the total population, which equates to 855,709 people (39).

5.1.9.2.4.6. Healthcare

Healthcare within the Emirate of Sharjah is under the jurisdiction of the Sharjah Health Authority (SHA). This overarching health authority was established in 2010 under the directive and vision of H.H. Dr. Sheikh Sultan bin Muhammed Al Qassimi, Member of the Supreme Council and the Ruler of Sharjah (42).

In April 2012, in response to the vision of H.H. Dr. Sheikh Sultan bin Muhammed Al Qassimi, Member of the Supreme Council and the Ruler of Sharjah, the Sharjah Healthy City programme was initiated and was registered in the World Health Organisation (WHO) regional healthy city network (43). This facilitates the focus of continued improvement to healthcare within the Emirate of Sharjah. A review three years after the initiation of this programme revealed that Sharjah had met and exceeded the indicators specified by WHO in various areas including health development, community-based engagements, education and literacy, skill development, water, sanitation and air, emergency preparedness etc. scoring 88%. WHO has also announced that Sharjah will become a regional training centre for other cities wishing to attain an endorsement for inclusion within the Healthy City programme (43).

In the same year that Sharjah became part of the Healthy City programme, and under the same directive and through the vision of H.H. Dr. Sheikh Sultan bin Muhammed Al Qassimi, Member of the Supreme Council and the Ruler of Sharjah, proposals for the Sharjah Healthcare City (SHCC) were established with the aim of providing an improved regional healthcare service industry (44) (45).

SHCC is intended to provide potential investors with the opportunity to establish themselves within a free zone area providing convenience and ease of operation with the intention of providing a wide range of services for the full demographic of the population of Sharjah city and the wider Emirate of Sharjah (45). The Free Zone status of SHCC enables investing companies to operate with 100% ownership status, with zero taxation or duties and excellent modern infrastructure specifically designed for the provision of medical services. SHCC is located within the vicinity of Sharjah International Airport and occupies an area of 2.5 million square metres (45).

In addition to the private healthcare provisions detailed above, there are numerous existing private hospitals throughout Sharjah, perhaps most notably Al Zahra Hospital, which was the first private hospital to be established in the Emirate of Sharjah in 1981. Sharjah also features public hospitals including Al Qasimi Hospital and Al Kwaiti Hospital, in addition to numerous public medical centres (46).

5.1.9.2.5. Oman

5.1.9.2.5.1. Population

The most recent information relating to the demographics for Oman dates back to 2019. During 2019 it was estimated there was a total population of 4,664,844, of which approximately 46% are immigrants. The vast majority of the population is located in and around the Al Hagar Mountains in the north of the country; another smaller cluster is found around the city of Salalah in the far south; most of the country remains sparsely populated (30).

5.1.9.2.5.2. Economy

Oman is heavily dependent on oil and gas resources, which can generate between and 68% and 85% of government revenue, depending on fluctuations in commodity prices. In 2016, low global oil prices drove Oman’s budget deficit to $13.8 billion, or approximately 20% of GDP, but the budget deficit is estimated to have reduced to 12% of GDP in 2017 as Oman reduced government subsidies. As of January 2018, Oman has sufficient foreign assets to support its currency’s fixed exchange rates. It is issuing debt to cover its deficit (30).

Oman is using enhanced oil recovery techniques to boost production, but it has simultaneously pursued a development plan that focuses on diversification, industrialization, and privatization, with the objective of reducing the oil sector's contribution to GDP. The key components of the government's diversification strategy are tourism, shipping and logistics, mining, manufacturing, and aquaculture (30).

Muscat also has notably focused on creating more Omani jobs to employ the rising number of nationals entering the workforce. However, high social welfare benefits - that had increased in the wake of the 2011 Arab Spring - have made it impossible for the government to balance its budget in light of current oil prices. In response, Omani officials-imposed austerity measures on its gasoline and diesel subsidies in 2016. These spending cuts have had only a moderate effect on the government’s budget, which is projected to again face a deficit of $7.8 billion in 2018 (30).

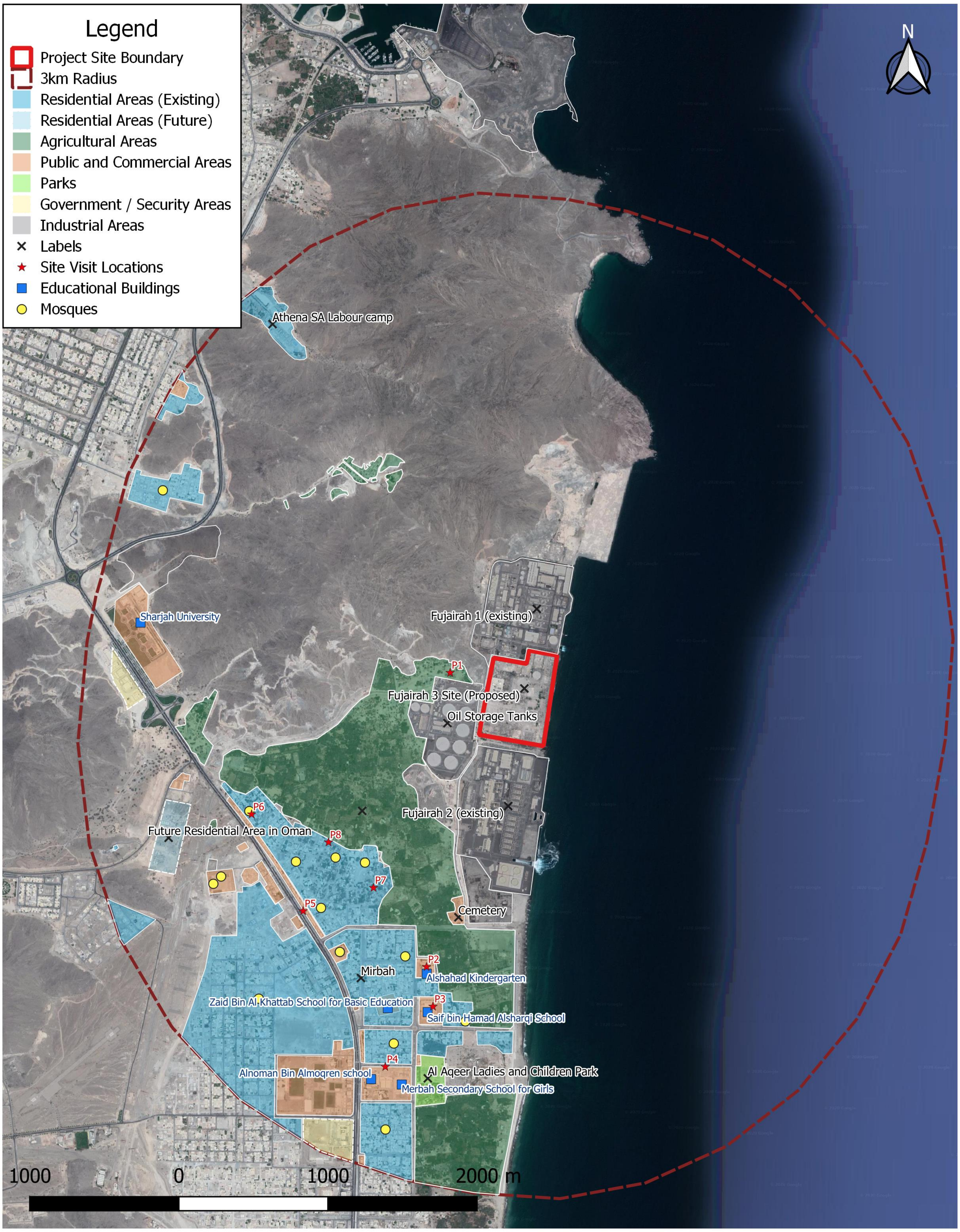
5.1.9.2.6. Key Sensitive Receptors

A number of key sensitive receptors have been identified (existing and proposed) which will be the core focus of the assessments undertaken within the ESIA technical chapters. These are considered to be the most sensitive receptors within a 3km radius of the Project.

The Project area is surrounded by industrial areas (F1, F2 and oil storage tanks). The wider area is dominated by agricultural areas (including plantations and farms with residential housing) and residential areas (such as Mirbah and Qibfa). Additionally, there are a number of small-scale commercial land uses that follow the main road through Mirbah. The majority of these are human impacts as shown in Table 5-28 and Figure 5-41 below.

Table 5-28: Key Sensitive Receptors Land Use

Land Use	Name Description	Closest Distance from Project Area
Residential Areas	– In Fujairah ▪ Mirbah ▪ Qidfa ▪ Small residential clusters – Sharjah ▪ Athena SA Labour camp – In Oman ▪ Future residential area ▪ Small residential area	– 1.00km – 1.00km – 2.35km – 2.20km – 1.95km – 2.47km
Agricultural Areas (farmland, livestock & plantations)	– In Fujairah ▪ Several agricultural areas in Qidfa & Mirbah – In Sharjah ▪ Scattered agricultural areas	– 0.09km – 1.29km
Public & Commercial Areas	– In Fujairah ▪ 13 Mosques ▪ Several shops along the main roads ▪ Cemetery ▪ Al Aqeer Ladies and Childrens park ▪ Merbah Secondary School for Girls ▪ Alnoman Bin Almoqren School ▪ Saif bin Hamad Alsharqi School ▪ Zaid Bin Al Khattab School for Basic Education ▪ Alshahad Kindergarten ▪ One petrol station – In Sharjah ▪ Sharjah University ▪ Small commercial area – In Oman ▪ One petrol station	– 1.09km – 1.58km – 1.02km – 2.10km – 2.30km – 2.33km – 1.80km – 1.85km – 1.55km – 1.88km – 2.00km – 2.69km – 1.93km
Industrial Areas	– In Fujairah ▪ F1 ▪ F2 ▪ Oil Storage Tanks – In Sharjah ▪ Quarrying works	– Adjacent – Adjacent – Adjacent – 1.97km
Government / Security Areas	– In Fujairah ▪ Government area in south Mirbah – In Sharjah ▪ Government area south of Khor Fakkan	– 2.65km – 2.25km



Project Number: 1116
Project Name: Fujairah 3
Data Sources: Various
Compiled By: AB

Scale: 1:31287
Coordinate System: World Mercator System
Datum: WGS84
Units: meters
Date: 02/02/20

Figure 5-41: Key Sensitive Receptors

5.1.10. Archaeology and Cultural Heritage

5.1.10.1. Baseline Methodology

Detailed walkover surveys of the Project site have been undertaken by Anthesis specialists, comprising visual inspections of all areas. On the basis that the Project site has been previously developed, and that no archaeological features were evident, further detailed investigations were not subsequently undertaken.

5.1.10.2. Baseline Results

No evidence for archaeological or cultural heritage sites has been identified within the Project site. Due to the previous level of disturbance associated with the previous development of power generation facilities and subsequent demolition, it is considered very low risk that any buried archaeological remains would be encountered. Nevertheless, control measures will be in place to ensure that if buried artefacts are identified during the construction phase, suitable mitigation measures will be adopted to ensure compliance with **Section 3.2.7**.

5.2. Components Likely To-Be-Affected

5.2.1. Ambient Air Quality

Environmental components most likely to be affected by emissions generated by construction and operation activities related to the Project are the closest residential areas which have been flagged as sensitive receptors (SRs) for the impact assessment. The identified SRs and locations are detailed in Table 5-29 and Figure 5-42.

Table 5-29: Sensitive Receptor Details

Receptor	Site Description	Universal Transverse Mercator (UTM) Coordinates	
		m E	m N
SR1	Outskirts of Khawr Fakkan	434,653	2,800,609
SR2	Village south east of Khor Fakkan	435,853	2,800,732
SR3	Residential properties immediately west of the F3 site	436,464	2,799,428
SR4	Northern outskirts of Qidfa	435,221	2,798,564
SR5	North east outskirts of Qidfa	435,867	2,798,278
SR6	University of Sharjah	434,412	2,799,600
SR7	Dwellings approximately 750 m west of the F3 site	435,899	2,799,519
SR8	Dwellings approximately 550 m south west of the F3 site	436,040	2,798,836
SR9	Qidfa beach	436,742	2,797,438
SR10	Madha residential area	433,334	2,796,828

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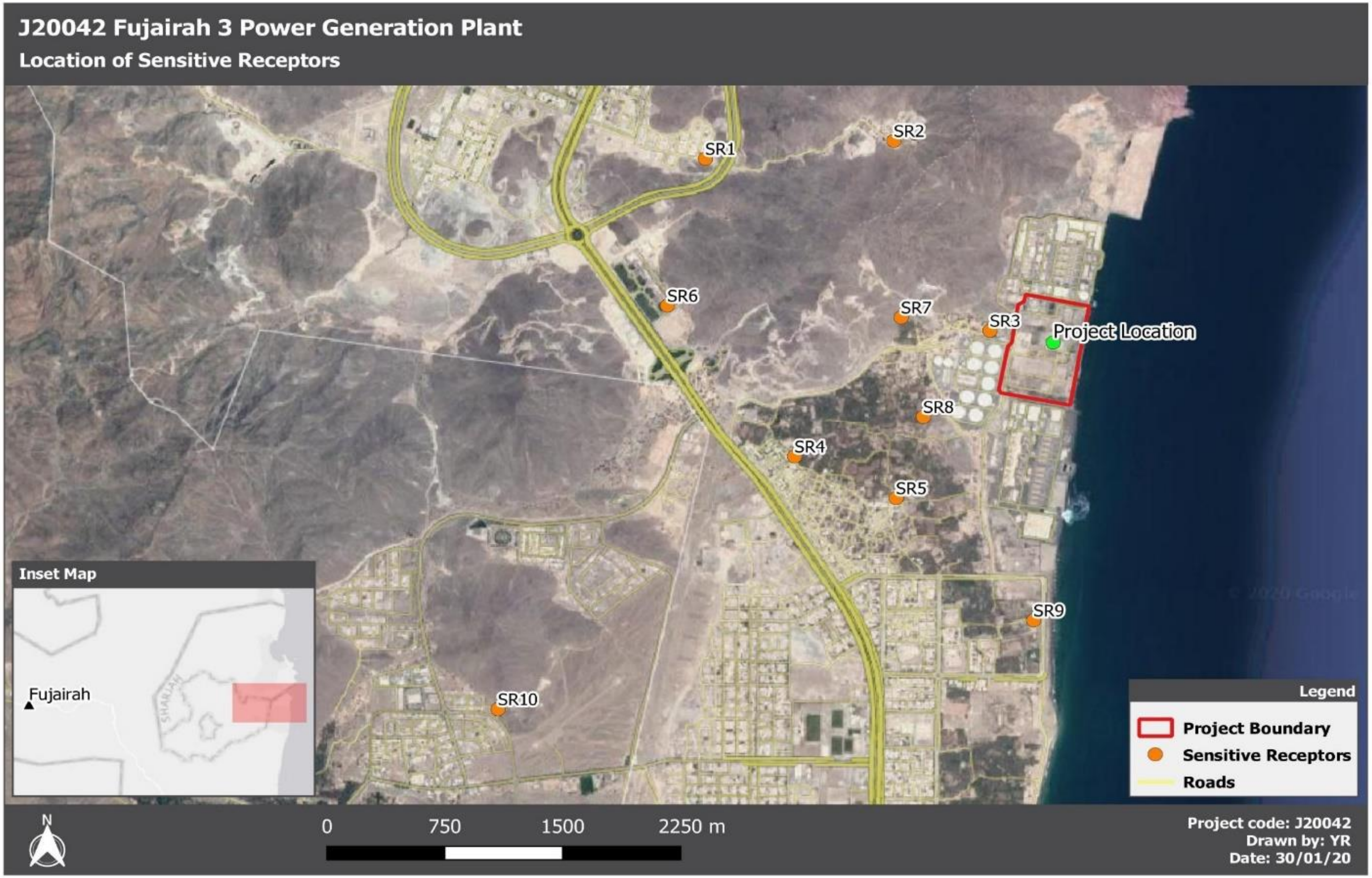

Figure 5-42: Sensitive Receptor Locations

5.2.2. Ambient Noise

Environmental components that will likely be affected by noise impact during the construction and operation of the Project include surrounding noise sensitive receptors (SRs) which have been identified within the vicinity of the Project and include residences, schools and a beach.

The locations of the SRs in relation to the Project are presented in Figure 5-43, with further details provided in Table 5-30.

Table 5-30: Sensitive receptor details, sensitivity and locations

Receptor	Site Description	Receptor Sensitivity	Universal Transverse Mercator (UTM) Coordinates	
			m E	m N
SR1	Outskirts of Khor Fakkan	*Medium-High*	434,653	2,800,609
SR2	Village south east of Khor Fakkan	*Medium-High*	435,853	2,800,732
SR3	Residential properties immediately west of the F3 site	*Medium-High*	436,464	2,799,428
SR4	Northern outskirts of Qidfa	*Medium-High*	435,221	2,798,564
SR5	North east outskirts of Qidfa	*Medium-High*	435,867	2,798,278
SR6	University of Sharjah	*High*	434,412	2,799,600
SR7	Dwellings approximately 750 m west of the F3 site	*Medium-High*	435,899	2,799,519
SR8	Dwellings approximately 550 m south west of the F3 site	*Medium-High*	436,040	2,798,836
SR9	Qidfa beach including residential housing	*Medium-High*	436,742	2,797,438
SR10	Madha residential area	*Medium-High*	433,334	2,796,828

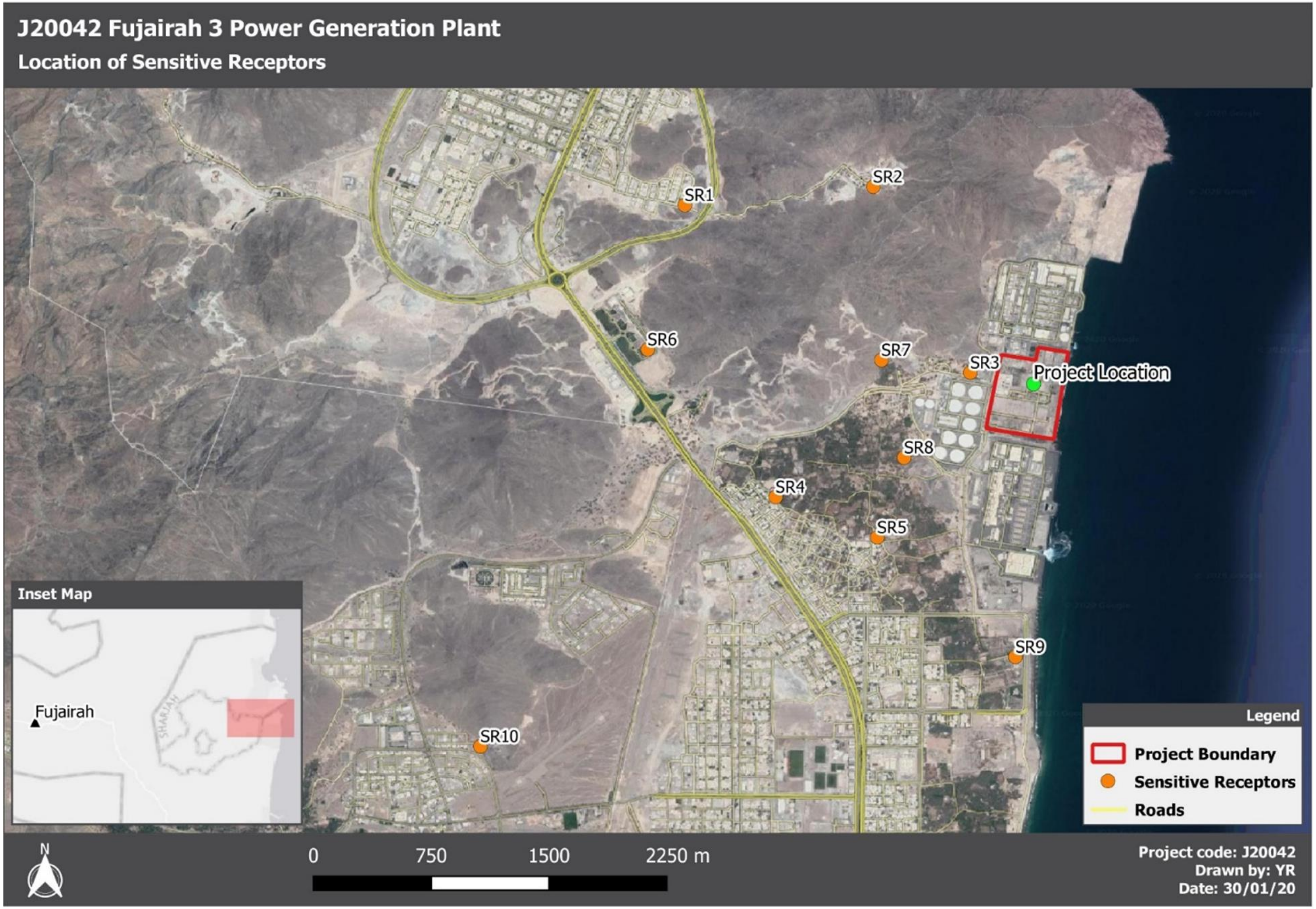

Figure 5-43: Sensitive receptor locations

5.2.3. Soil, Surface Water and Groundwater

Environmental components that will likely be affected by the construction and operation of the Project are generally limited to:

- On-site soil and groundwater impacted by soil erosion and contamination;
- The marine environment; and
- Staff.

5.2.4. Terrestrial Ecology

Due to fact that no natural habitats remain on the study area, no ecologically sensitive areas occur within or adjacent to the study area.

5.2.5. Marine Water & Sediment

Environmental components that will likely be affected by the construction and operation of the Project are generally limited to:

- Increased sedimentation due to construction activities;
- Contamination of marine water and sediment from spilled pollutants, oils and fuel;
- Impacts linked to discharge of cooling water from outfall and related increases in temperature, chlorine and salinity; and
- Marine water and sediment quality around the outfall.

5.2.6. Marine Ecology

Environmental components that will likely be affected by the construction and operation of the Project are generally limited to:

- Loss of marine habitat, due to direct construction activities related to the inlet and outfall pipelines as well as secondary impacts from sedimentation ad changes in water / sediment quality;
- Accidental collisions with marine mammals and reptiles from construction vessels;
- Addition of hard substrate habitat;
- Temperature, chlorine and salinity increases at outfall; and
- Marine fauna getting trapped or sucked into inlet pipeline.

5.2.7. Waste

Environmental components and facilities that will likely be affected by the construction and operation of the Project include:

- Pressure on waste treatment facilities;
- Contamination of soil and groundwater;
- Disturbance / Nuisance to marine ecology; and

- General nuisance (including odour) to nearby sensitive receptors and staff.

5.2.8. Socio-Economy

Environmental components & facilities that will likely be affected by the construction and operation of the Project include:

- Noise emissions;
- Air quality (Odour); and
- The marine environment.

5.2.9. Archaeology and Cultural Heritage

No evidence for archaeological or cultural heritage sites has been identified within or near the Project site. Although the risk of encountering any buried archaeological remains is low risk as the Project site has been extensively developed in the past, this cannot be definitively excluded and therefore appropriate control measures will be required.

6. IMPACTS PREDICTION AND EVALUATION

6.1. The Most Important Environmental Aspects and Impacts

Table 6-1: Construction activities and impacts

Significant Environmental Impacts	Construction Activities						
	Site Clearance & Demolition	Site Improvement	Excavation works	Site enabling works (access roads and tracks)	Foundation construction	Erection of mechanical and electrical equipment (including general construction of the plant)	Construction of offshore intake and out fall pipelines
Construction dust impacting on Sensitive Receptors	×	×	×	×	×	×	
Construction dust impacting on turbine air intakes at F1 and F2	×	×	×	×	×	×	
Vehicle exhaust emissions from construction traffic	×	×	×	×	×	×	
Exceedance of off-site noise SRs Federal/IFC limits.	×	×	×	×	×	×	
Soil erosion	×	×	×	×	×		
Mobilisation of existing Contamination	×	×	×	×	×		
Storage, use and handling of hazardous materials			×			×	
Storage and disposal of hazardous wastes			×			×	
Generation of sanitary effluents	×	×	×	×	×	×	
Disposal of washdown effluents	×	×	×	×	×	×	
Importation of fill material		×	×	×	×	×	
Groundwater contamination			×	×	×	×	
Asbestos in existing buildings and structures	×	×					
Vegetation clearing	×	×					
Landscaping and construction	×	×	×		×		
Vibration and noise disturbance	×	×	×		×	×	
Chemical pollution					×	×	
Dust deposition	×	×	×	×	×	×	
Sedimentation from construction activities							×
Spill of hazardous materials to marine environment							×
Loss of habitat							×
Collisions with marine mammals and reptiles							×
Sedimentation							×
Pressure on Waste Facilities	×	×	×	×		×	
Impacts on Surrounding Receptors due to Improper Storage and Handling of Wastes	×	×	×	×		×	
Health and Safety impacts on workers and surrounding human receptors	×	×	×	×	×	×	
Impact on terrestrial ecology	×	×	×				

Significant Environmental Impacts	Construction Activities						
	Site Clearance & Demolition	Site Improvement	Excavation works	Site enabling works (access roads and tracks)	Foundation construction	Erection of mechanical and electrical equipment (including general construction of the plant)	Construction of offshore intake and out fall pipelines
Impact on Marine ecology							×
Impact on aesthetics	×		×	×	×	×	
Impact on odour	×				×	×	
Transportation of construction and demolition waste	×	×	×	×		×	
Landscape and visual impacts	×	×	×	×	×	×	
Exposure to Asbestos in Existing Buildings and Structures	×	×					
Construction impacts on unknown buried archaeological remains	×	×	×	×	×	×	

Table 6-2: Operational activities and impacts

Significant Environmental Impacts	Operational Activities					
	Maintenance of key components	Normal operation of facility systems	Abnormal operation of facility systems	Civil works	Laboratory assessments	Security / cleaning
Increase in short and long-term ambient concentrations of PM, SO_2, NO_2, and CO (with SCR)	×	×				
Increase in short and long-term ambient concentrations of PM, SO_2, NO_2, and CO (without SCR)	×		×			
Increase in ambient concentrations of NO_2, PM, SO_2 and CO at Sensitive Receptor locations	×		×			
Exceedance of noise limit of Project boundary/industrial receptors surrounding the Project site.	×	×	×	×		
Noise impacts on sensitive receptors	×	×	×			
Operational leakages and accidental discharges	×	×	×	×	×	
Impacts to flora and fauna	×	×	×	×		
Thermal discharge		×	×			
Chlorine discharge		×	×			
Salinity discharge		×	×			
Placement of intake and outfall pipelines	×	×				
Pumping water from inlet pipeline	×	×				
Pressure on Waste Facilities	×	×	×	×	×	×
Impact on soil and groundwater	×		×	×		
Impact on marine ecology		×	×			
Impact on aesthetics		×	×			
Impact on odour		×	×			
Health and Safety impacts on workers and surrounding human receptors	×	×	×	×	×	×
Transportation of operational waste		×		×	×	×
Impacts on Local Businesses and Social Issues		×	×	×	×	
Landscape and visual impacts		×	×			
Health and safety impacts upon workers	×	×	×	×	×	×

6.2. The ESIA Matrix

The ESIA matrices for the Project are provided in Table 6-4 and Table 6-5, and have been developed to reflect the different components of the environmental impacts before and after the mitigation measures were applied. The scoring criteria from the ESIA matrices for the Project are specified in Table 6-3.

Table 6-3: Scoring criteria for the ESIA matrix

Impact Significance	Score	Criteria
Magnitude	1	Change / Effect only within the Project site
	2	Change / Effect to local conditions and/or areas immediately outside
	3	Regional / National / International change / Effect
Duration / Permanence	1	No change / Not applicable
	2	Temporary
	3	Permanent
Reversibility	1	No change / Not applicable
	2	Reversible
	3	Irreversible
Cumulative Impact	1	No change / Not Applicable
	2	Non-cumulative / Single
	3	Cumulative

Table 6-4: ESIA impact matrix prior mitigation measures

Environmental Impact	Source	Magnitude	Permanence	Reversibility	Cumulative
Construction Phase					
Construction dust impacting on Sensitive Receptors	Increase in dust emissions due to construction activities, such as equipment use and excavation work	2	2	2	3
Construction dust impacting on turbine air intakes at F1 and F2	Increase in dust emissions due to construction activities, such as equipment use and excavation work	2	2	2	3
Vehicle exhaust emissions from construction traffic	Increase in vehicle exhaust emissions due to construction vehicles	2	2	2	3
Exceedance of off-site noise SRs Federal/IFC limits.	Increase in offsite noise levels due to construction activities, such as equipment use and excavation work	2	2	2	3
Soil erosion	Loss of soil and aggregate reserves within the Project site	1	3	3	2
Mobilisation of existing Contamination	Soil and groundwater contamination from improper storage and handling causing spills and leaks	1	2	3	3
Storage, use and handling of hazardous materials		1	2	3	3
Storage and disposal of hazardous wastes		2	2	3	3
Generation of sanitary effluents	Potential for groundwater contamination as a result of improper storage, handling and processing	2	3	3	3
Disposal of washdown effluents		2	3	3	3
Importation of fill Material	Importation of contaminants to local soil and groundwater	1	3	3	3
Groundwater contamination	Contamination of local groundwater levels through construction activities	2	3	3	3
Asbestos in existing buildings and structures	Risk of the potential inhalation of asbestos fibres located within existing buildings and structures found within the Project site soil	1	3	3	2
Vegetation clearing	Loss of Vegetation and Habitat due to construction activities such a site clearing	1	3	3	2
Landscaping and construction		1	3	3	2
Vibration and noise disturbance	Disturbance to Fauna due to construction activities such vehicle movement or equipment use	1	2	2	3
Chemical pollution	Disturbance to Fauna and Flora due to construction activities such as earthwork	1	3	3	2
Dust deposition	Disturbance to Fauna and Flora due to construction activities such as vehicle movement or equipment use	1	2	2	2
Sedimentation from construction activities	Increased turbidity, metals and nutrients due to construction activities such as pipeline construction or dredging	2	2	2	3
Spill of hazardous materials to marine environment	Pollution to marine water and sediments due to paints, oils, fuels and solvents from construction activities	2	2	3	3
Loss of habitat	Loss of seagrass habitat due to construction of the inlet and outfall pipelines	1	3	3	2
Collisions with marine mammals and reptiles	Injury or death to marine fauna due to collisions with construction vessels	1	2	3	2
Sedimentation	Loss of seagrass habitat due to construction of the inlet and outfall pipelines	1	3	3	3
Pressure on Waste Facilities	Generation of construction and demolition waste	3	2	2	3
	Generation of excavation waste	3	2	2	3

Environmental Impact	Source	Magnitude	Permanence	Reversibility	Cumulative
	Generation of hazardous waste	3	2	2	3
	Generation of wastewater	3	2	2	3
Impacts on Surrounding Receptors due to Improper Storage and Handling of Wastes	Soil and groundwater contamination from improper storage and handling causing spills and leaks	1	2	3	3
Health and Safety impacts on workers and surrounding human receptors	Workforce exposure to harmful substances	1	2	3	2
	Workforce exposure to onsite asbestos & asbestos from demolition of structures containing asbestos	1	3	3	3
	Fire hazard due to flammability of some waste material	1	3	3	3
	Working outside in high temperatures and site based working hazards	1	2	2	3
	Reasonable working hours, wages and other benefits	1	2	2	3
Impact on terrestrial ecology	Improper storage and handling of waste	1	2	2	2
Impact on Marine ecology		2	2	2	3
Impact on aesthetics		1	2	2	2
Impact on odour		2	2	2	3
Transportation of construction and demolition waste	Direct / indirect impacts relating to air quality, dust and congestion resulting from waste transportation	2	2	2	2
Landscape and visual impacts	Impact of visual amenity from construction activities	1	2	2	2
Exposure to Asbestos in Existing Buildings and Structures	Demolition of existing structures and existing asbestos	1	2	3	2
Construction impacts on unknown buried archaeological remains	Disturbance to archaeological finds through excavation and groundwork	1	2	3	2
Operation Phase					
Increase in short and long-term ambient concentrations of PM, SO_2, NO_2, and CO	Increase in ambient air quality due to Operational impacts on ambient air quality with SCR	2	3	2	3
Increase in short and long-term ambient concentrations of PM, SO_2, NO_2, and CO	Increase in ambient air quality due to Operational impacts on ambient air quality without SCR	2	3	2	3
Increase in ambient concentrations of NO_2, PM, SO_2 and CO at Sensitive Receptor locations	Increase in ambient air quality due to operational impacts utilising diesel as fuel	2	2	2	3
Exceedance of noise limit of Project boundary/industrial receptors surrounding the Project site.	Increase in noise levels at site boundary and off-site receptors due to operational activities	2	2	2	3
Impact upon SR3.	Increase in off-site noise levels due to operation of noisy equipment on-site	2	2	2	3
Impact upon all other SRs	Increase in off-site noise levels due to operation of noisy equipment on-site	2	2	2	3
Operational Leakages and Accidental Discharges	Potential leaks and spills associated with the plant operations and storage of hazardous materials on-site	1	2	3	3
Impacts to Flora and Fauna	N/A	1	1	1	1

Environmental Impact	Source	Magnitude	Permanence	Reversibility	Cumulative
Thermal discharge	Increase in temperature over ambient levels due to operational discharge	2	3	2	3
Chlorine discharge	Increase in chlorine over ambient levels due to operational discharge	2	3	2	3
Salinity discharge	Increase in salinity above ambient levels due to operational discharge	2	3	2	3
Placement of intake and outfall pipelines	Provision of hard substrate habitat that can be colonised by invertebrate benthic species	1	2	2	2
Pumping water from inlet pipeline	Entrainment of faunal species	1	2	2	2
Pressure on Waste Facilities	Generation of wastewater through facility processes and operations	3	2	2	3
	Generation of solid waste through facility processes and operations	3	2	2	3
	Generation of hazardous through facility processes and operations	3	2	2	3
Impact on soil and groundwater	Improper storage and handling of waste	2	3	3	3
Impact on marine ecology		2	2	3	3
Impact on aesthetics		1	2	2	2
Impact on odour		2	2	2	3
Health and Safety impacts on workers and surrounding human receptors	Fire hazard due to flammability of some waste material	1	3	3	2
Transportation of operational waste	Direct / indirect impacts relating to air quality, dust and congestion resulting from waste transportation	2	2	2	3
Impacts on Local Businesses and Social Issues	Impact on local services such as hospitals	2	2	2	2
Landscape and visual impacts	Impact of visual amenity from operational activities	1	3	2	2
Health and safety impacts upon workers	Working outside in high temperatures and site based working hazards	1	2	3	2

Table 6-5: ESIA impact matrix following mitigation measures

Environmental Impact	Source	Magnitude	Permanence	Reversibility	Cumulative
Construction Phase					
Construction dust impacting on Sensitive Receptors	Increase in dust emissions due to construction activities, such as equipment use and excavation work	2	2	2	3
Construction dust impacting on turbine air intakes at F1 and F2	Increase in dust emissions due to construction activities, such as equipment use and excavation work	2	2	2	3
Vehicle exhaust emissions from construction traffic	Increase in vehicle exhaust emissions due to construction vehicles	2	2	2	3
Exceedance of off-site noise SRs Federal/IFC limits.	Increase in offsite noise levels due to construction activities, such as equipment use and excavation work	1	2	2	3
Soil erosion	Loss of soil and aggregate reserves within the Project site	1	3	3	2
Mobilisation of existing Contamination	Soil and groundwater contamination from improper storage and handling causing spills and leaks	1	2	3	3
Storage, use and handling of hazardous materials		1	2	3	3
Storage and disposal of hazardous wastes		2	2	3	3
Generation of sanitary effluents	Potential for groundwater contamination as a result of improper storage, handling and processing	2	3	3	3
Disposal of washdown effluents		2	3	3	3
Importation of fill Material	Importation of contaminants to local soil and groundwater	1	3	3	3
Groundwater contamination	Contamination of local groundwater levels through construction activities	2	3	3	3
Asbestos in existing buildings and structures	Risk of the potential inhalation of asbestos fibres located within existing buildings and structures found within the Project site soil	1	3	3	2
Vegetation clearing	Loss of Vegetation and Habitat due to construction activities such a site clearing	1	3	3	2
Landscaping and construction		1	3	3	2
Vibration and noise disturbance	Disturbance to Fauna due to construction activities such vehicle movement or equipment use	1	2	2	3
Chemical pollution	Disturbance to Fauna and Flora due to construction activities such as earthwork	1	3	3	2
Dust deposition	Disturbance to Fauna and Flora due to construction activities such as vehicle movement or equipment use	1	2	2	2
Sedimentation from construction activities	Increased turbidity, metals and nutrients due to construction activities such as pipeline construction or dredging	2	2	2	3
Spill of hazardous materials to marine environment	Pollution to marine water and sediments due to paints, oils, fuels and solvents from construction activities	2	2	3	3
Loss of habitat	Loss of seagrass habitat due to construction of the inlet and outfall pipelines	1	3	3	2
Collisions with marine mammals and reptiles	Injury or death to marine fauna due to collisions with construction vessels	1	2	3	2
Sedimentation	Loss of seagrass habitat due to construction of the inlet and outfall pipelines	1	3	3	3
Pressure on Waste Facilities	Generation of construction and demolition waste	3	2	2	3
	Generation of excavation waste	3	2	2	3

Environmental Impact	Source	Magnitude	Permanence	Reversibility	Cumulative
	Generation of hazardous waste	3	2	2	3
	Generation of wastewater	3	2	2	3
Impacts on Surrounding Receptors due to Improper Storage and Handling of Wastes	Soil and groundwater contamination from improper storage and handling causing spills and leaks	1	2	3	3
Health and Safety impacts on workers and surrounding human receptors	Workforce exposure to harmful substances	1	2	3	2
	Workforce exposure to onsite asbestos & asbestos from demolition of structures containing asbestos	1	3	3	3
	Fire hazard due to flammability of some waste material	1	3	3	3
	Working outside in high temperatures and site based working hazards	1	2	2	3
	Reasonable working hours, wages and other benefits	1	2	2	3
Impact on terrestrial ecology	Improper storage and handling of waste	1	2	2	2
Impact on Marine ecology		2	2	2	3
Impact on aesthetics		1	2	2	2
Impact on odour		1	2	2	3
Transportation of construction and demolition waste	Direct / indirect impacts relating to air quality, dust and congestion resulting from waste transportation	2	2	2	2
Landscape and visual impacts	Impact of visual amenity from construction activities	1	2	2	2
Exposure to Asbestos in Existing Buildings and Structures	Demolition of existing structures and existing asbestos waste	1	2	3	2
Construction impacts on unknown buried archaeological remains	Disturbance to archaeological finds through excavation and groundwork	1	2	3	2
Operation Phase					
Increase in short and long-term ambient concentrations of PM, SO_2, NO_2, and CO	Increase in ambient air quality due to Operational impacts on ambient air quality with SCR	2	3	2	3
Increase in short and long-term ambient concentrations of PM, SO_2, NO_2, and CO	Increase in ambient air quality due to Operational impacts on ambient air quality without SCR	2	3	2	3
Increase in ambient concentrations of NO_2, PM, SO_2 and CO at Sensitive Receptor locations	Increase in ambient air quality due to operational impacts utilising diesel as fuel	2	2	2	3
Exceedance of noise limit of Project boundary/industrial receptors surrounding the Project site.	Increase in noise levels at site boundary and off-site receptors due to operational activities	1	2	2	3
Impact upon SR3.	Increase in off-site noise levels due to operation of noisy equipment on-site	1	2	2	3
Impact upon all other SRs	Increase in off-site noise levels due to operation of noisy equipment on-site	1	2	2	3
Operational Leakages and Accidental Discharges	Potential leaks and spills associated with the plant operations and storage of hazardous materials on-site	1	2	3	3
Impacts to Flora and Fauna	N/A	1	1	1	1

Environmental Impact	Source	Magnitude	Permanence	Reversibility	Cumulative
Thermal discharge	Increase in temperature over ambient levels due to operational discharge	2	3	2	3
Chlorine discharge	Increase in chlorine over ambient levels due to operational discharge	2	3	2	3
Salinity discharge	Increase in salinity above ambient levels due to operational discharge	2	3	2	3
Placement of intake and outfall pipelines	Provision of hard substrate habitat that can be colonised by invertebrate benthic species	1	2	2	2
Pumping water from inlet pipeline	Entrainment of faunal species	1	2	2	2
Pressure on Waste Facilities	Generation of wastewater through facility processes and operations	3	2	2	3
	Generation of solid waste through facility processes and operations	3	2	2	3
	Generation of hazardous through facility processes and operations	3	2	2	3
Impact on soil and groundwater	Improper storage and handling of waste	2	3	3	3
Impact on marine ecology		2	2	3	3
Impact on aesthetics		1	2	2	2
Impact on odour		1	2	2	3
Health and Safety impacts on workers and surrounding human receptors	Fire hazard due to flammability of some waste material	1	3	3	2
	Working outside in high temperatures and site based working hazards	1	2	3	2
Transportation of operational waste	Direct / indirect impacts relating to air quality, dust and congestion resulting from waste transportation	2	2	2	3
Impacts on Local Businesses and Social Issues	Impact on local services such as hospitals	2	2	2	2
Landscape and visual impacts	Impact of visual amenity from operational activities	1	3	2	2

6.3. Impact Assessment

6.3.1. Ambient Air Quality

6.3.1.1. Air Quality Impact Assessment Criteria

6.3.1.1.1. Construction Phase

6.3.1.1.1.1. Receptor Sensitivity

The receptor sensitivity for the construction phase assessment accounts for the number of potentially affected receptors (Table 6-6), where a single receptor is represented as a dwelling or cluster of inhabited dwellings.

Table 6-6: Human Receptor Sensitivity

Number of Receptors Potentially Impacted	Receptor Sensitivity
>10	High
5-10	Medium High
1-5	Low

6.3.1.1.1.2. Dust Emissions

As dust emissions are primarily associated with nuisance impacts at nearby receptors, a qualitative assessment of dust emissions during construction related activities has been undertaken.

The significance of dust impacts is largely dependent on wind direction, rainfall and distance from point of emission, as dust formation is considered low during wet and calm periods. The US EPA states that precipitation of greater than 0.2 mm/h will affectively attenuate dust and wind speeds of >5.3 m/s are typically required to lift dust from open surfaces (47). This will be lower for dust generated by mechanical means (i.e. during excavation and due to the movement of vehicles over unpaved surfaces), at around 3 m/s (47). The assessment criteria that is presented below is based on the following key points:

- At all but the most extreme wind speeds, dust will typically travel a maximum of 200 m from source before falling from the air column;
- At the highest wind speeds, dust is unlikely to travel more than 500 m from source; and
- Precipitation will effectively attenuate dust, with rainfall of >0.2 mm/h likely to effectively minimise dust emissions.

In order to assess the potential impact for significant dust nuisance to arise from the construction phase, the matrix detailed in Table 6-7 has been developed.

Table 6-7: Air Quality Impact Severity (Construction)

Impact Severity	Impact Criteria
No Change / Slight	– Dust generating activities for <12 months – Receptor > 500 m from dust source – Downwind for <2 percent of the year where wind and rainfall conditions promote dust generation
Low	– Dust generating activities for >12 months – Receptor between 200 m to 500m from dust source – Downwind for 2-5 percent of the year where wind and rainfall conditions promote dust generation
Medium	– Dust generating activities for >12 months – Receptor within 200 m of dust source – Downwind for between 5 and 10 percent of the year where wind and rainfall conditions promote dust generation
High	– Dust generating activities for >12 months – Receptor within 200 m of dust source – Downwind for >10 percent of the year where wind and rainfall conditions promote dust generation

6.3.1.1.2. Operational Phase

6.3.1.1.2.1. Receptor Sensitivity

The sensitivity of human receptors is defined as outlined in Table 6-8.

Table 6-8: Receptor Sensitivity

Sensitivity	Human Receptors
Negligible	N/A
Low	Uninhabitable Areas
Medium High	General Population
High	Vulnerable Populations (hospitals, old age homes, kindergartens)

6.3.1.1.2.2. Impact Severity

The impact severity is assessed as a percentage of the AAQS outlined in Table 6-9. Note that for ease of reference, a ‘traffic light’ colour-coding system has been adopted. This enables a quick identification of the Project’s contribution towards the attainment of the AAQS.

Table 6-9: Air Quality Impact Assessment Impact Severity Descriptors

Impact Severity	Significance Criteria
Insignificant	The Project Contribution is less than 10% of the AAQS
Slight	The Project Contribution is more than 10% but less than 25% of the AAQS
Low	Project Contribution greater than 25% but less than 50% of AAQS
Medium	Project contribution greater than 50% but less than 100% of AAQS
High	Project contribution greater than 100% of AAQS

6.3.1.2. Construction Phase Impact Assessment

6.3.1.2.1. Construction Related Dust

Impacts associated with nuisance dust and fine particulate matter from construction related activities are unlikely to occur at locations approximately 200 – 500 m from the Project, except in the most extreme weather conditions. Precipitation quantities greater than 0.2 mm/hour will attenuate dust and wind speeds less than 5.3 m/s are unlikely to lift dust (47). Based on available data, the maximum rainfall on a single day in Fujairah was estimated to be 10 mm/day (48), with the wetter season extending from November to the end of March. The average rainfall reduces to almost 0 mm during the driest parts of the dry season (April to early November). Natural precipitation is therefore unlikely to attenuate construction-related dust.

Receptors located within 500m of the site boundary include dwellings located nearby (SR3 and SR8), which are located on the west and south west side of the facility. In addition, the turbine air intakes for Fujairah 1 and 2 would also be considered as receptors during the construction phase, as high dust concentrations can be particularly challenging for turbine filter systems. Figure 6-1 shows the location of the sensitive receptors, in addition to the daytime windrose, with wind speeds exceeding dust lift-off threshold of 5.3 m/s.

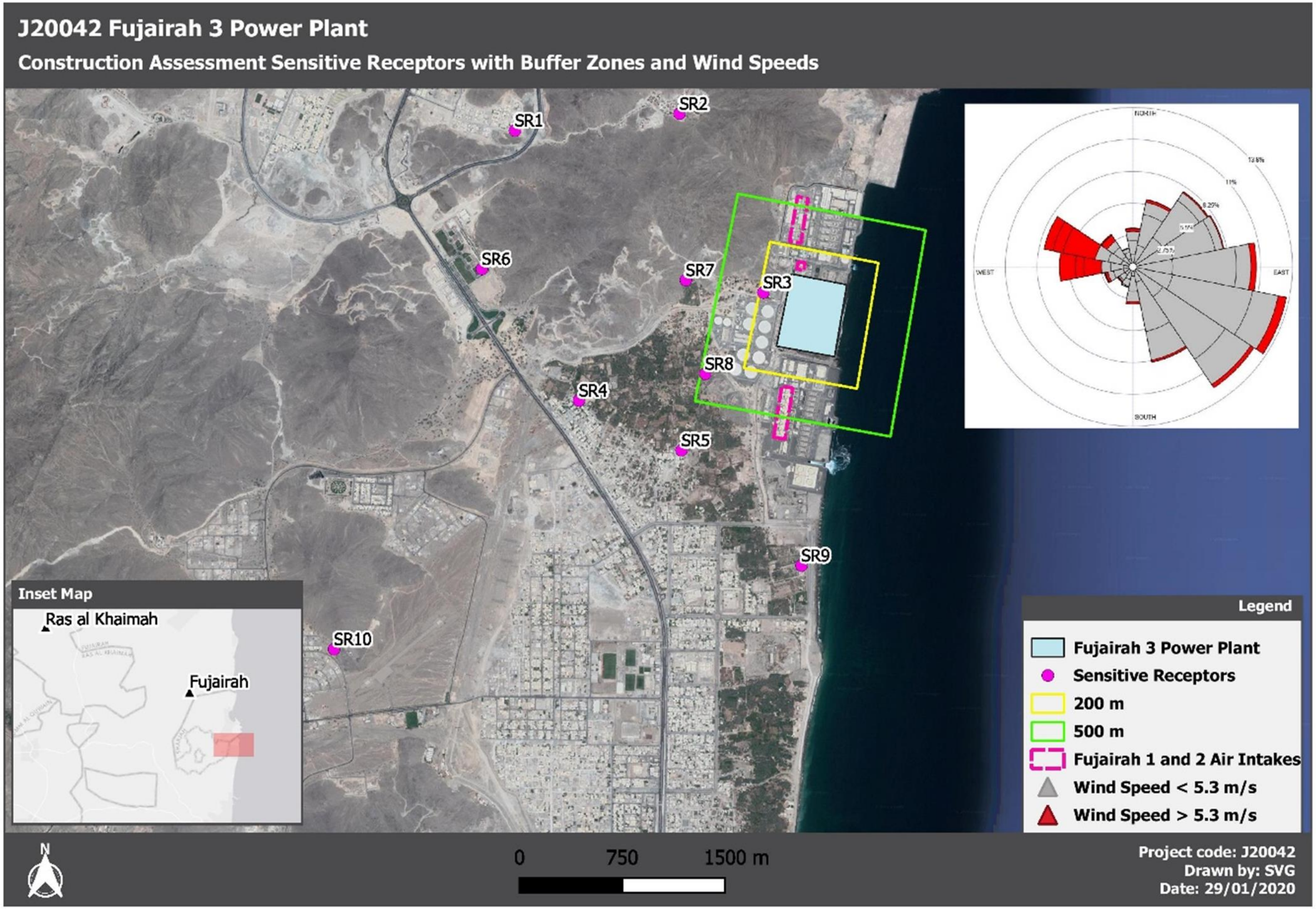

Figure 6-1: Construction Assessment Buffer Zones and Daytime Wind Direction

Table 6-10 shows the average direction wind (blowing from) and the percentage of the time when wind speeds exceed the threshold of 5.3 m/s (2016 – 2018), extracted from prognostic meteorological data.

Table 6-10: Summary of Wind Speed

Wind Direction (blowing from)	N	NE	E	SE	S	SW	W	NW
Percentage (%) of year with wind speed >5.3 m/s	0.50	0.24	0.58	0.54	0.27	0.25	12.98	2.83
Wind speed unlikely to result in dust generation (percentage (%) of the year)	81.81							

Analysis of wind speeds indicate that majority of the time, windspeeds are likely to be below the threshold for dust lift off (81.81% of the year). Dust generated from construction related activities for the remainder of the year (18.19%) will move to the east and south-east of the facility based on the predominant wind direction, where SR3 and SR8 are located. It should be noted that whilst the vehicle access to and from the construction site has not yet been finalised, the roads are currently unpaved in the vicinity of SR3 and SR7, hence if this routing is selected along the base of the mountain range, vehicle track out (dust) represents a potential negative impact for these receptors. The predicted impact upon the nearest sensitive receptors – SR3 and SR8 - is considered to be an impact of low severity upon a receptor of high sensitivity. This impact is therefore predicted to be of **moderate negative** significance in the absence of mitigation measures.

In terms of the turbine air intakes for Fujairah 1 and 2, these are located to the north and south of the Project site. The nearest turbine air intake at Fujairah 1 is located at approximately 80m from the Project boundary, whilst the nearest air intake at Fujairah 2 is located approximately 250m from the Project boundary. Winds exceeding the 5.3 m/s threshold blowing from the Project site to Fujairah 1 are expected to occur approximately 0.27% of the time, whilst winds blowing from the Project site to Fujairah 2 are expected to occur 0.5% of the time. The impact upon the turbine air intakes for Fujairah 1 and 2 would be considered to be an impact of medium severity, although this is conservative as the percentage time that the F1 and F2 facilities will be down wind is well below 5%. It is assumed that the filtration systems for F1 and F2 would have been designed to meet the high naturally levels of dust in the region, hence sensitivity has been subjectively assessed as medium. The predicted impact is therefore of **minor negative significance** in the absence of mitigation measures.

6.3.1.2.2. Equipment and Vehicle Emissions

The predicted quantities of construction vehicle emissions have been estimated using internationally recognised emission factors (including the United States Environmental Protection Agency (US EPA) Non-road Engine and Vehicle Emissions Study (NEVES)) (49). The NEVES approach provides approximated emissions for a comprehensive list of construction equipment items based on an expected usage and distance travelled over the course of the given construction period. While details of the construction equipment inventory for the Project is not definitively known, a preliminary inventory of equipment list for the project has been used to conservatively approximate the emissions due to construction activity.

The emissions arising from equipment and vehicle operation have been quantified to the extent reasonably possible and are presented within Table 6-11.

Table 6-11: Air Emissions Estimates during Peak Construction Year

Equipment	No. of Units	Emissions (tonnes/year)				
		CO	HC	NO_x	SO_x	PM_{10}
Excavators	5	6.28	0.86	12.98	1.12	1.23
Cranes	16	17.21	5.30	42.20	3.81	4.19
Off-highway Trucks	10	18.07	5.57	50.35	5.74	3.67
Loaders	5	5.01	0.90	10.74	0.90	0.96
Trailers/Loaders/Backhoes	3	2.07	0.44	3.08	0.26	0.32
Crawler Tractors	2	1.99	0.54	4.27	0.35	0.46
Aerial Lifts	1	0.34	0.09	0.79	0.05	0.06
TOTAL	42	**50.97**	**13.69**	**124.44**	**12.24**	**10.66**

Construction emissions will arise over a relatively large geographical area for the entire construction period, hence any deterioration in air quality is expected to be minor and transient. Previous experience of assessing the exhaust emissions from on-site plant activities and site traffic suggests that they are unlikely to make a significant impact on local air quality (50). The impact severity is therefore assessed as representing no change, which would impact upon a receptor of high sensitivity (residential areas). The impact is therefore predicted to be of **negligible** significance.

6.3.1.2.3. Summary of Construction Impacts

A summary of the construction phase impact assessment is provided in Table 6-12 and has been undertaken in accordance with the impact severity criteria outlined in Table 6-7.

Table 6-12: Construction Phase impacts and potential mitigation measures

Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
Construction dust impacting on Sensitive Receptors	Low	High*	Moderate Negative
Construction dust impacting on turbine air intakes at F1 and F2	Medium**	Medium***	Minor Negative
Vehicle exhaust emissions from construction traffic	No change	High	Negligible

6.3.1.3. Operational Phase Impact Assessment

In order to determine the potential impacts to air quality, an Air Dispersion Modelling (ADM) assessment was undertaken. The full report is provided as **Appendix 2.2,** while an overview of the modelling methodology, emission sources, inventory and results have been presented in the sections below.

6.3.1.3.1. Assessment Methodology Overview

In order to estimate Ground Level Concentrations (GLCs) for each study pollutant associated with the operational phase traffic, an ADM study has been undertaken using Lakes CALPUFF-View (V 8.6.1) software package.

CALPUFF is a multi-layer, multi-species non-steady-state puff dispersion modelling system that simulates the effects of time-and space-varying meteorological conditions on pollutant transport, transformation, and removal. The main components of the CALPUFF modelling system are CALMET (a diagnostic 3-dimensional meteorological model), CALPUFF (an air quality dispersion model), and CALPOST (a post processing package).

The CALPUFF model was selected for this air quality impact assessment based on the model's ability to account for the coastal effects, and the complex terrain/topography surrounding the facility.

6.3.1.3.2. Contextualisation Regarding the Application of Ambient Air Quality Standards

It should be noted that predicted concentrations, in the short-term, are subject to high variability during the year, being dependent on specific local meteorological conditions. Consequently, exceedances of short term air quality guideline values are often linked to adverse meteorological conditions that may not occur often over the course of a year (e.g. calm winds, stable atmospheric conditions). To account for rare conditions that may result in short-term exceedances, many regulatory regimes (for example the EU) allow for a certain number of exceedances per year for short-term standards. Following international precedents, a certain number of hourly/daily exceedances predicted in the modelling would be excluded from consideration. In particular the European Directive 2008/50/EC on Ambient Air Quality sets a more stringent 1 hour NO_2 numerical concentration limit than provided in UAE Federal Law, but allows for the following exceedances per calendar year:

- NO_2 1-hour concentration, limit of 200 µg/m^3 (as opposed to the federal limit of 400 µg/m^3) not to be exceeded more than 18 times a calendar year.

When analysing the one-hour NO_2 results, which is the primary pollutant of concern, the maximum result has been presented and compared against national standards as maximum values and against the EU standards using the 99.79th percentile (or 18 exceedances). This provides additional context around the results to account for outliers and results which are influenced by infrequent meteorological conditions.

6.3.1.3.3. Stack Height Analysis

The stack height optimisation undertaken by Mott MacDonald based on modelled annual average ground level concentrations (GLC) (which are most critical for long term evaluation of an airshed), demonstrates that the benefits of a 70m stack over a 60m stack are marginal (less the 0.2 micrograms /m^3) which is appreciably lower than the uncertainty associated with dispersion models. This study is presented in **Appendix 2.1**.

This study has demonstrated that there are marginal (if any) benefits associated with a 70m stack versus a 60m stack and based upon this a thorough evaluation of the 60m stack height has been considered as part of this ESIA utilizing the Lakes CALPUFF-View (V 8.6.1) software package. This evaluation was comprehensive in nature and includes consideration of the impacts of "coastal effects" and topography which is considered to be an important factor within the Project site area.

The model data for the 60m stack demonstrate that when outlier values are accounted for (as per the EU ambient air quality standards) the 60m stack is adequate for dispersion of pollutants, prevention of community health issues and is not visually intrusive for the local population, which is also an important factor when considering stack height.

6.3.1.3.4. Model Scenarios

The modelled results and discussions for all the above-mentioned scenarios are presented in the section below. The results have been compared against both the Federal ambient air quality standards, the specific Project Standards, in addition to the EU ambient air quality standards. The major background stationary emission sources (F1 and F2) relating to the key pollutants of concern are accounted for and explicitly modelled within the air dispersion modelling study. The measured background concentrations from the Fujairah Municipality have also been added to the modelled data.

6.3.1.3.4.1. Scenario 1 – Baseline

This scenario presents the existing F1 and F2 powerplants operating on natural gas under normal operating conditions. The modelled results were assessed against the Federal standards in Table 6-13. These results indicate an exceedance of the standard for NO_2 for the 1 hour averaging period (refer to Figure 6-2 for the isopleth), whilst compliance is expected for the 24-hour averaging period. Assessment of the NO_2 results at the SRs (**Appendix 2.2**) show exceedances of the 1-hour AAQS at 2 SRs (SR8 and SR9). The CO model values indicated compliance for all averaging periods at all locations. Note that the exceedance contours for Figure 6-2 are not visible, as the high values only occur at a few isolated receptors (interpolation not visible at this scale).

It should be noted that predicted concentrations, in the short-term, are subject to high variability during the year, being dependent on specific local meteorological conditions. Consequently, exceedances of short-term air quality guideline values are often linked to adverse meteorological conditions that may not occur often over the course of a year (e.g. calm winds, stable atmospheric conditions).

To account for rare conditions that may result in short-term exceedances, many regulatory regimes (for example the EU) allow for a certain number of exceedances per year for short-term standards. The results taking into account the number of exceedances permitted by the European Union (EU) AAQA are presented in Table 6-14 for the model maximum, and in **Appendix 2.2** for the SRs. These results show predicted compliance for all averaging periods for all pollutants. Figure 6-3 below shows the NO_2 1 hour averaging period isopleth for the EU standards.

Table 6-13: Scenario 1 Results for Federal Standards

Pollutant	Averaging Period	Federal AAQS (µg/m³)	Model Results (µg/m³)	Background Concentration (µg/m³)	Cumulative Results (µg/m³)	Model Results % of Federal Standard	Below Federal Standard?
NO_2	1 Hour	400	787.17	54.57	841.74	196.79	No
	24 Hour	150	63.50	54.57	118.07	42.33	Yes
CO	1 Hour	30,000	1,984.60	1,568.48	3,553.08	6.62	Yes
	8 Hour	10,000	406.46	1,568.48	1,974.94	4.06	Yes

Table 6-14: Scenario 1 Results for EU Standards

Pollutant	Averaging Period	EU AAQS(µg/m3)	Permitted Exceedances as per EU AAQS	Model Results (µg/m³)	Background Concentration (µg/m³)	Cumulative Results (µg/m³)	Model Results % of EU Standard	Below EU Standard?
NO_2	1 Hour	200	18	107.83	54.57	162.40	53.92	Yes
	Annual	40	-	5.49	27.29	32.78	13.73	Yes
CO	8 Hour	10,000	-	406.46	1,568.48	1,974.94	4.06	Yes

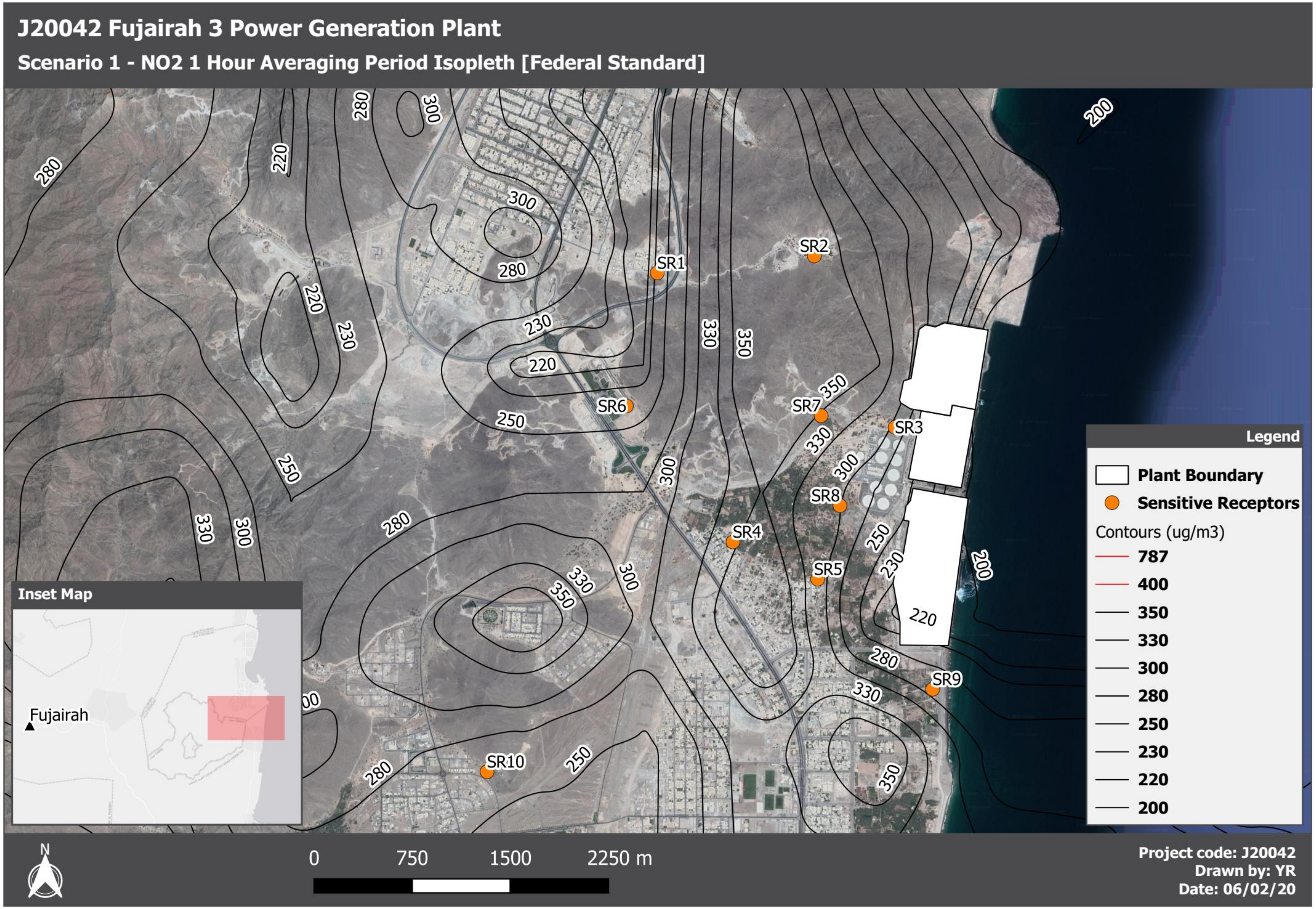

Figure 6-2: Scenario 1 NO_2 1-hour Isopleths (Federal Standard)

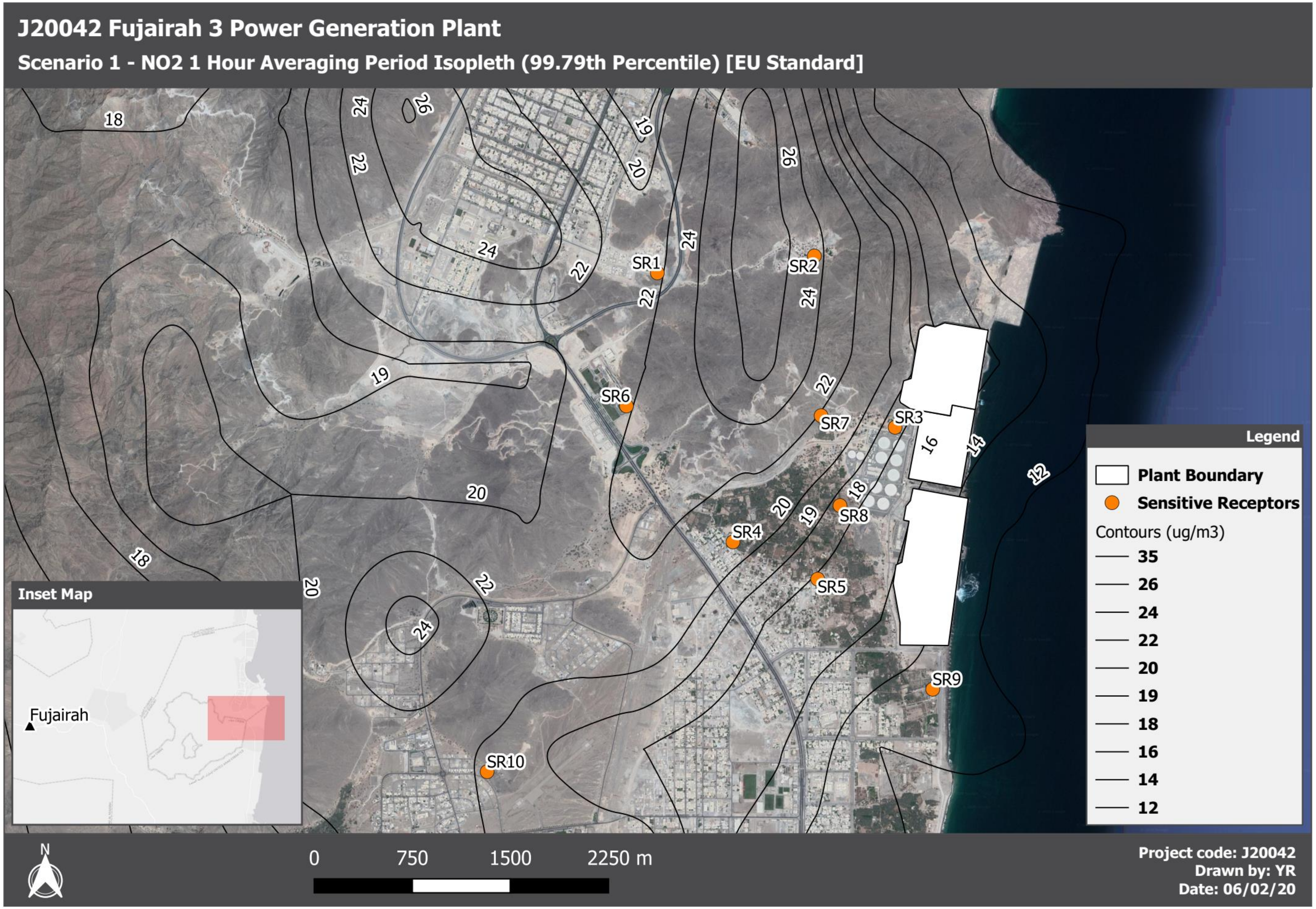

Figure 6-3: **Scenario 1 NO_2 1 Hour Isopleths (EU Standard)**

6.3.1.3.4.2. Scenario 2 A – Normal Operations of F3 in Isolation with Selective Catalytic Reduction (SCR)

This scenario presents normal continuous operations of the Project (F3) in isolation, with natural gas as the fuel and the inclusion of a Selective Catalytic Reduction (SCR) unit. SCR is a means of converting nitrogen oxides, also referred to as NOx with the aid of a catalyst into diatomic nitrogen, and water. A gaseous reductant, typically anhydrous ammonia or aqueous ammonia is added to the flue gas and is adsorbed onto a catalyst. The NOx emission limit for this scenario is 20 mg/Nm^3.

This case also considers the Project NO_2 1-hour ambient standard of 200 mg/Nm^3, which has been set by the Project Owner, EWEC. The results presented in Table 6-15 show that both the NO_2 and CO modelled results for all relevant averaging periods are below the Federal and Project specific standards, with the exception of the comparison against the NO_2 1 hour Project standard. All maximum GLCs, with the exception of the NO_2 1-hour averaging period were found to be less than 25 % of the federal standard. The SR results in **Appendix 2.2** and Figure 6-4 show that concentrations at all SRs are expected to be complaint with both the Federal and Project standards. The modelled result was predicted however to be in excess of 25% of the AAQS at 6 SRs (SR2, SR4, SR5, SR6, SR7 and SR8) for NO_2 for the 1-Hour averaging period.

The assessment against the EU standards was undertaken to account for rare meteorological conditions that may result in short-term exceedances of the standards. The model predicted values (Table 6-16), indicate that all pollutant concentrations are expected to be below the AAQS and less than 25 % of the standard. As depicted in **Appendix 2.2** this was also the case at all SR's for all averaging periods. Figure 6-5 below shows the NO_2 1 hour averaging period isopleths for the EU standards.

Table 6-15: Scenario 2A Results for Federal and Project Standards

Pollutant	Averaging Period	Federal AAQS (μg/m³)	Project Standards (μg/m³)	Results (μg/m³)	% of Federal Standard	< 25% of the Federal Standard	Below Federal Standard?	Below Project Standard?
NO_2	1 Hour	400	200	283	70.73	No	Yes	No
	24 Hour	150	-	18.8	12.53	Yes	Yes	-
CO	1 Hour	30,000	-	1422.10	4.74	Yes	Yes	-
	8 Hour	10,000	-	273.15	2.73	Yes	Yes	-
PM_{10}	24 Hour	150	-	1.89	1.26	Yes	Yes	-

Table 6-16: Scenario 2A Results for EU Standards

Pollutant	Averaging Period	EU AAQS(μg/m³)	Permitted Exceedances as per EU AAQS	Results (μg/m³)	% of EU Standard	< 25% of the EU Standard	Below EU Standard?
NO_2	1 Hour	200	18	39.11	19.55	Yes	Yes
	Annual	40	-	1.53	3.81	Yes	Yes
CO	8 Hour	10,000	-	273.15	2.73	Yes	Yes
PM_{10}	24 Hour	50	35	0.33	0.66	Yes	Yes
	Annual	40	-	0.11	0.28	Yes	Yes
$PM_{2.5}$	Annual	25	-	0.11	0.44	Yes	Yes

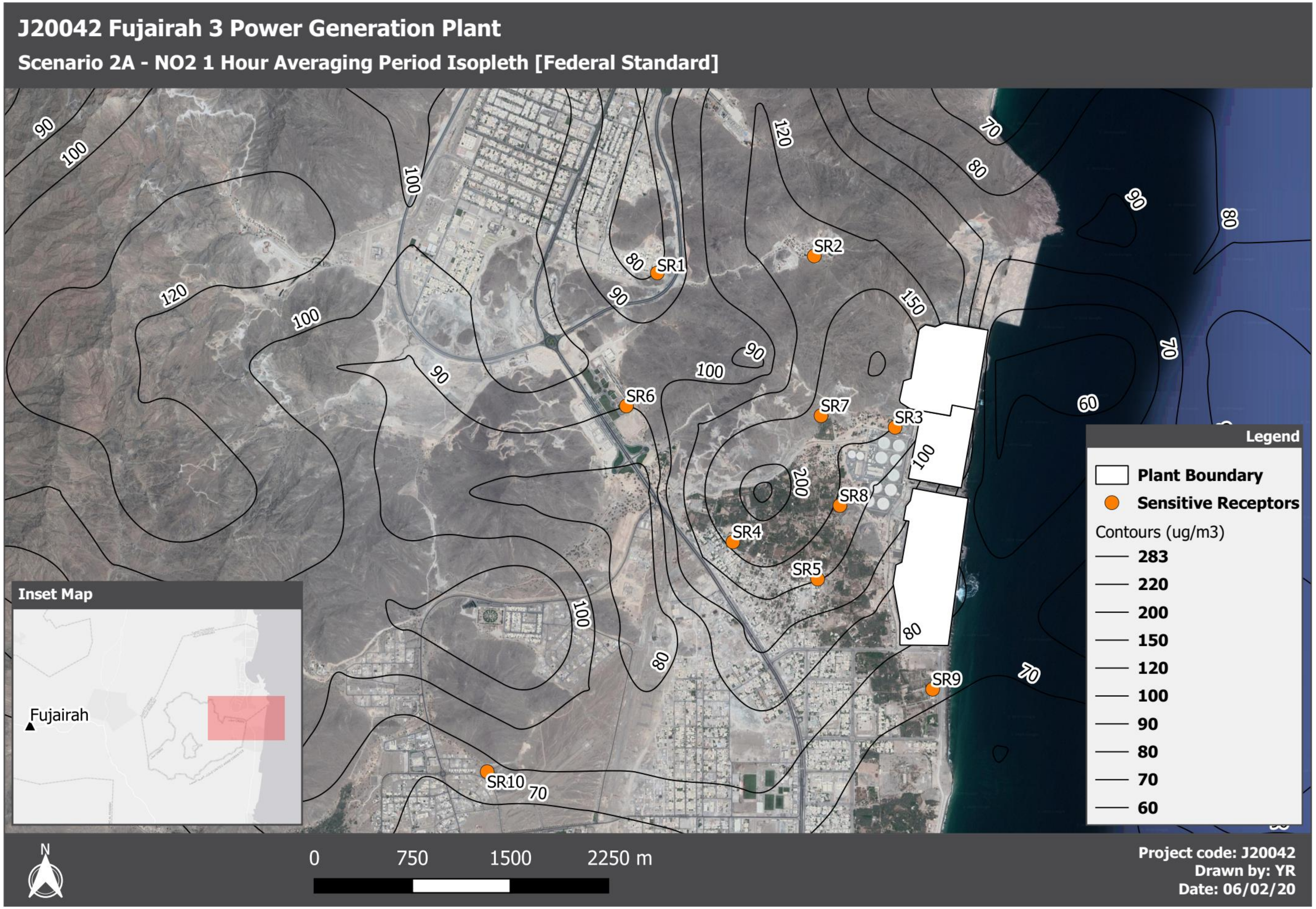

Figure 6-4: Scenario 2A NO_2 1 Hour Isopleths (Federal Standard)

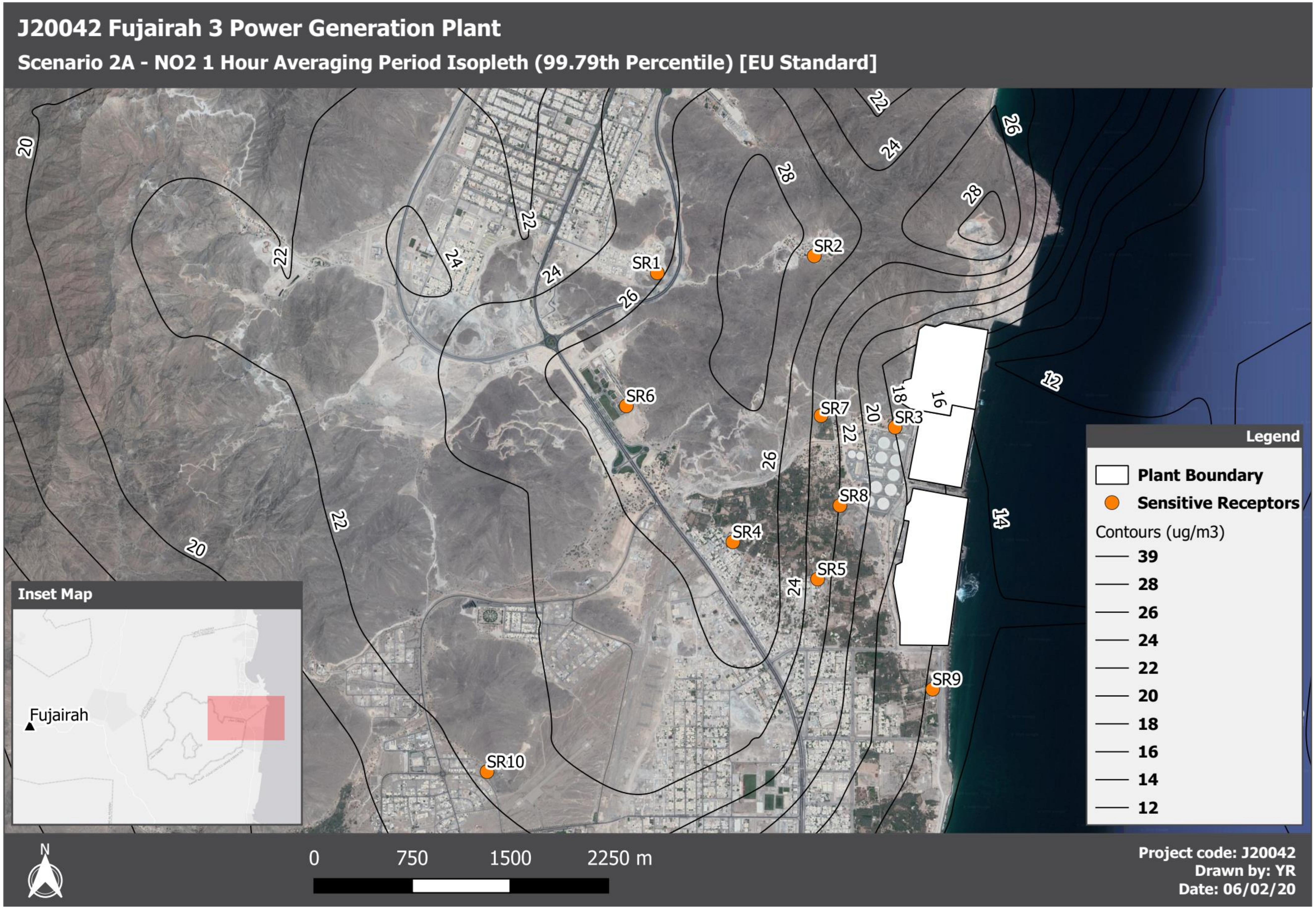

Figure 6-5: Scenario 2A NO_2 1 Hour Isopleths (EU Standard)

6.3.1.3.4.3. Scenario 2B – Normal Operations of F3 with SCR including baseline (F1 and F2)

This scenario considers the cumulative impacts from F1, F2 and F3, with the inclusion of an SCR unit at F3 with a NOx emission limit of 20 mg/Nm^3. The results presented in Figure 6-6 and Figure 6-7 indicate that the modelled concentrations for the NO_2 1-hour averaging periods are expected to be above the Federal standards, whilst CO and PM_{10} are expected to be compliant with the Federal standards. In terms of SR results (**Appendix 2.2**), the model values are expected to exceed the NO_2 1 hour Federal standards at 3 locations (SR7, SR8 and SR9). Results for all other averaging periods and pollutants are expected to be below the relevant standards. The cumulative results, which included the addition of the measured air quality baseline data, showed the same trend as the modelled results for all pollutants and averaging periods. With the addition of background data to the model results, the NO_2 1 hour standard may be exceeded at SR2, SR6-SR10, while sensitive receptor results for all other pollutants are expected to be below the standards.

It should be noted that predicted concentrations, in the short-term, are subject to high variability during the year, being dependent on specific local meteorological conditions. Consequently, exceedances of short term air quality guideline values are often linked to adverse meteorological conditions that may not occur often over the course of a year (e.g. calm winds, stable atmospheric conditions).

The results in Table 6-18 and **Appendix 2.2** show the comparison against the EU standards, taking into account the permitted number of exceedances to account for rare conditions that may result in short-term exceedances. No exceedances of the standards for any of the pollutants for any of the averaging periods were observed. Figure 6-7 below shows compliance of the NO_2 1 hour averaging period for the EU standards. The cumulative assessment (addition of baseline) yielded the same conclusions in that there are no predicted exceedances of the standards for any of the pollutants for all averaging periods. The results at sensitive receptor locations were also predicted to be below the relevant EU standards for all pollutants.

Table 6-17: Scenario 2B Results for Federal Standards

Pollutant	Averaging Period	Federal AAQS (µg/m³)	Model Results (µg/m³)	Background Concentration (µg/m³)	Cumulative Results (µg/m³)	Model Results % of Federal Standard	Below Federal Standard?
NO_2	1 Hour	400	846.12	54.57	900.69	211.53	No
	24 Hour	150	69.68	54.57	124.25	46.45	Yes
CO	1 Hour	30,000	2,226.00	1,568.48	3,794.48	7.42	Yes
	8 Hour	10,000	504.64	1,568.48	2,073.12	5.05	Yes
PM_{10}	24 Hour	150	1.89	-	1.89	1.26	Yes

Table 6-18: Scenario 2B Results for EU Standards

Pollutant	Averaging Period	EU AAQS(µg/m³)	Permitted Exceedances as per EU AAQS	Model Results (µg/m³)	Background Concentration (µg/m³)	Cumulative Results (µg/m³)	Below EU Standard?
NO_2	1 Hour	200	18	135.09	54.57	189.66	Yes
	Annual	40	-	6.75	27.29	34.04	Yes
CO	8 Hour	10,000	-	504.64	1,568.48	2,073.12	Yes
PM_{10}	24 Hour	50	35	0.33	-	0.33	Yes
	Annual	40	-	0.11	-	0.11	Yes
$PM_{2.5}$	Annual	25	-	0.11	-	0.11	Yes

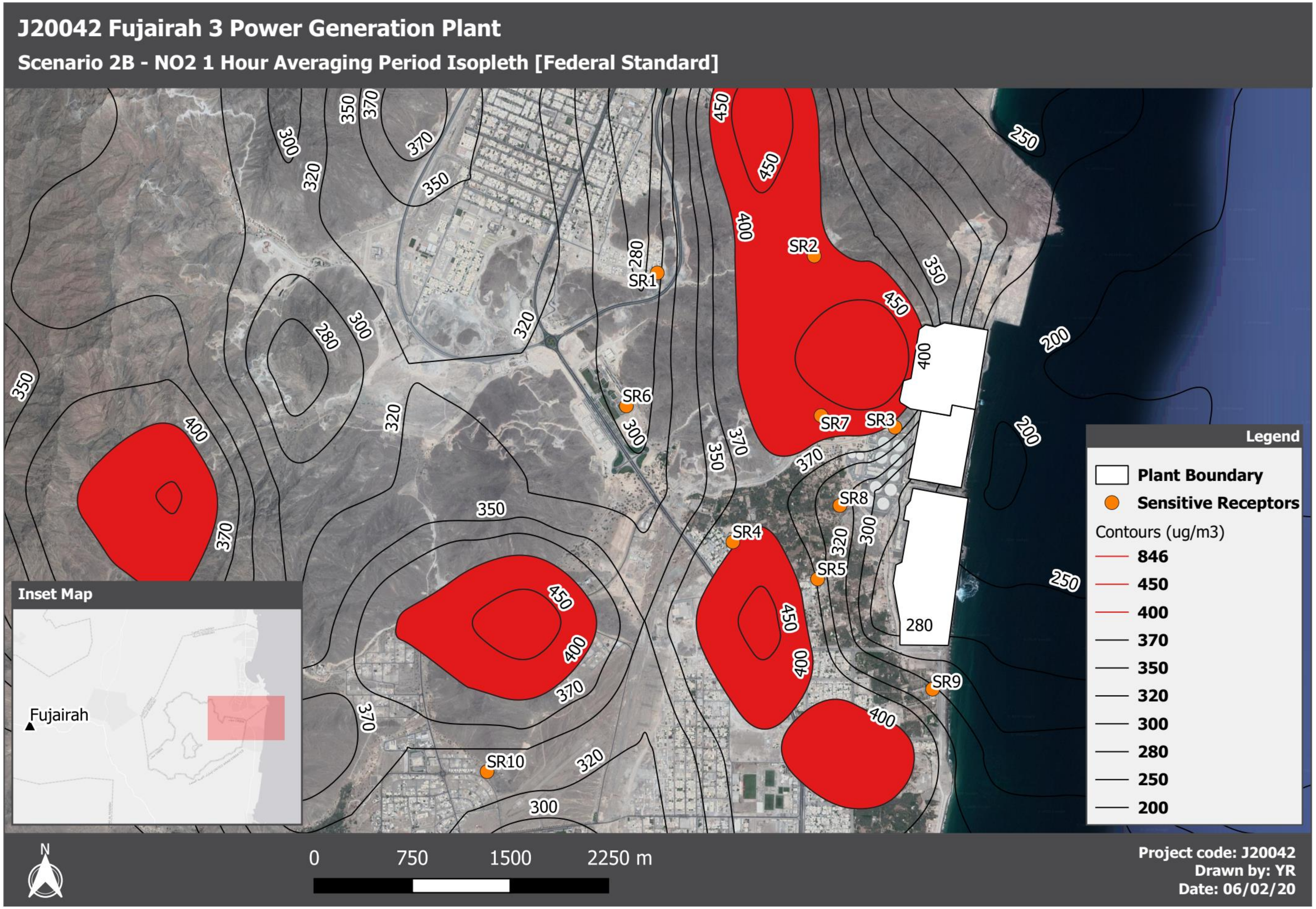

Figure 6-6: Scenario 2B NO_2 1 Hour Isopleths (Federal Standard)

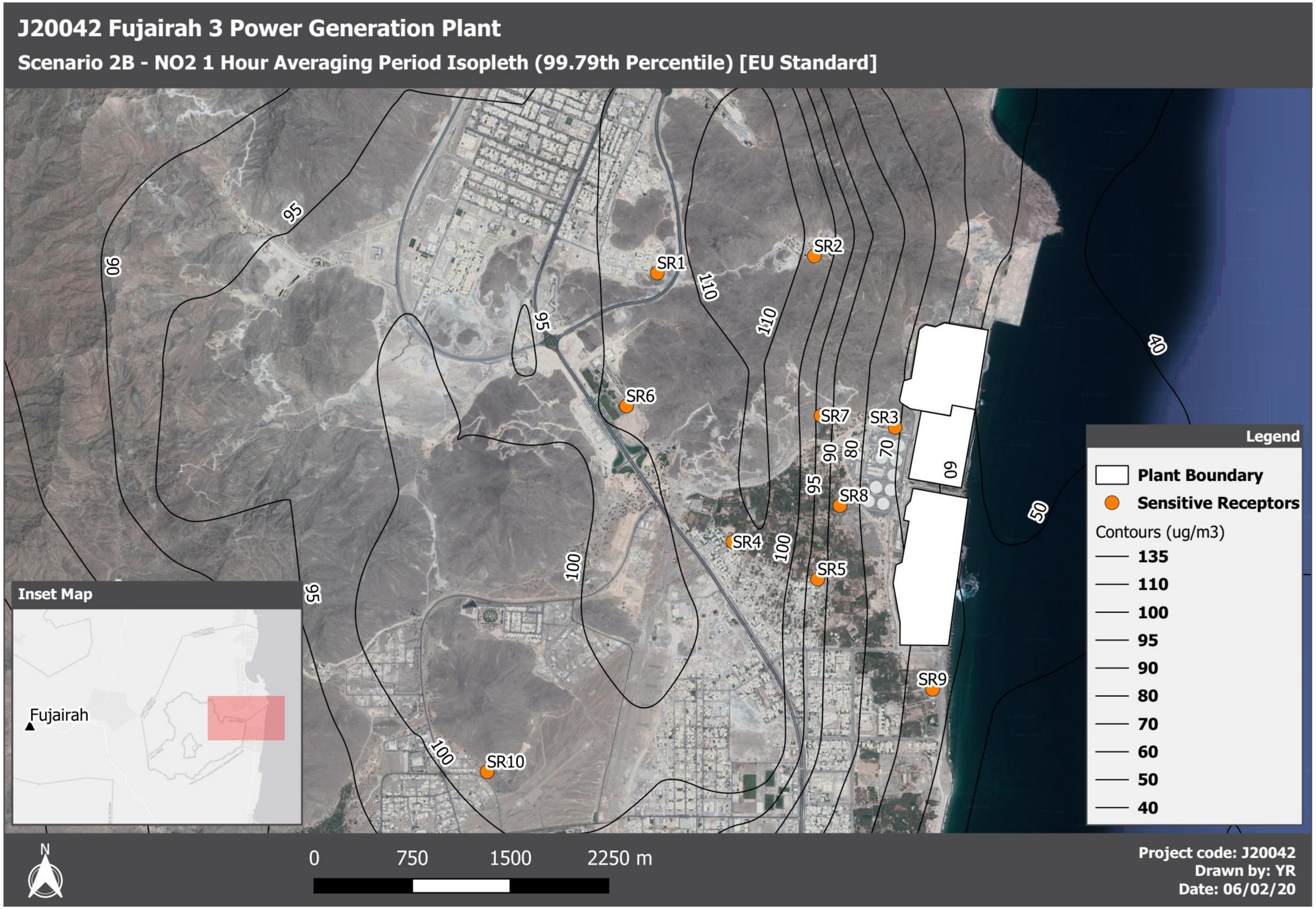

Figure 6-7: Scenario 2B NO_2 1 Hour Isopleths (EU Standard)

6.3.1.3.4.4. Scenario 3 A – Normal Operations of F3 in Isolation without SCR

Scenario 3A considers the Project in isolation with the SCR unit offline. The vendor NO_x guarantee for the turbines in the absence of the SCR unit emission limit is 50 mg/Nm^3. The results for this scenario compared against the Federal and Project Standards are presented in Table 6-19. The modelled concentrations show that the NO_2 1-hour model values are likely to exceed both the Federal AAQS and the Project Standards at the point of maximum impact (as shown in Figure 6-8), and therefore do not achieve the IFC guideline requirement (below 25 % of the relevant standard). The CO and PM results were found to be both below and less than 25 % of the Federal standard. **Appendix 2.2** shows the modelled results at all SRs assessed against the Federal and Project standards. The results at the SRs were found to exceed the Federal standards for NO_2 (1 hour) at 3 receptors (SR4, SR5 and SR7) while the Project standard was exceeded at 7 SRs (SR2, SR4, SR5, SR6, SR7, SR8, SR10). The values at all SRs were above 25% of the NO_2 Federal Standards. The NO_2 24-hour results as well as the CO results for both averaging periods (1-hour and 8-Hour) at the SRs were below the Federal standard and, for CO, less than 25 % of the standard.

Assessing the modelled results against the EU standards, i.e. taking into account a permitted number of exceedances, it was found that the NO_2 , CO and PM results were compliant with the EU standards (amounting to less than 50% of the standard) (Table 6-20); however, the NO_2 1 hour maximum exceeded the IFC 25% guideline.

The results at the SRs (**Appendix 2.2**) are predicted to be below the EU standards for all pollutants and relevant averaging periods. In terms of the IFC guideline, the model values at the SR's were predicted to be less than 25 % of the standard for PM, CO and for NO_2 for the annual averaging period however regarding the NO_2 1-hour averaging period the results were only below the 25% threshold at 2 of the SRs (SR3 and SR9). Figure 6-9 below shows compliance with the NO_2 1 hour averaging period for the EU standards.

Table 6-19: Scenario 3A Results for Federal and Project Standards

Pollutant	Averaging Period	Federal AAQS (µg/m³)	Project Standards (µg/m³)	Results (µg/m³)	% of Federal Standard	< 25% of the Federal Standard	Below Federal Standard?	Below Project Standard?
NO_2	1 Hour	400	200	707.41	176.85	No	No	No
	24 Hour	150	-	47.02	31.35	No	Yes	-
CO	1 Hour	30,000	-	1,422.10	4.74	Yes	Yes	-
	8 Hour	10,000	-	273.15	2.73	Yes	Yes	-
PM_{10}	24 Hour	150	-	1.89	1.26	Yes	Yes	-

Table 6-20: Scenario 3A Results for EU Standards

Pollutant	Averaging Period	EU AAQS(µg/m³)	Permitted Exceedances as per EU AAQS	Results (µg/m³)	% of EU Standard	< 25% of the EU Standard	Below EU Standard?
NO_2	1 Hour	200	18	97.78	48.89	No	Yes
	Annual	40	-	3.82	9.56	Yes	Yes
CO	8 Hour	10,000	-	273.15	2.73	Yes	Yes
PM_{10}	24 Hour	50	35	0.33	0.66	Yes	Yes
	Annual	40	-	0.11	0.28	Yes	Yes
$PM_{2.5}$	Annual	25	-	0.11	0.44	Yes	Yes

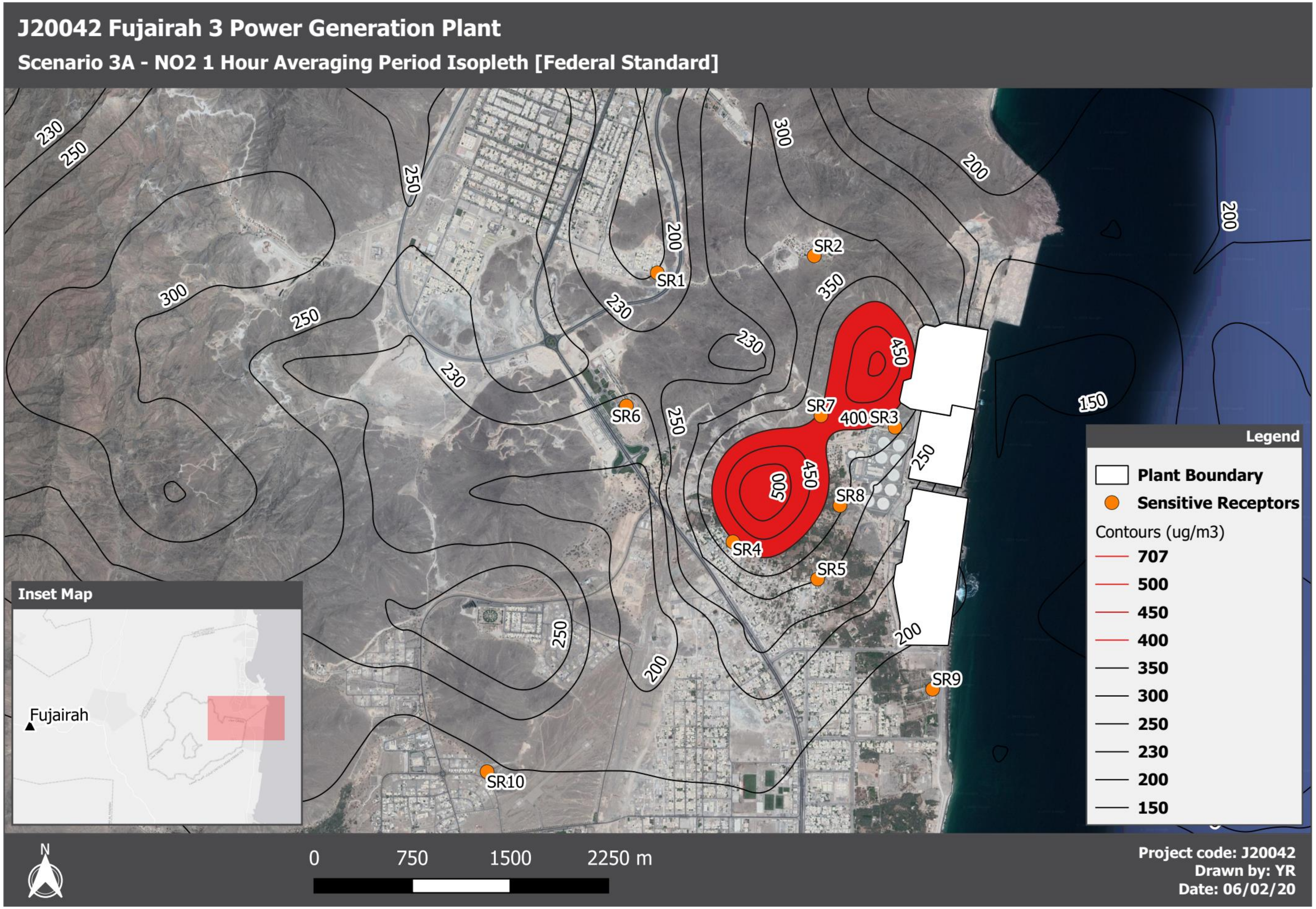

Figure 6-8: Scenario 3A NO_2 1 Hour Isopleths (Federal Standard)

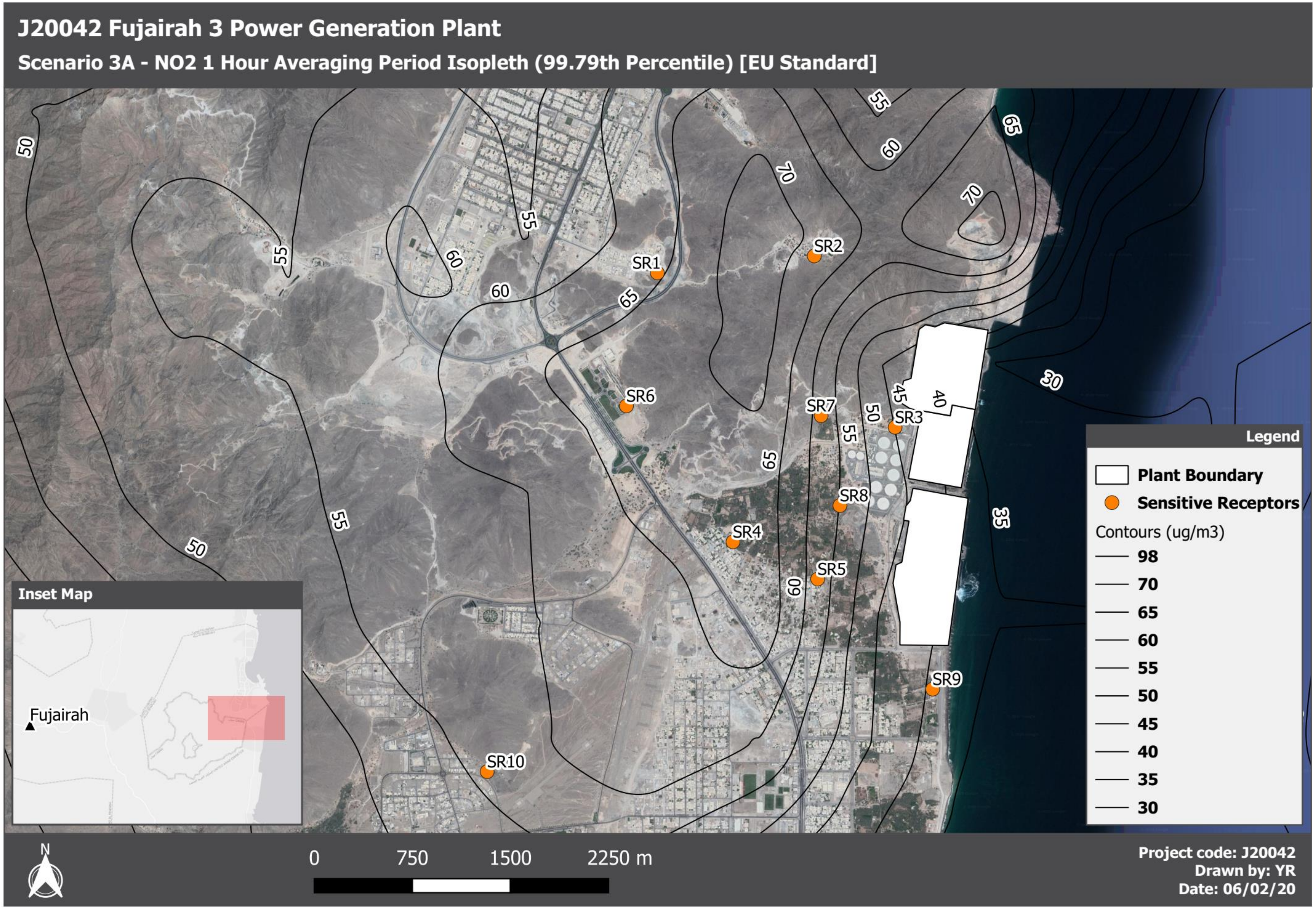

Figure 6-9: Scenario 3A NO_2 1 Hour Isopleths (EU Standard)

6.3.1.3.4.5. Scenario 3 B – Normal Operations of F3 without SCR including baseline (F1 and F2)

Scenario 3B considers the cumulative assessment of F1, F2 and F3, with the Project (F3) SCR unit (SCR offline (50 mg/Nm^3 NO_x emission limit). The results presented in Table 6-21 shows the modelled results against the Federal standards. All values except the NO_2 1-hour results were below the Federal standards, as shown in Figure 6-10. When considering the SR locations, the NO_2 1-hour results (**Appendix 2.2**) were also found to exceed the Federal standards at all SR locations with the exception of SR1 and SR3. All other pollutant averaging periods and concentrations are expected to be compliant with the Federal standards. The cumulative assessment (addition of measured background) also indicates compliance for all pollutants at all averaging periods with the exception of the NO_2 1 hour period. The sensitive receptor cumulative assessment (addition of measured background) showed potential exceedances for the NO_2 1 hour averaging at all receptors, while sensitive receptor results for all other pollutants were predicted to be below the relevant standards at all receptors.

When considering permitted exceedances as per the EU standards, the results in Table 6-22 and **Appendix 2.2** results show that modelled concentrations for all pollutants and all averaging periods are expected to be below the EU AAQS. Figure 6-11 below shows compliance of the NO_2 1 hour averaging period for the EU standards. The cumulative assessment with the addition of measured background) indicates an exceedance for NO_2 1 hour value, with all other pollutant concentrations expected to be below the relevant standards. It should be noted that there is an element of double counting as the measured background data also includes the contribution from the existing F1 and F2, which have also been modelled. The results at the sensitive receptors (when considering the cumulative assessment and addition of measured background) were found to be below the relevant standards for all pollutants at all sensitive receptors

Table 6-21: Scenario 3B Results for Federal Standards

Pollutant	Averaging Period	Federal AAQS ($\mu g/m^3$)	Model Results ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	Cumulative Results ($\mu g/m^3$)	Below Federal Standard?
NO_2	1 Hour	400	934.56	54.57	989.13	No
	24 Hour	150	79.04	54.57	133.61	Yes
CO	1 Hour	30,000	2,226.00	1,568.48	3,794.48	Yes
	8 Hour	10,000	504.64	1,568.48	2,073.12	Yes
PM_{10}	24 Hour	150	1.89	-	1.89	Yes

Table 6-22: Scenario 3B Results for EU Standards

Pollutant	Averaging Period	EU AAQS(µg/m3)	Permitted Exceedances as per EU AAQS	Model Results (µg/m3)	Background Concentration (µg/m3)	Cumulative Results (µg/m3)	Below EU Standard?
NO_2	1 Hour	200	18	167.52	54.57	222.09	No
	Annual	40	-	8.65	27.29	35.94	Yes
CO	8 Hour	10,000	-	504.64	1,568.48	2,073.12	Yes
PM_{10}	24 Hour	50	35	0.33	-	0.33	Yes
	Annual	40	-	0.11	-	0.11	Yes
$PM_{2.5}$	Annual	25	-	0.11	-	0.11	Yes

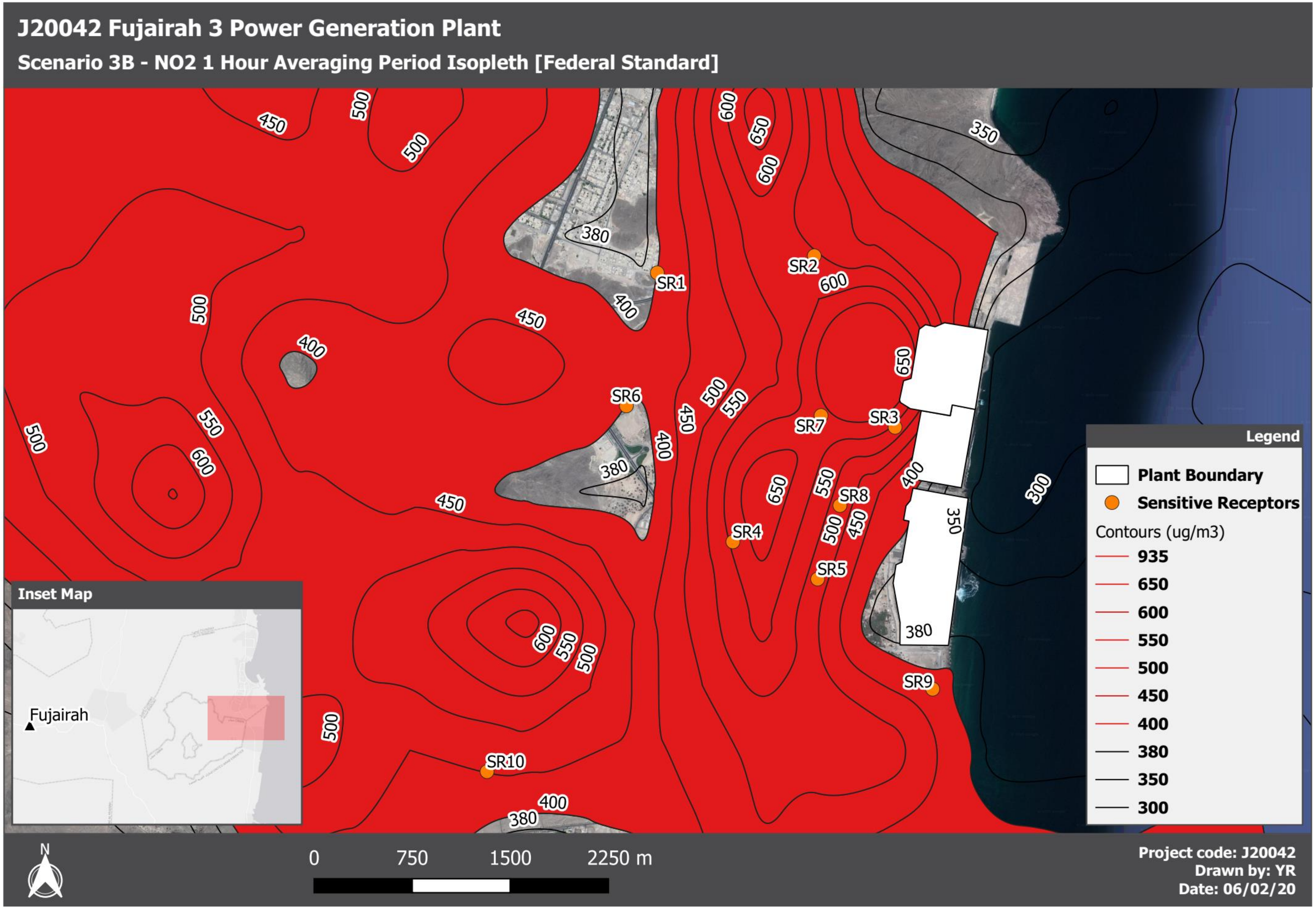

Figure 6-10: Scenario 3B NO_2 1 Hour Isopleths (Federal Standard)

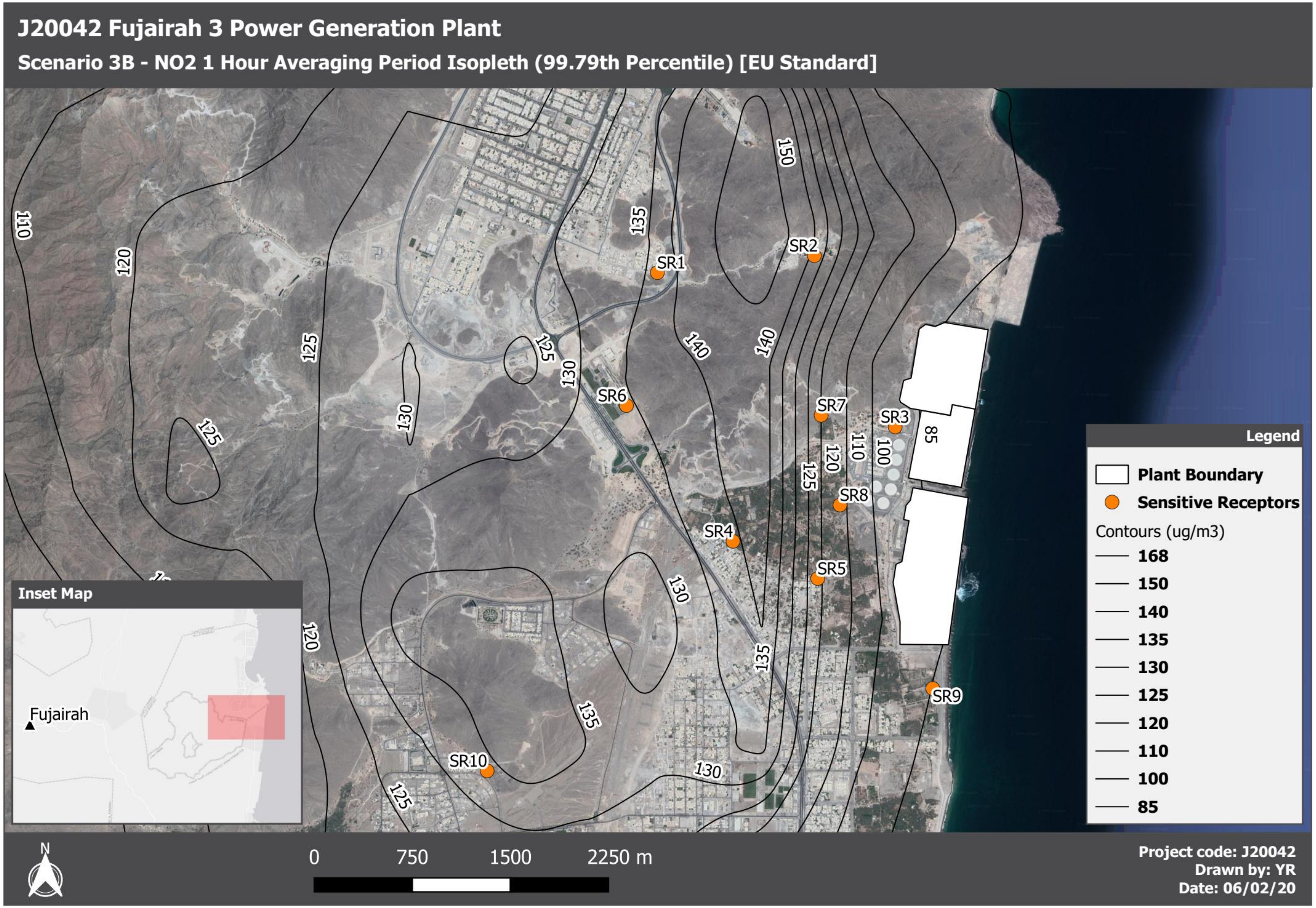

Figure 6-11: Scenario 3B NO_2 1 Hour Isopleths (EU Standard)

6.3.1.3.4.6. Scenario 4 – Normal Operations of F3 with Diesel Fuel and F1 and F2

This scenario considers the F3 facility operating on diesel fuel with a sulphur content of 10 ppm and vendor guaranteed emission limits for NO_2 (120 mg/Nm^3) and CO (50 mg/Nm^3). The gas turbines will operate with natural gas as the primary fuel and only in the event of natural gas interruption, off specification supply gas, or requirement for testing purposes, will the plant operate on a back-up liquid fuel, which is diesel.

Based on discussions with the Project team this is a very unlikely scenario and is only expected to occur for very short periods (1 to 2 hours per year, with a conservative maximum of 20 hours). The approach that may be considered when modelling impacts from intermittent emissions follows a US EPA method and is based on an average hourly rate, rather than the maximum hourly emission. In this instance the modelling analysis assumes continuous operation at the average hourly rate, i.e., the maximum hourly emission rate for each turbine multiplied by a factor of 20/8760. This approach accounts for potential worst-case meteorological conditions associated with turbine emissions by assuming continuous operation, while use of the average hourly emission represents a simple approach to account for the probability of the turbines operating on diesel for a given hour in the year (51).

The results in Table 6-23 were assessed against the Federal and Project standards. The modelled concentrations showed compliance with all standards for all pollutants. The SR results presented in **Appendix 2.2** show no exceedances for any of the pollutants at any of the SRs. The temporary operation of the turbines on diesel is also not likely to lead to a breach of the EU standards (Table 6-24). Figure 6-12 and Figure 6-13 below shows compliance of the NO_2 1 hour averaging period for the Federal and EU standards respectively. When the relevant background concentrations were added to the model results, it was found that the results for all pollutants were below the relevant standards for all pollutants. This was also the case at all SRs.

Table 6-23: Scenario 4 - Results for Federal and Project Standards

Pollutant	Averaging Period	Federal AAQS (µg/m3)	Project Standards (µg/m3)	Model Results (µg/m3)	Background Concentration (µg/m3)	Cumulative Results (µg/m3)	Model Results % of Federal Standard	Below Federal Standard?	Below Project Standard?
NO_2	1 Hour	400	200	3.88	54.57	58.45	0.97	Yes	Yes
	24 Hour	150	-	0.24	54.57	54.81	0.16	Yes	-
SO_2	1 Hour	350	200	0.05	-	0.05	0.01	Yes	Yes
	24 Hour	150	-	Negligible	-	Negligible	Negligible	Yes	-
	Annual	60	-	Negligible	-	Negligible	Negligible	Yes	-
CO	1 Hour	30,000	-	3.17	1,568.48	1,571.65	0.01	Yes	-
	8 Hour	10,000	-	0.56	1,568.48	1,569.04	0.006	Yes	-
PM_{10}	24 Hour	150	-	Negligible	-	Negligible	Negligible	Yes	-

Table 6-24: Scenario 4 Results for EU Standards

Pollutant	Averaging Period	EU AAQS(µg/m3)	Permitted Exceedances as per EU AAQS	Model Results (µg/m3)	Background Concentration (µg/m3)	Cumulative Results (µg/m3)	Model Results % of EU Standard	Below EU Standard?
NO_2	1 Hour	200	18	0.42	54.57	54.99	0.21	Yes
	Annual	40	-	0.01	27.29	27.30	0.04	Yes
CO	8 Hour	10,000	-	0.56	1,568.48	1,569.04		Yes
SO_2	1 Hour	350	24	0.010	-	0.010	0.003	Yes
	24 Hour	125	3	Negligible	-	Negligible	Negligible	Yes
PM_{10}	24 Hour	50	35	Negligible	-	Negligible	Negligible	Yes
	Annual	40	-	Negligible	-	Negligible	Negligible	Yes

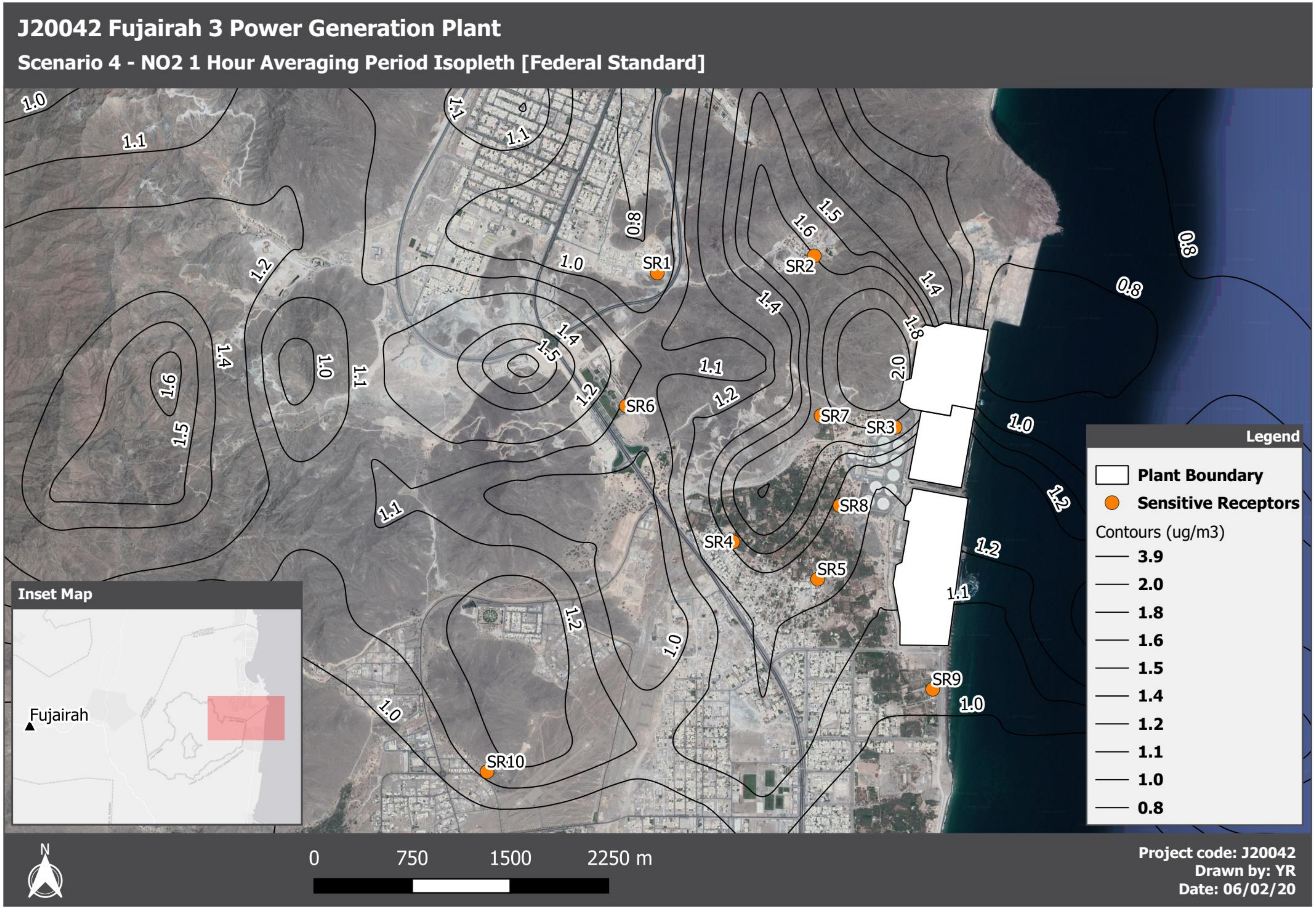

Figure 6-12: Scenario 4 NO_2 1 Hour Isopleths (Federal Standard)

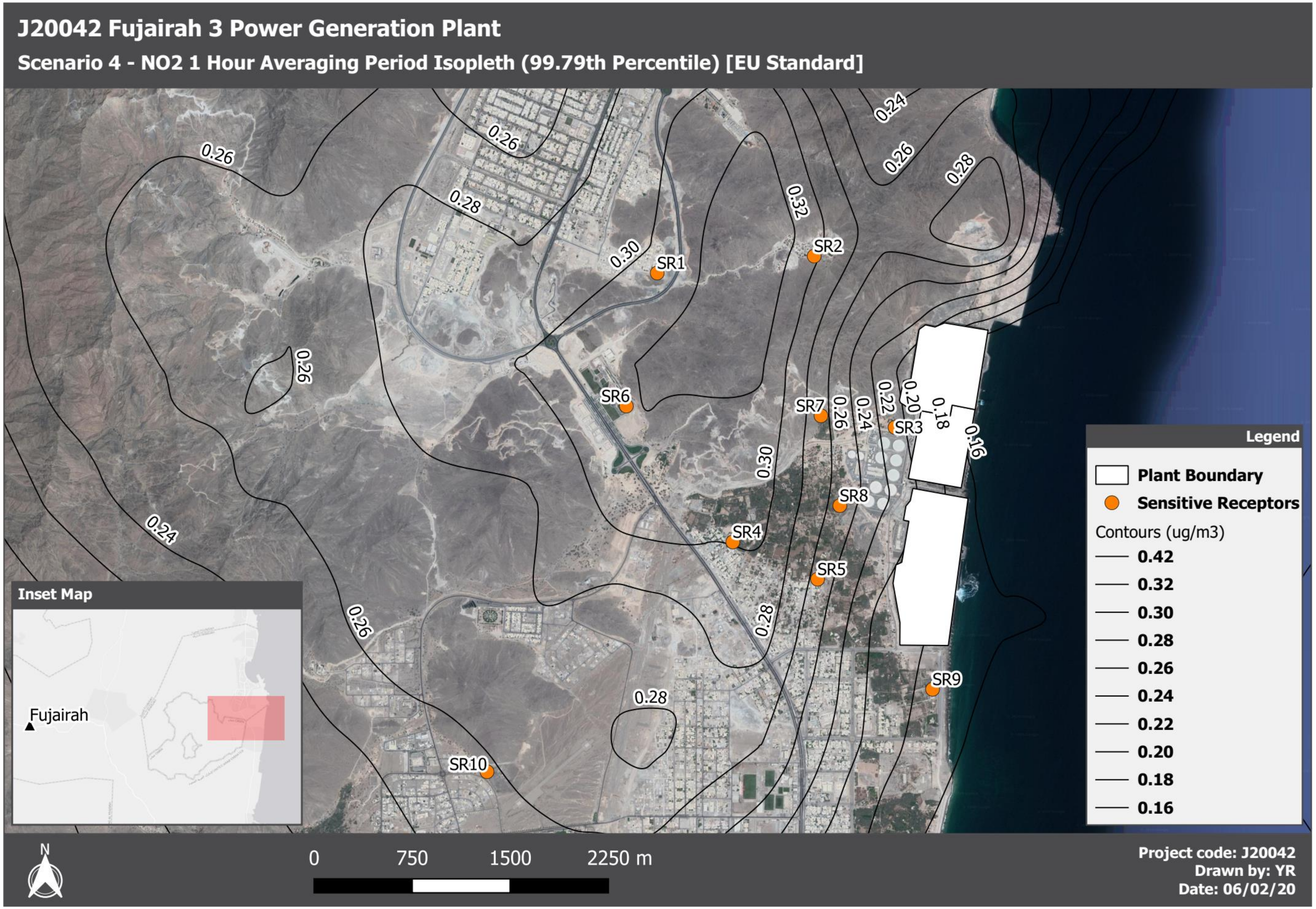

Figure 6-13: Scenario 4 NO_2 1 Hour Isopleths (EU Standard)

6.3.1.3.4.7. Scenario 5 A – Bypass Operations of F3 in Isolation without SCR

This scenario presents the F3 power plant operating all 3 turbines running on bypass (i.e. simple cycle) fuelled by natural gas without the inclusion of an SCR unit. This scenario was included as the Project is anticipated to operate with all three turbines in open cycle between April 2022 and March 2023 as part of the Phased introduction to plant capacity. In the absence of the SCR the NO_x emission limit was set at 50 mg/Nm^3. The results for the scenario, presented in Table 6-25, were compared against the Federal and Project standards. The modelled concentrations for all pollutants were below the relevant Federal and Project standards. All maximum GLCs, except the NO_2 1 Hour concentration was less than 25% of the Federal standard. The SR results presented in **Appendix 2.2** and Figure 6-14 show that concentration at all SRs are expected to be below both the Federal and Project standards.

Assessing the modelled results against the EU standards it was found that all concentrations are expected to be complaint with the EU standards. Modelled results for all pollutants were also predicted to be less than 25% of the relevant standard. The SR results, presented in **Appendix 2.2**, were found to be compliant with the EU standards at all SRs for all pollutants. Modelled concentrations for NO_2, CO and PM_{10} were predicted to be well below 25 % of the relevant EU standard. The isopleths displayed in Figure 6-15 depict that the predicted modelled concentrations at the SRs are well below the EU standards.

Table 6-25: Scenario 5A Results for Federal and Project Standards

Pollutant	Averaging Period	Federal AAQS (µg/m^3)	Project Standards (µg/m^3)	Model Results (µg/m^3)	Model Results % of Federal Standard	< 25% of the Federal Standard	Below Federal Standard?	Below Project Standard?
NO_2	1 Hour	400	200	190.94	47.74	No	Yes	Yes
	24 Hour	150	-	14.63	9.75	Yes	Yes	-
CO	1 Hour	30,000	-	382.68	1.28	Yes	Yes	-
	8 Hour	10,000	-	70.86	0.71	Yes	Yes	-
PM_{10}	24 Hour	150	-	0.59	0.39	Yes	Yes	-

Table 6: Scenario 5A Results for EU Standards

Pollutant	Averaging Period	EU AAQS(µg/m^3)	Permitted Exceedances as per EU AAQS	Model Results (µg/m^3)	Model Results % of EU Standard	< 25% of the EU Standard	Below EU Standard?
NO_2	1 Hour	200	18	22.93	11.47	Yes	Yes
	Annual	40	-	0.51	1.28	Yes	Yes
CO	8 Hour	10,000	-	70.86	0.71	Yes	Yes
PM_{10}	24 Hour	50	35	0.59	1.18	Yes	Yes
	Annual	40	-	0.02	0.05	Yes	Yes
$PM_{2.5}$	Annual	25	-	0.02	0.08	Yes	Yes

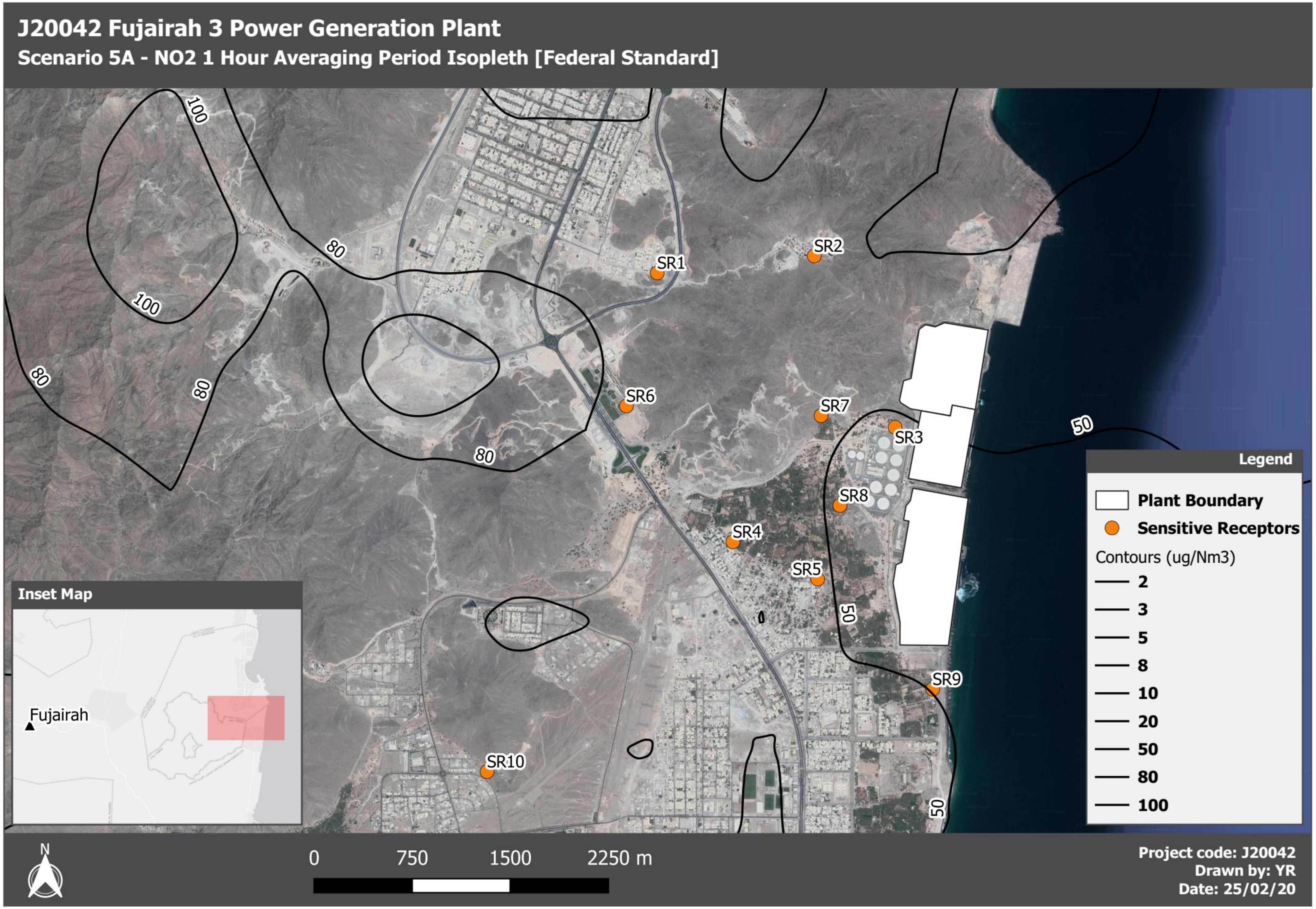

Figure 6-14: Scenario 5A NO_2 1 Hour Isopleths (Federal Standard)

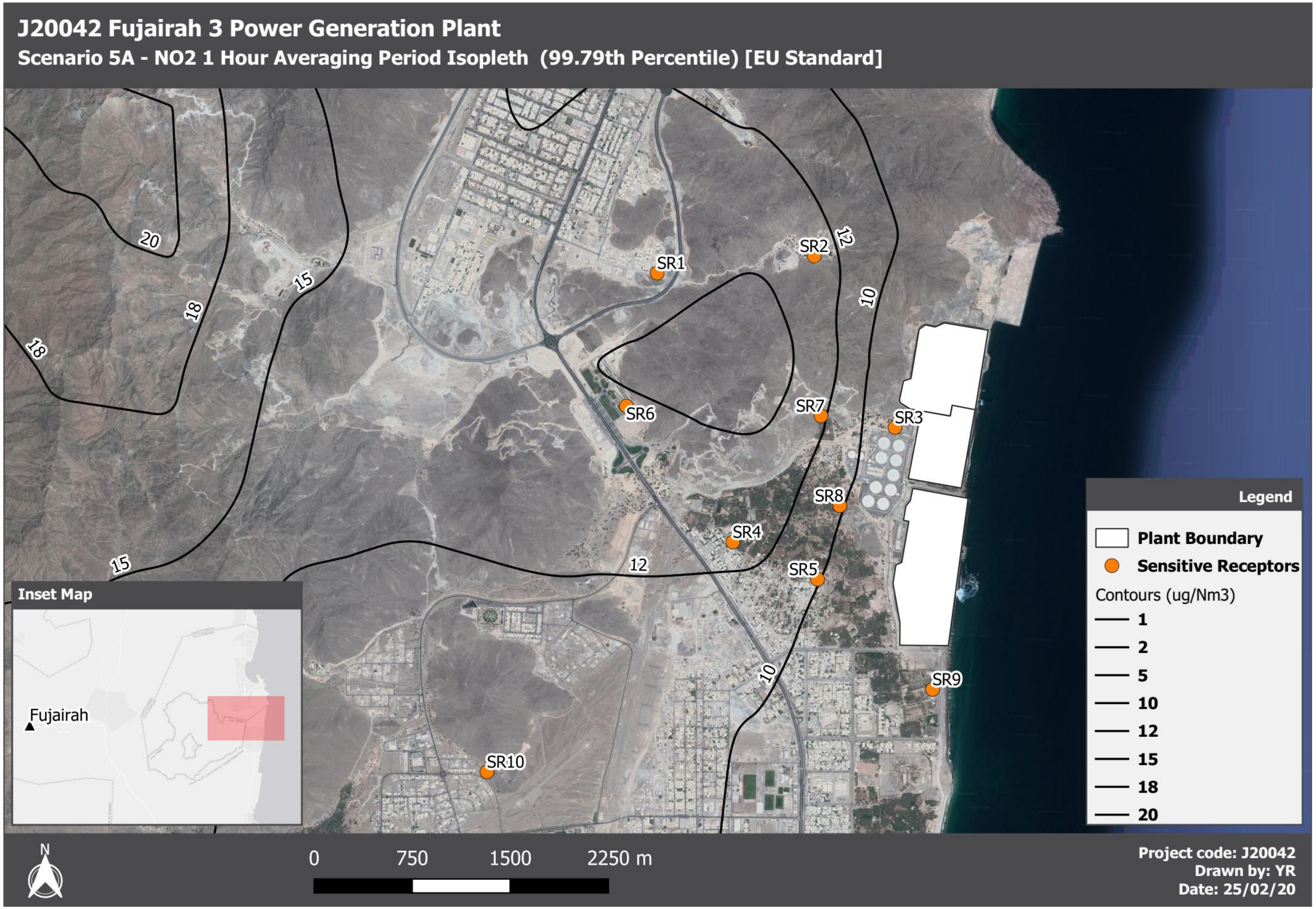

Figure 6-15: Scenario 5A NO_2 1 Hour Isopleths (EU Standard)

6.3.1.3.4.8. Scenario 5 B – Bypass Operations of F3 in Isolation without SCR including Baseline (F1 and F2)

This scenario considers the cumulative impacts from F1, F2 and F3, without the inclusion of an SCR unit and all 3 turbines running on simple cycle with a NO_x emission limit of 50 mg/Nm^3. The modelled results presented in Figure 6-16 and Table 6-26 indicate that the modelled concentrations for the NO_2 1-hour averaging period are expected to be above the Federal standards, whilst CO and PM_{10} are expected to be compliant with the Federal standards. In terms of the SR results, the model values do not exceed the Federal standards at any of the SRs (**Appendix 2.2**). The cumulative results (with addition of measured baseline) presented in Table 6-26 showed the same trend as the modelled results for all pollutants and averaging periods.

When accounting for the permitted number exceedances, as per the EU standards, the results show that the modelled concentrations for all pollutants were below the relevant standards (Table 6-27). Figure 6-17 displays the NO_2 concentration across the SRs, showing that the NO_2 are expected to be complaint with the EU AAQS at all SRs (**Appendix 2.2**). The cumulative results presented in Table 6-27 and **Appendix 2.2** indicate that the pollutant maximum GLCs as well as the SR results are below the relevant EU standards.

Table 6-26: Scenario 5B Results for Federal and Project Standards

Pollutant	Averaging Period	Federal AAQS (µg/m³)	Model Results (µg/m³)	Background Concentration (µg/m³)	Cumulative Results (µg/m³)	Below Federal Standard?
NO_2	1 Hour	400	787.17	54.57	841.74	No
	24 Hour	150	63.48	54.57	118.05	Yes
CO	1 Hour	30,000	1,985.00	1,568.48	3,553.48	Yes
	8 Hour	10,000	406.46	1,568.48	1974.94	Yes
PM_{10}	24 Hour	150	0.59	-	0.59	Yes

Table 6-27: Scenario 5B Results for EU Standards

Pollutant	Averaging Period	EU AAQS(µg/m³)	Permitted Exceedances as per EU AAQS	Model Results (µg/m³)	Background Concentration (µg/m³)	Cumulative Results (µg/m³)	Below EU Standard?
NO_2	1 Hour	200	18	109.06	54.57	163.63	Yes
	Annual	40	-	4.40	27.29	31.69	Yes
CO	8 Hour	10000	-	406.46	1,568.48	1,974.94	Yes
PM_{10}	24 Hour	50	35	0.59	-	0.59	Yes
	Annual	40	-	0.02	-	0.02	Yes
$PM_{2.5}$	Annual	25	-	0.02	-	0.02	Yes

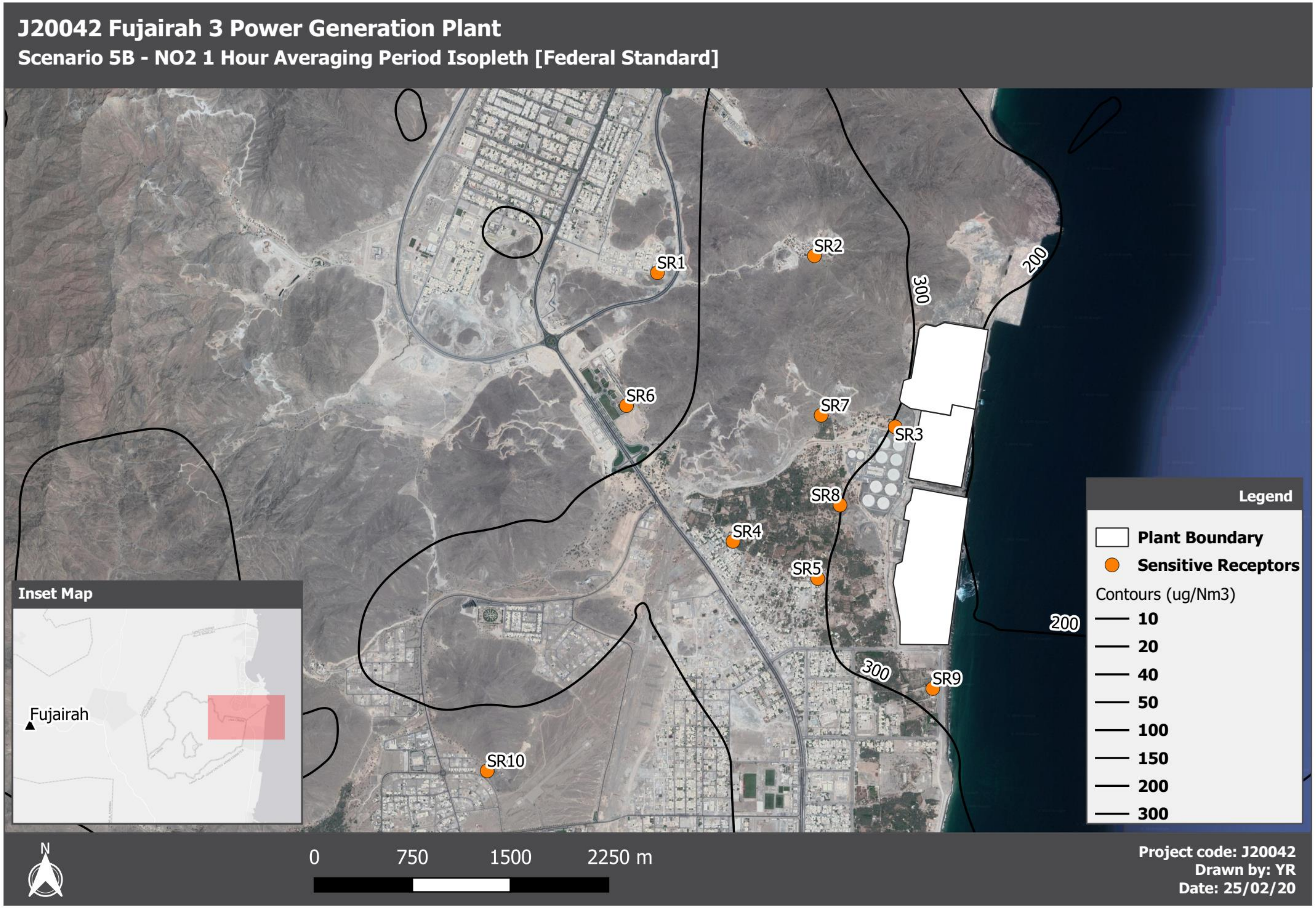

Figure 6-16: Scenario 5B NO_2 1 Hour Isopleths (Federal Standard)

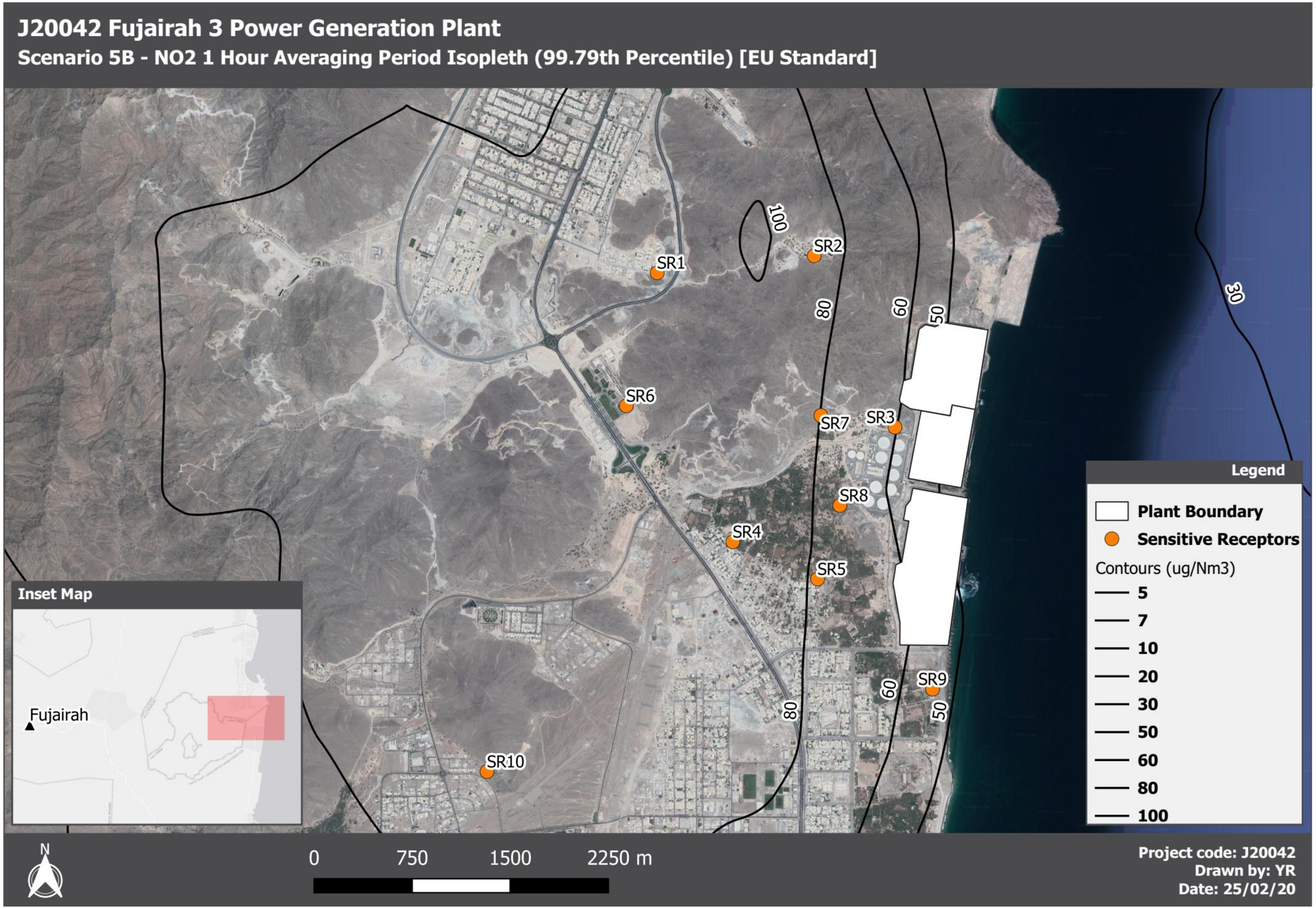

Figure 6-17: Scenario 5B NO_2 1 Hour Isopleths (EU Standard)

6.3.1.3.5. Summary of Operational Impacts

This assessment has considered the potential impacts to ambient air quality from the operation of the F3 Project using the internationally recognised CALPUFF dispersion modelling system. Emissions from the various sources have been considered in terms of the potential impact to air quality for NO_2, SO_2, CO, and PM associated with normal and abnormal operations of the facility.

The following scenarios were considered in the assessment:

- Scenario 1: Baseline Case - normal operation of existing power stations F1 and F2;
- Scenario 2A: F3 in isolation - normal operations with the Selective Catalytic Reduction (SCR) Unit. The NOx emission limit for this scenario is 20 mg/Nm^3;
- Scenario 2B: Cumulative assessment - normal operations of all three power plants (F1, F2 and F3) with the F3 turbines operating with a SCR Unit. The F3 NOx emission limit for this scenario is 20 mg/Nm^3;
- Scenario 3A: F3 in isolation - normal operations of F3 with the F3 turbines operating without SCR Unit. The NOx emission limit for this scenario is 50 mg/Nm^3;
- Scenario 3B: Cumulative assessment - normal operations of all three power plants (F1, F2 and F3) with the F3 turbines operating without a SCR Unit. The F3 NOx emission limit for this scenario is 50 mg/Nm^3;
- Scenario 4: Alternate fuel operations (short term - 20 hours per year), F3 turbines operating on 10ppm diesel;
- Scenario 5A: F3 in isolation - bypass operations of F3 with the F3 turbines operating in simple cycle without SCR Unit. The NOx emission limit for this scenario is 50 mg/Nm^3; and
- Scenario 5B: Cumulative assessment - bypass operations of F3 with normal operations of the other two power plants (F1 and F2). The F3 turbines operate without a SCR Unit. The F3 NOx emission limit for this scenario is 50 mg/Nm^3.

The modelled results have been compared against both the Federal ambient air quality standards and the specific Project Standards, which have been set by EWEC. It should be noted that predicted concentrations, in the short-term, are subject to high variability during the year, being dependent on specific local meteorological conditions. It should be noted that as the Federal Standards do not allow for any exceedances, the EU standards have also been adopted for comparative purposes.

In summary the assessment concluded that the pollutants SO_2, CO and PM are not considered to be a constraint for the Project, given that the fuel is natural gas (under normal operation), and that the pollutant concentrations for these pollutants are expected to contribute a fraction of the ambient air quality standards.

In terms of the pollutant NO_2, the findings are summarised below:

- SC2A Normal Operations with SCR (Project in isolation), is expected to be compliant with the Federal standards, and compliant with EU standards for both short term and long term averaging periods. In addition, the Project in isolation is expected to contribute less than 25% of the EU AAQS, which meets the IFC General EHS guideline (considering the EU AAQA).
- SC2B In a cumulative context with baseline (F1 and F2) and background measured data the Federal Standards may be exceeded for the 1 hour averaging period, however the EU standards are likely to be achieved;
- SC3A Normal Operations without SCR (Project in isolation), it is possible that the Federal standards will be exceeded on a short-term basis (1-hour); however, when compared against the EU standards compliance is

expected. This case does not meet the IFC 25% requirement for the Federal or EU standards in isolation, however with the addition of baseline (F1 and F2), and in a cumulative context with background data, compliance with the EU standards is expected (with the exception of the 1 hour NO_2 averaging period, which is predicted to exceed the standards with the addition of background measured data);

- Based on the above it is recommended that the SCR is adopted over the "without" SCR option for normal combined cycle operations, considering:
  - That whilst the Federal and Project standards may not be met, the EU AAQS are likely to be achieved;
  - This case achieves the IFC General EHS guideline that a Project in isolation should not contribute more than 25% of the AAQS for Non Degraded airsheds (considering the EU AAQS);
- SC4: In terms of the short term (approximately 20 hours in a year) alternate fuel case, it is expected that the operation of the facility on diesel for short durations is not likely to lead to exceedances of the relevant AAQS;
- SC5A: Project operating in isolation (open cycle for approximately 1 year as part of the plant phased introduction). The modelled concentrations for all pollutants were below the relevant Federal and Project standards. All maximum GLCs, except the NO_2 1 Hour concentration was predicted to be less than 25% of the Federal standard. The concentrations at all SRs are expected to be below the Federal, Project and EU standards; and
- SC5B: Cumulative assessment of open cycle operations for approximately 1 year as part of the plant phased introduction. The modelled concentrations for the NO_2 1-hour averaging period are expected to be above the Federal standards, whilst CO and PM_{10} are expected to be compliant with the Federal standards. In terms of the SR results, the model values do not exceed the Federal standards at any of the SRs. When accounting for the permitted number exceedances, as per the EU standards, the results show that the modelled concentrations for all pollutants are expected to be below the relevant standards (with the addition of modelled and measured background).

A summary of the Project related impacts are presented in Table 6-28, Table 6-30 and Table 6-31: SC3B Cumulative Impacts - Normal Operation without SCR

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
3B	Cumulative increase in long and short term ambient concentrations of PM, SO2 and CO at Sensitive Receptor locations	No Change / Insignificant A	Medium High	Negligible
3B	Cumulative increase in long term ambient concentrations of NO2 Sensitive Receptor locations	Medium B	Medium High	Moderate Negative
3B	Cumulative increase in short term (1 hour) ambient concentrations of NO2 at Sensitive Receptor locations as a result of the Project (Federal Standards).	High C	Medium High	Major Negative

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
3B	Cumulative increase in short term (1 hour) ambient concentrations of NO2 Sensitive Receptor locations as a result of the Project (EU Standards).	High [C]	Medium High	Major Negative
3B	Breach of 1 hour NO2 AAQS at location of highest model value as a result of Cumulative Impacts (Federal)	High [C]	Low [D]	Moderate Negative
3B	Breach of 1 hour NO2 AAQS at location of highest model value as a result of Cumulative Impacts (EU Standard)	High [C]	Low [D]	Moderate Negative
[A] Cumulative Value less than 25% of the Federal / EU Standard [B] Cumulative value between 75% and 100% of the relevant Standard [C] Cumulative value greater than relevant AAQS [D] Highest cumulative value falls within uninhabited area				

Table 6-32 for scenario 2A, 3A and 4, respectively. The impact significance criteria were based on the categorisation of the sensitivity of the receptor and the impact severity as per Table 6-9 while assessing against the matrix provided in Table 3-25.

Table 6-28: SC2A Impact Assessment for Project in Isolation - Normal Operation with SCR

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
2A	Increase in long and short term ambient concentrations of PM, SO_2 and CO at Sensitive Receptor locations	No Change / Insignificant	Medium High	Negligible
2A	Increase in long term ambient concentrations of NO_2 Sensitive Receptor locations	No Change / Insignificant	Medium High	Negligible
2A	Increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project in Isolation (Federal Standards).	Low*	Medium High	Minor Negative
2A	Increase in short term (1 hour) ambient concentrations of NO_2 Sensitive Receptor locations as a result of the Project in Isolation (EU Standards).	Slight**	Medium High	Minor Negative
2A	Breach of AAQS as a result of Project in Isolation (Federal)	Low*	Medium High	Minor Negative
2A	Breach of AAQS as a result of Project in Isolation (EU Standard)	Slight**	Medium High	Minor Negative
* 1 hour model values at all SR location are expected to be greater than 25% but less than 50% of the Federal Standard **1 hour model values at all SR locations are expected to be less than 25% of the EU Standard				

Table 6-29: SC2B Cumulative Impacts - Normal Operation with SCR

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
2B	Cumulative increase in long and short term ambient concentrations of PM, SO_2 and CO at Sensitive Receptor locations	No Change / Insignificant [A]	Medium High	Negligible

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
2B	Cumulative increase in long term ambient concentrations of NO_2 Sensitive Receptor locations	Medium [B]	Medium High	Moderate Negative
2B	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project (Federal Standards).	High [C]	Medium High	Major Negative
2B	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project (EU Standards).	Medium [B]	Medium High	Moderate Negative
2B	Breach of 1 hour NO_2 AAQS at location of highest model value as a result of Cumulative Impacts (Federal)	High [C]	Low [D]	Moderate Negative
2B	Breach of 1 hour NO_2 AAQS at location of highest model value as a result of Cumulative Impacts (EU Standard)	Medium [B]	Low [D]	Negligible

[A] Cumulative Value less than 25% of the Federal / EU Standard
[B] Cumulative value between 75% and 100% of the EU Standard
[C] Cumulative value greater than Federal AAQS
[D] Highest cumulative value falls within uninhabited area

Table 6-30: Impact Assessment for Project in Isolation - Normal Operation without SCR

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
3A	Increase in short-term and long-term ambient concentrations of PM, SO_2 and CO at Sensitive Receptor locations	No change / Insignificant	Medium High	Negligible
3A	Increase in long term ambient concentrations of NO_2 Sensitive Receptor locations	No Change / Insignificant	Medium High	Negligible
3A	Increase in short term (1-hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project in Isolation (Federal Standards).	High[1]	Medium High	Major Negative

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
3A	Increase in short term (1 hour) ambient concentrations of NO_2 Sensitive Receptor locations as a result of the Project in Isolation (EU Standards).	Medium[2]	Medium High	Moderate Negative
[1] 1 hour model values at 3 SR locations are expected to be greater than 100% of the Federal Standard [2] 1 hour model values at 8 SR locations are expected to be greater than 25% but less than 50% of the EU Standards				

Table 6-31: SC3B Cumulative Impacts - Normal Operation without SCR

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
3B	Cumulative increase in long and short term ambient concentrations of PM, SO_2 and CO at Sensitive Receptor locations	No Change / Insignificant [A]	Medium High	Negligible
3B	Cumulative increase in long term ambient concentrations of NO_2 Sensitive Receptor locations	Medium [B]	Medium High	Moderate Negative
3B	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project (Federal Standards).	High [C]	Medium High	Major Negative
3B	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 Sensitive Receptor locations as a result of the Project (EU Standards).	High [C]	Medium High	Major Negative
3B	Breach of 1 hour NO_2 AAQS at location of highest model value as a result of Cumulative Impacts (Federal)	High [C]	Low [D]	Moderate Negative
3B	Breach of 1 hour NO_2 AAQS at location of highest model value as a result of Cumulative Impacts (EU Standard)	High [C]	Low [D]	Moderate Negative

[A] Cumulative Value less than 25% of the Federal / EU Standard
[B] Cumulative value between 75% and 100% of the relevant Standard
[C] Cumulative value greater than relevant AAQS
[D] Highest cumulative value falls within uninhabited area

Table 6-32: Impact Assessment for Normal Operation utilising Diesel as Fuel

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
4	Increase in ambient concentrations of NO_2, PM, SO_2 and CO at Sensitive Receptor locations	No Change*	Medium High	Negligible
** 1 hour model values at all SR locations less than 10% of the Federal and EU Standards				

Table 6-33: SC5A Impact Assessment for Project in Isolation – Open Cycle without SCR

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
5A	Increase in short and long term ambient concentrations of PM, SO_2 and CO at Sensitive Receptor locations	No change / Insignificant	Medium High	Negligible
5A	Increase in long term ambient concentrations of NO_2 Sensitive Receptor locations	No Change / Insignificant	Medium High	Negligible
5A	Increase in short term (1-hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project in Isolation (Federal Standards).	Low [A]	Medium High	Minor Negative
5A	Increase in short term (1 hour) ambient concentrations of NO_2 Sensitive Receptor locations as a result of the Project in Isolation (EU Standards).	Insignificant [B]	Medium High	Negligible
[A] 1 hour model values expected to be greater than 25% but less than 50% of the Federal Standard [B] 1 hour model values at SR locations are expected to less than 10% of the EU Standards				

Table 6-34: SC5B Cumulative Impacts– Open Cycle without SCR

Scenario	Description of the Impacts	Impact Severity	Sensitivity of Receptor	Impact Significance Prior to Mitigation Measures
5B	Cumulative effects on long and short term ambient concentrations of PM, SO_2 and CO at Sensitive Receptor locations	No Change / Insignificant [A]	Medium High	Negligible
5B	Cumulative effects on long term ambient concentrations of NO_2 Sensitive Receptor locations	Medium [B]	Medium High	Moderate Negative
5B	Cumulative effects on short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project (Federal Standards).	High [C]	Medium High	Major Negative
5B	Cumulative effects on short term (1 hour) ambient concentrations of NO_2 Sensitive Receptor locations as a result of the Project (EU Standards).	Slight [D]	Medium High	Minor Negative
5B	Breach of 1 hour NO_2 AAQS at location of highest model value as a result of Cumulative Impacts (Federal)	High [E]	Low [F]	Moderate Negative
5B	Breach of 1 hour NO_2 AAQS at location of highest model value as a result of Cumulative Impacts (EU Standard)	Medium [C]	Low [F]	Negligible

[A] Cumulative Value less than 25% of the Federal / EU Standard
[B] Cumulative value between 75% and 100% of the relevant Standard
[C] Cumulative value greater than relevant AAQS at SR7, SR8 and SR9
[D] Cumulative values at SR's greater than 25% but less than 50%
[E] Cumulative values greater than AAQS
[F] Highest cumulative value falls within uninhabited area
G Highest cumulative value between 75% and 100% of the EU Standard

In summary, with the implementation of the SCR system (Scenario 2A), normal operations of the facility may lead to lead to **minor negative** impacts associated with NO_2 1 hour maximum when compared against the Federal and EU Standards. When considering the long term pollutant concentration increases at SR's the Project is likely to lead to a **negligible** impact significance.

When considering the Project cumulatively (F1, F2 and measured background data) with the SCR in operation (Scenario 2B), the project may lead to **major negative** impact significance associated with a potential cumulative exceedance of the Federal standard (for the NO_2 1 hour averaging period). In addition, the cumulative long term NO_2 values are likely to compromise between 75% and 100% of the EU annual standard, which corresponds to a **moderate negative** significance of impact. There may be a breach of the NO_2 Federal 1 hour standard at locations where there are currently no receptors located and these impacts correspond to **moderate negative** and

negligible when considering the Federal and EU 1 hour standards respectively. The cumulative impacts for all other pollutants and averaging periods are expected to correspond to a **negligible** significance of impact.

Operating the facility without the SCR (SC3A) is likely to lead to **major negative** impacts when compared to the 1 hour NO_2 Federal Standards and **moderate negative** when compared to the 1 hour NO_2 EU standards. In terms of the long term pollutant averaging periods (all pollutants), the project is likely to have a **negligible** impact significance.

When considering the Project cumulatively (F1, F2 and measured background data) with the SCR offline (Scenario 3B), the project may lead to **major negative** impact significance associated with a potential cumulative exceedance of the Federal standard and EU standard (for the NO_2 1 hour averaging period). In addition, the cumulative long term NO_2 values are likely to compromise between 75% and 100% of the EU annual standard, which corresponds to a **moderate negative** impact significance. There may be a breach of the NO_2 Federal 1 hour standard at locations where there are currently no receptors located and these impacts correspond to **moderate negative** significance of impact when considering the Federal and EU 1 hour standards respectively. The cumulative impacts for all other pollutants and averaging periods are expected to correspond to a **negligible** significance of impact.

The potential impacts associated with operations on liquid fuel (i.e. distillate diesel oil) (SC4), which will only be used for emergency backup or maintenance testing (20 hours in a year) are expected to be of **negligible** impact significance.

The Open Cycle scenario, which is anticipated to last for up to a year while the plant is phased into full capacity, and when considered in isolation (SC5A), is likely to have **minor negative** impact significance, with regards to increases in 1 hour NO_2 concentrations, an a **negligible impact** significance when considering other pollutants and averaging periods (both federal and EU standards). In terms of the cumulative assessment of the open cycle scenario (SC5B), this case may lead to a **major negative** impact significance when considering the short term NO_2 concentrations in the context of the Federal Standards, however when the results are adjusted for comparison against the EU standards, the impact significance lowers to **minor negative**. Potential breaches of the AAQS are rated as **moderate negative** when compared against the Federal Standards, however the impacts significance lowers to **negligible** when considering the EU standards.

6.3.2. Ambient Noise

6.3.2.1. Noise Impact Assessment Criteria

6.3.2.1.1. Construction Phase

In the absence of national construction noise limits, the construction noise assessment has been carried out in accordance with internationally recognised construction noise guidelines of the Department of Environment and Climate Change New South Wales (NSW) (52).

The interim construction noise guidelines define a construction noise threshold margin of 10 dB(A) above the background noise levels with a 75 dB(A) upper limit for construction operations during standard hours. A construction noise threshold margin of 5 dB(A) above the background noise levels is defined for construction operations outside recommended standard hours. This is due to the temporary / short-term and transient nature of construction noise, as opposed to operational noise levels or conditions that are long-term (and therefore considered more significant). A noise level of L_{Aeq} 75 dB(A) represents the point above which there may be strong community reaction to noise and indicates a need to consider other feasible and reasonable ways to reduce noise, such as restricting the times of very noisy works to provide respite to affected residences.

Table 6-35 presents the impact assessment matrix relating to the contributed noise level from the construction phase. Given the duration of construction for this project, a conservative approach has been taken, adopting the most stringent (> 6 months duration) long term criteria.

Table 6-35: Construction noise impact severity assessment criteria

Impact Severity	Normal Working Hours (Daytime)		Abnormal Working Hours (Night-time)	
	Incremental Change in Ambient Noise Level	Description of Impact	Incremental Change in Ambient Noise Level	Description of Impact
No Change	0 dB(A)	Not discernible.	N/A	See below
Slight	0.1 – 2.9 dB(A)	Not discernible – Marginal changes in noise levels of less than 3 dB(A) in residential areas, or outdoor recreational areas in close proximity to main roads.	0 - 1 dB(A)	Not discernible however impulsive and tonal sounds from construction activities may be audible at night.
Low	3 – 4.9 dB(A)	Noticeable adverse – Noise levels of 3-5 dB(A) in residential areas, or at outdoor recreational areas.	1 – 2.9 dB(A)	Marginal changes in noise levels of less than 3 dB(A) in residential areas, or outdoor recreational areas in close proximity to main roads.
Medium	5 – <10 dB(A)	Considerable adverse – Noise levels warrant mitigation of residential properties on a widespread basis in a community, or for outdoor recreation areas.	3 – 4.9 dB(A)	Considerable adverse – Noise levels warrant mitigation of residential properties on a widespread basis in a community, or for outdoor recreation areas.
High	10 dB(A) or in excess of 75 dBA	Major adverse – Noise increases to a level where continued residential use of individual properties is inappropriate, or where the use of a community building could be inappropriate.	5 dB(A) or in excess of 75 dB(A)	Major adverse – Noise increases to a level where continued residential use of individual properties is inappropriate, or where the use of a community building could be inappropriate.

6.3.2.1.2. Operational Phase

The criteria for the assessment of change in noise levels arising at noise SRs from the operation of the Project have been adapted from the joint Institute of Environmental Management and Assessment (IEMA) and the Institute of Acoustics (IoA) guidelines for noise and vibration impact assessment categories and are given in Table 6-36.

Table 6-36: Noise impact severity assessment criteria

Impact Severity	Incremental Change in Ambient Noise Level	Description of Impact
No Change	0 dB(A)	Not discernible.
Slight	0.1 – 2.9 dB(A)	Not discernible – Marginal changes in noise levels of less than 3 dB(A) in residential areas, or outdoor recreational areas in close proximity to main roads.

Impact Severity	Incremental Change in Ambient Noise Level	Description of Impact
Low	3 – 4.9 dB(A)	Noticeable adverse – Noise levels of 3-5 dB(A) in residential areas, or at outdoor recreational areas.
Medium	5 – <10 dB(A)	Considerable adverse – Noise levels warrant mitigation of residential properties on a widespread basis in a community, or for outdoor recreation areas.
High	10 dB(A) or more	Major adverse – Noise increases to a level where continued residential use of individual properties is inappropriate, or where the use of a community building could be inappropriate.

6.3.2.2. Construction Phase Impact Assessment

6.3.2.2.1. Assessment Methodology

The calculation of construction noise has been carried out in accordance with the British Standard BS5228:2014 ‘Noise and Vibration Control on Construction and Open Sites’ (53). The standard provides a comprehensive construction equipment inventory with associated noise levels, a construction noise calculation method, practical information on noise reduction measures, and promotes ‘Best Practice Means’ approach to control noise emissions during construction.

The equipment inventory (Table 6-37), used to estimate construction noise levels, was based on Client provided equipment numbers for the construction of the Project Facilities.

It is not possible to identify an exact location from which to measure the edge of the construction site, as a result, construction noise has been assessed by assuming construction activities occur at the boundary nearest to the closest receptor.

To represent a reasonable worst-case scenario, all items in the general construction equipment detailed in the inventory have been assumed to be operating for 100% of the construction hours (daytime and night-time), concurrently at a single location.

Table 6-37: Assumed construction equipment inventory

Plant/Activity	Equipment Total	Sound Pressure Level @ 10 m, L_{Aeq} (dB(A))	Reference[1]
General Construction			
Crawler Crane (1,000 ton)	1	66,00	No. 50 C4
Crawler Crane (300 tons)	2	73,01	No. 52 C5
Hydro Crane (200 tons)	3	75,77	No. 37 C5
Hydro Crane (120 tons)	3	75,77	No. 37 C5
Hydro Crane (100 tons)	4	77,02	No. 37 C5
RT Crane (100 tons)	1	65,00	No. 30 C3

Plant/Activity	Equipment Total	Sound Pressure Level @ 10 m, L_{Aeq} (dB(A))	Reference[1]
Hydraulic Gantry Lift	1	63,00	No. 61 C4
Excavator	5	78,99	No. 2 C2
Wheel Loader	5	80,99	No. 26 C2
Barge	6	66,78	No. 42 C4
Dump Truck	10	84,00	No. 30 C2
Stone Columns Equipment	3	88,77	No. 1 C3
Tower Crane (25 tons)	2	74,01	No. 48 C4
Notes: [1] References from are from Annex C of BS5228 (53) and the SoundPlan Ref. Library.			

6.3.2.2.2. Construction Noise Impact Assessment

The construction noise thresholds are based on the internationally recognised construction noise guidelines of the Department of Environment & Climate Change NSW (52). In terms of the construction phase assessment, the study considers the noisiest activities for general construction.

The predicted noise levels in the area surrounding the Project site are detailed in Table 6-38 which presents the predicted noise levels at specific intervals from 50 m to 1,000 m.

Table 6-38: Predicted construction noise emissions at sensitive receptors

Distance from Project Boundary (m)	General Construction (dB(A))
50	77.5
100	71.4
150	67.9
200	65.4
500	57.5
1,000	51.4

Table 6-39 details the assessment of predicted daytime noise levels at the SRs in terms of the calculated construction noise threshold level (i.e. background noise level + 10 dB) (52).

Table 6-40 details the assessment of predicted night-time noise levels at the SRs in terms of the calculated construction noise threshold level (i.e. background noise level + 5 dB) (52).

Table 6-39: Daytime noise levels and limits at baseline locations

Baseline Locations1	Distance from Unit Boundary (m)	Baseline Noise at Sensitive Receptor	Highest Construction Noise Level at Receptors (dB(A))	Noise Limit at Receptor as per Construction Guideline Threshold2 (dB(A)) (52)	Guideline Threshold Exceeded	Cumulative Noise Level (dB(A))	Maximum Change in Noise Level at Receptor (dB(A))	Impact Severity	Receptor Sensitivity	Impact Significance
SR1	2,274	49.13	44.3	59.1	No	50.3	1.2	*Slight*	*Medium-High*	Minor
SR2	1,433	54.63	48.3	64.6	No	55.5	0.9	*Slight*	*Medium-High*	Minor
SR3	170	54.6	66.8	64.6	Yes	67.1	12.5	*High*	*Medium-High*	Major
SR4	1,424	49.1	48.4	59.1	No	51.8	2.7	*Slight*	*Medium-High*	Minor
SR5	1,030	61.13	51.2	71.1	No	61.5	0.4	*Slight*	*Medium-High*	Minor
SR6	2,218	49.13	44.5	59.1	No	50.4	1.3	*Slight*	*High*	Minor
SR7	742	54.63	54.0	64.6	No	57.3	2.7	*Slight*	*Medium-High*	Minor
SR8	561	44.8	56.5	54.8	Yes	56.8	12.0	*High*	*Medium-High*	Major
SR9	1,543	58.63	47.7	68.6	No	58.9	0.3	*Slight*	*Medium-High*	Minor
SR10	3,915	49.13	39.6	59.1	No	49.6	0.5	*Slight*	*Medium-High*	Minor

Notes:
[1] Note that baseline locations are the same as those shown in the baseline section, Figure 5-43, and have the same ID
[2] Threshold calculated based on background daytime noise level and NSW interim construction noise guidelines (i.e. background noise level + 10 dB)
[3] Baseline values were assigned based on the closest monitored receptor

Table 6-40: Night-time noise levels and limits at baseline locations

Baseline Locations[1]	Distance from Unit Boundary (m)	Baseline Noise at Sensitive Receptor	Highest Construction Noise Level at Receptors (dB(A))	Noise Limit at Receptor as per Construction Guideline Threshold[2] (dB(A)) (52)	Guideline Threshold Exceeded	Cumulative Noise Level (dB(A))	Maximum Change in Noise Level at Receptor (dB(A))	Impact Severity	Receptor Sensitivity	Impact Significance
SR1	2,274	46.1[3]	44.3	51.1	No	48.3	2.2	*Low*	*Medium-High*	Minor
SR2	1,433	52.8[3]	48.3	57.8	No	54.1	1.3	*Low*	*Medium-High*	Minor
SR3	170	52.8	66.8	57.8	Yes	67.0	14.2	*High*	*Medium-High*	Major
SR4	1,424	46.1	48.4	51.1	No	50.4	4.3	*Medium*	*Medium-High*	Moderate
SR5	1,030	49.3[3]	51.2	54.3	No	53.4	4.1	*Medium*	*Medium-High*	Moderate
SR6	2,218	46.1[3]	44.5	51.1	No	48.4	2.3	*Low*	*High*	Moderate
SR7	742	52.8[3]	54.0	57.8	No	56.5	3.7	*Medium*	*Medium-High*	Moderate
SR8	561	45.4	56.5	50.4	Yes	56.8	11.4	*High*	*Medium-High*	Major
SR9	1,543	53.3[3]	47.7	58.3	No	54.4	1.1	*Low*	*Medium-High*	Minor
SR10	3,915	46.1[3]	39.6	51.1	No	47.0	0.9	*Slight*	*Medium-High*	Minor

Notes:
[1] Note that baseline locations are the same as those shown in the baseline section, Figure 5-43, and have the same ID
[2] Threshold calculated based on background daytime noise level and NSW interim construction noise guidelines (i.e. background noise level + 5 dB)
[3] Baseline values were assigned based on the closest monitored receptor

The facility is located within close proximity to residential zones, with the closest residences being approximately 170 m (SR3) and 561 m (SR8) from the nearest unit boundary where construction will take place. As shown in the above tables, the predicted noise levels generated by general construction activities for daytime and night-time periods are anticipated to be below the construction noise thresholds for all locations with the exception of SR3 and SR8 (52). However, this represents a reasonable worst-case scenario, where all items in the general construction equipment list have been assumed to be operating concurrently at a single location. Additionally, it can be noted that SR8 might have substantial screening due to the large tanks located between the receptor and the Project boundary which has not been accounted for in the construction noise model.

6.3.2.2.3. Summary of Construction Impacts

A summary of the impacts on the identified locations generated during the construction phase are presented in Table 6-41 below.

Table 6-41: Noise impacts during construction phase

Impact	Environmental Aspects	Impact Significance prior to Mitigation Measures
Noise increase at SR3 and SR8 during day-time	Increase in off-site noise levels due to construction noise.	Major
Noise increase at other SRs during day-time	Increase in off-site noise levels due to construction noise.	Minor
Noise increase at SR3 and SR8 during night-time	Increase in off-site noise levels due to construction noise.	Major
Noise increase at other SRs during night-time	Increase in off-site noise levels due to construction noise.	Moderate

6.3.2.3. Operational Phase Impact Assessment

In order to estimate the operational noise levels, the internationally recognised noise modelling software 'SoundPLAN' has been utilised. The propagation methodology adopted within the SoundPLAN model was the International Organisation for Standardisation (ISO) 9613 "Acoustics -- Attenuation of sound during propagation outdoors" (54). This document can be referred to for an in-depth description of the methodology SoundPLAN utilises for attenuation of sound and propagation outdoors.

6.3.2.3.1. Assessment Methodology

Calculations have been carried out under normal operating conditions to determine the level of compliance with the environmental noise requirements. A series of noise contour maps have been produced to predict the noise levels in plant areas across the Project site. Noise contour maps are detailed in *Appendix A* of the Noise Study report (**Appendix 2.3** of this EIA report).

6.3.2.3.2. Equipment Included in Study

Overall, 151 continuous noise generating equipment items were modelled for normal operations, this excluded all equipment items that were identified as 'spare' or exclusively for start-up. Full details of all modelled equipment can be found within the Noise Study report (**Appendix 2.3** of this EIA report).

6.3.2.3.3. Site Boundary Noise Contribution

The Project requirements specify that the noise level should not exceed a L_{Aeq} of 70 dB(A) at the property boundary for daytime and 65 dB(A) for night-time conditions. For the purposes of assessment and modelling, point receptors were set up on the boundary fence of the site. Figure 6-18 details the locations of these point receptors, where several points are named as a reference.

An average daytime baseline level of 49.6 dB(A) and a night-time baseline noise level of 52.8 dB(A) was applied at the boundary based on the noise measurements taken at the property boundary.

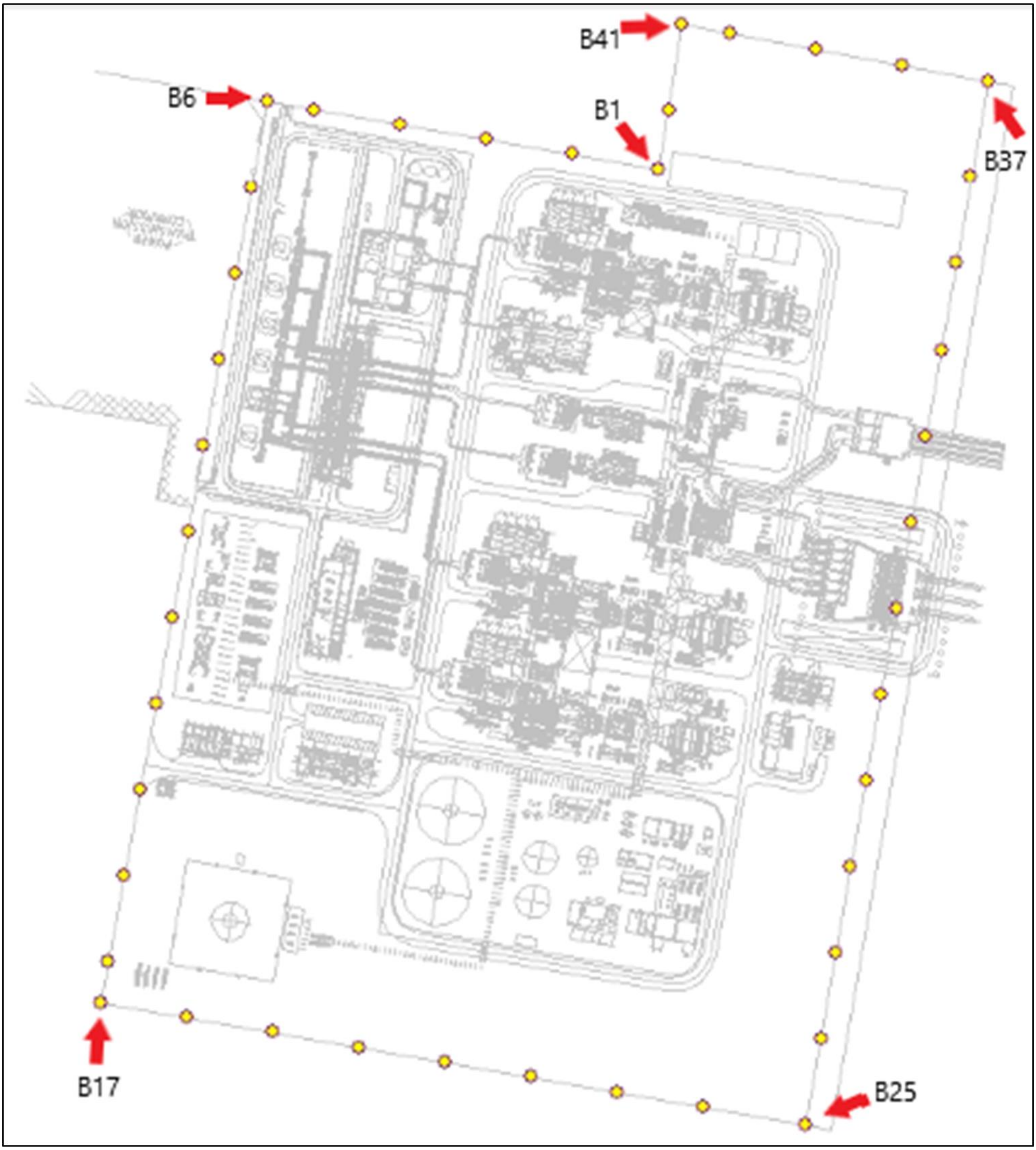

Figure 6-18: Site boundary point receiver locations

Table 6-42 and Table 6-43 detail the modelled noise contribution of the proposed Project equipment items, as well as the estimated cumulative noise at the predefined receptors on the boundary of the site. Table 6-42 presents the cumulative noise in terms of daytime baseline noise, and Table 6-43 presents the corresponding night-time noise results.

Table 6-42: Cumulative daytime boundary contribution from Project noisy equipment for normal operations

Boundary Receptor	Boundary Noise Contribution (dB(A))	Baseline Noise (dB(A))	Cumulative Noise (dB(A))	70 dB(A) Limit Exceeded
B1	69.0	49.6	69.0	No
B2	66.4	49.6	66.5	No
B3	64.3	49.6	64.4	No
B4	62.0	49.6	62.2	No
B5	60.0	49.6	60.4	No
B6	59.2	49.6	59.7	No
B7	59.9	49.6	60.3	No
B8	60.4	49.6	60.7	No
B9	62.3	49.6	62.5	No
B10	64.0	49.6	64.2	No
B11	66.4	49.6	66.5	No
B12	67.3	49.6	67.4	No
B13	64.7	49.6	64.8	No
B14	57.3	49.6	58.0	No
B15	57.9	49.6	58.5	No
B16	56.6	49.6	57.4	No
B17	55.8	49.6	56.7	No
B18	56.9	49.6	57.6	No
B19	57.6	49.6	58.2	No
B20	59.4	49.6	59.8	No
B21	61.6	49.6	61.9	No
B22	61.9	49.6	62.1	No
B23	60.9	49.6	61.2	No
B24	61.5	49.6	61.8	No
B25	61.5	49.6	61.8	No
B26	63.8	49.6	64.0	No
B27	66.4	49.6	66.5	No
B28	68.7	49.6	68.8	No
B29	69.8	49.6	69.8	No

Boundary Receptor	Boundary Noise Contribution (dB(A))	Baseline Noise (dB(A))	Cumulative Noise (dB(A))	70 dB(A) Limit Exceeded
B30	70.3	49.6	70.3	Yes
B31	69.9	49.6	69.9	No
B32	69.5	49.6	69.5	No
B33	69.2	49.6	69.2	No
B34	68.4	49.6	68.5	No
B35	68.3	49.6	68.4	No
B36	66.0	49.6	66.1	No
B37	63.2	49.6	63.4	No
B38	64.0	49.6	64.2	No
B39	64.1	49.6	64.3	No
B40	64.0	49.6	64.2	No
B41	63.3	49.6	63.5	No
B42	66.2	49.6	66.3	No

Table 6-43: Cumulative night-time boundary contribution from Project noisy equipment for normal operations

Boundary Receptor	Boundary Noise Contribution (dB(A))	Baseline Noise (dB(A))	Cumulative Noise (dB(A))	65 dB(A) Limit Exceeded
B1	69.0	52.8	69.1	Yes
B2	66.4	52.8	66.6	Yes
B3	64.3	52.8	64.6	No
B4	62.0	52.8	62.5	No
B5	60.0	52.8	60.8	No
B6	59.2	52.8	60.1	No
B7	59.9	52.8	60.7	No
B8	60.4	52.8	61.1	No
B9	62.3	52.8	62.8	No
B10	64.0	52.8	64.3	No
B11	66.4	52.8	66.6	Yes
B12	67.3	52.8	67.5	Yes
B13	64.7	52.8	65.0	No
B14	57.3	52.8	58.6	No
B15	57.9	52.8	59.1	No
B16	56.6	52.8	58.1	No

Boundary Receptor	Boundary Noise Contribution (dB(A))	Baseline Noise (dB(A))	Cumulative Noise (dB(A))	65 dB(A) Limit Exceeded
B17	55.8	52.8	57.6	No
B18	56.9	52.8	58.3	No
B19	57.6	52.8	58.8	No
B20	59.4	52.8	60.3	No
B21	61.6	52.8	62.1	No
B22	61.9	52.8	62.4	No
B23	60.9	52.8	61.5	No
B24	61.5	52.8	62.0	No
B25	61.5	52.8	62.0	No
B26	63.8	52.8	64.1	No
B27	66.4	52.8	66.6	Yes
B28	68.7	52.8	68.8	Yes
B29	69.8	52.8	69.9	Yes
B30	70.3	52.8	70.4	Yes
B31	69.9	52.8	70.0	Yes
B32	69.5	52.8	69.6	Yes
B33	69.2	52.8	69.3	Yes
B34	68.4	52.8	68.5	Yes
B35	68.3	52.8	68.4	Yes
B36	66.0	52.8	66.2	Yes
B37	63.2	52.8	63.6	No
B38	64.0	52.8	64.3	No
B39	64.1	52.8	64.4	No
B40	64.0	52.8	64.3	No
B41	63.3	52.8	63.7	No
B42	66.2	52.8	66.4	Yes

The results presented in Table 6-42 and Table 6-43 show that during normal operations, the predicted cumulative site boundary noise levels will be below the daytime limit of 70 dB(A) L_{Aeq} at all 42 boundary assessment points with the exception of point B30.

The predicted cumulative night-time noise levels are above the night-time noise limit at locations B1, B2, B11, B12, B27-B36 and B42 on the northern, western and eastern boundary. These exceedances could be attributed to the close proximity of some of the equipment items to the boundary, particularly the pumps on the Eastern boundary between boundary receptors B30 and B33, combined with a lower night-time noise limit which contributes to the number of exceedances. It must also be noted that the assumption that all equipment items are operating at a noise level of 85 dB(A) at 1m is the most conservative assumption, in practice it is expected that a number of equipment items will be operating at lower noise levels, particularly for the gas fuel compressor and the fin fan cooler, located near B11 and B12, which are small equipment and expected to be well below 85 dB(A). It is therefore recommended that an update to the model is completed once vendor data and more complete plot plans are available in order to verify if these predicted exceedances are still present.

The projects contributions at the plant boundary in isolation is illustrated in the noise contour map presented in Figure 6-19 below.

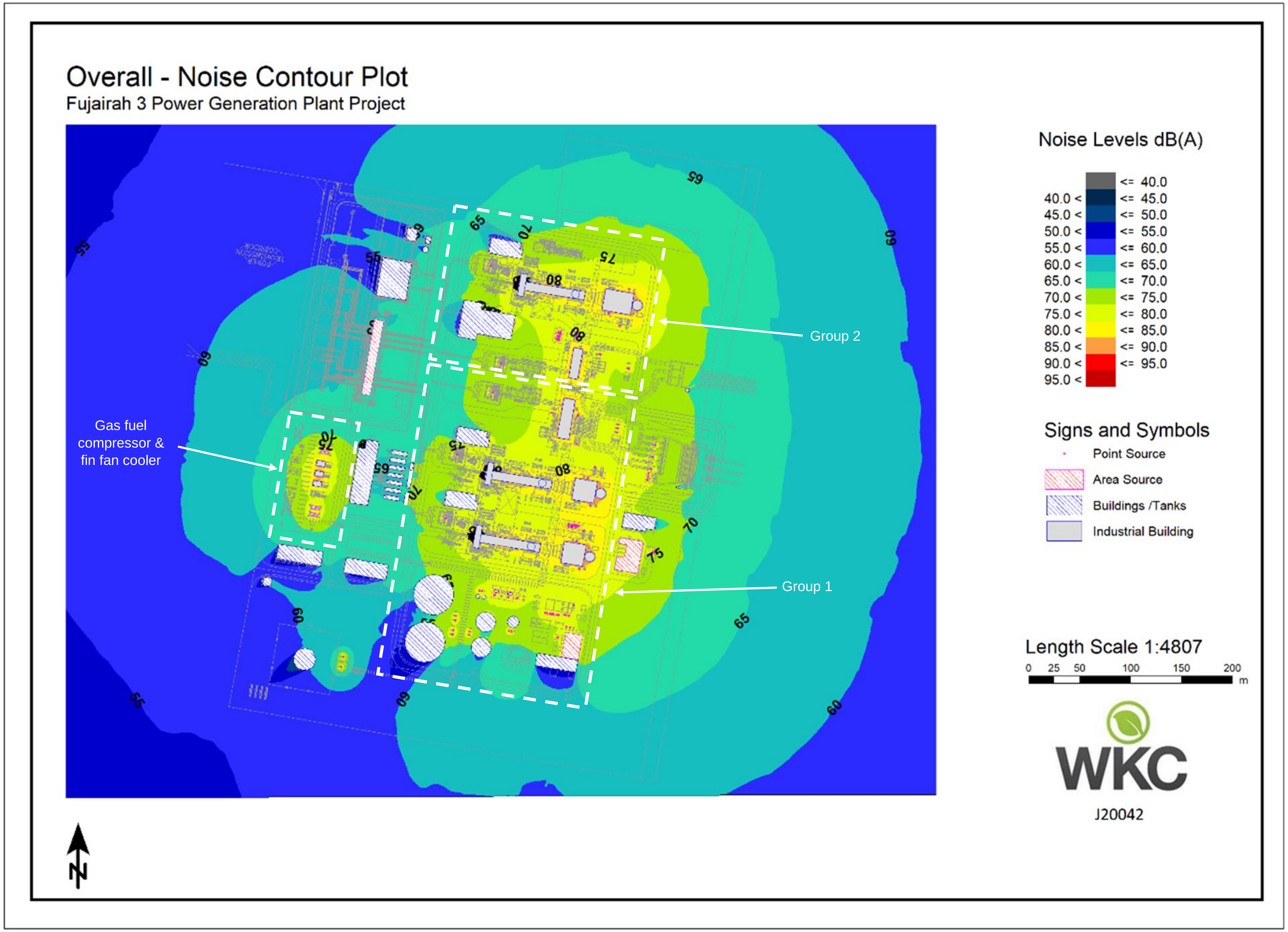

Figure 6-19: Overall plant noise contour plot

6.3.2.3.4. Sensitive Receptor Noise Contribution

An assessment of the noise contribution of the proposed plant has been conducted at various SRs identified in close proximity to the Project site. These include residences, schools and a beach. The predicted noise levels have been compared to the most stringent limits defined in the Federal standards and the IFC guideline noise levels.

6.3.2.3.4.1. Project Noise Contribution in Isolation

The results of the predicted Project noise contributions at the SR locations in isolation are shown in Table 6-44 below.

Table 6-44: Contributed noise levels at selected sensitive receptors

ID.	Description	Most Stringent Noise Limits (dB(A))		Modelled Results (dB(A))	Value above Daytime Limit dB(A)	Value above Night-Time Limit (dB(A))
		Daytime	Night-Time			
SR1	Mixed Residential	60 (Federal)	50 (Federal)	36.2	-	-
SR2	Mixed Residential	60 (Federal)	50 (Federal)	38.3	-	-
SR3	Mixed Residential	60 (Federal)	50 (Federal)	55.0	-	5.0
SR4	Mixed Residential	60 (Federal)	50 (Federal)	38.0	-	-
SR5	Mixed Residential	60 (Federal)	50 (Federal)	40.4	-	-
SR6	Institutional/ Educational	55 (IFC)	45 (IFC)	33.7	-	-
SR7	Mixed Residential	60 (Federal)	50 (Federal)	43.6	-	-
SR8	Mixed Residential	60 (Federal)	50 (Federal)	44.6	-	-
SR9	Mixed Residential	60 (Federal)	50 (Federal)	38.8	-	-
SR10	Mixed Residential	60 (Federal)	50 (Federal)	29.3	-	-

Table 6-44 shows the predicted noise levels from project contributions are below the Federal and IFC most stringent daytime and night-time limits at all locations with the exception of point SR3.

The highest modelled noise result of 55 dB(A) belonged to SR3, which is 170 m from the Project boundary. The result shows exceedance of the night-time limit of 50 dB(A) by 5.0 dB(A). The high noise level at SR3 can be attributed to the close proximity of the proposed project site to the existing receptors in the area and the cumulative noise level from noisy equipment items identified for this project. No single item has a major contribution that can be solely attributed to the exceedances, but rather a cumulative effect. The noise contour plot for the normal operations of the facility is provided in Figure 6-20.

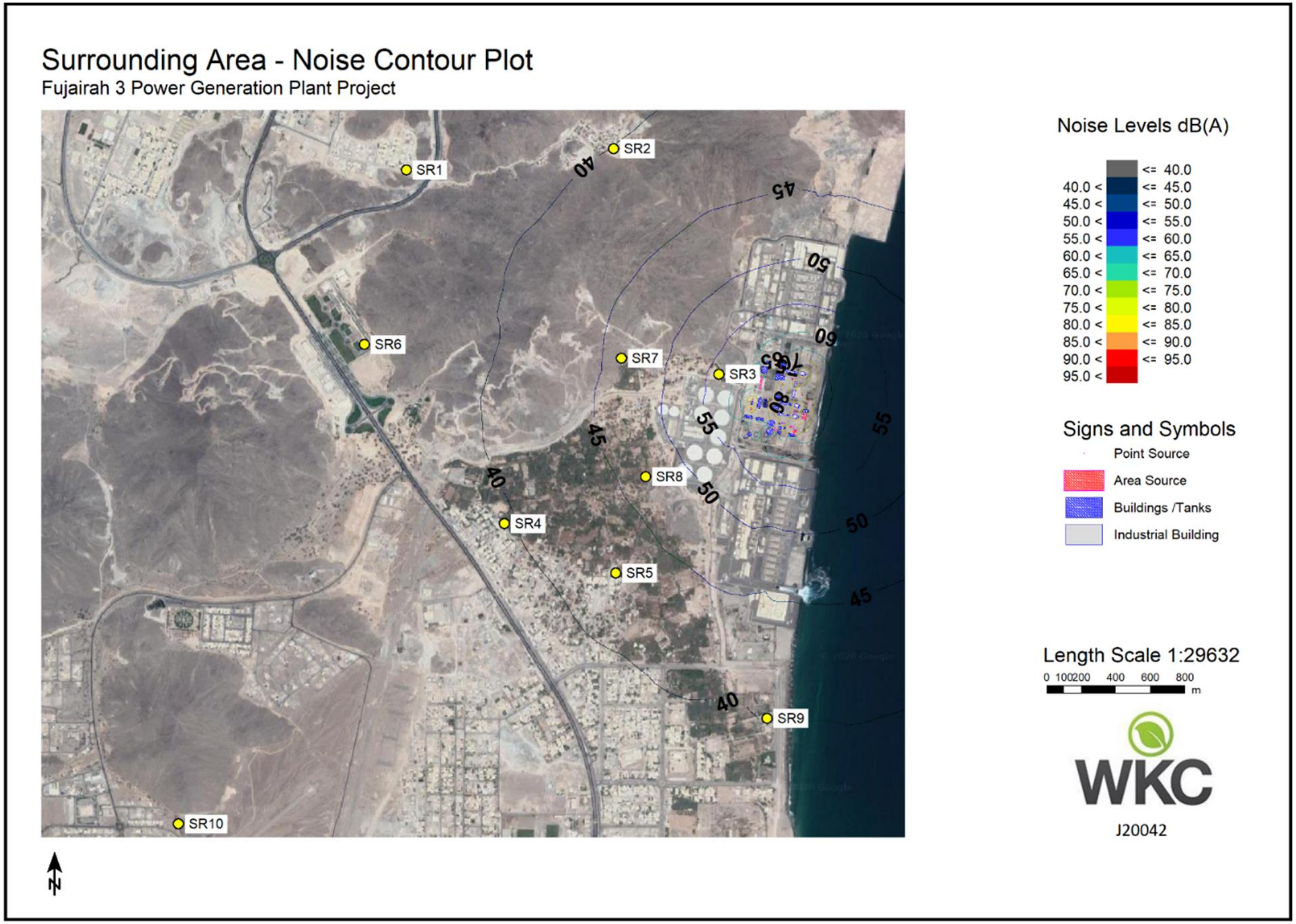

Figure 6-20: Surrounding area-noise contour plot

6.3.2.3.4.2. Cumulative Noise Impact Assessment

A cumulative noise impact assessment was performed in order to determine the severity of the impact of the Project at the nearest SR locations in the context of existing ambient noise levels. The results of the Project noise contribution and resulting cumulative noise and impacts at the identified SR´s is presented in Table 6-45 for both daytime and night-time operations, with the impact severity based upon Table 6-36.

Table 6-45: Operational impact assessment

ID.	Description	Most Stringent Noise Limits (dB(A))	Project Noise Contribution (dB(A))	Baseline Noise Level (dB(A))	Cumulative Noise Level (dB(A))	Maximum Change in Noise Level at Receptor (dB(A))	Noise Limit Exceeded?	Cumulative Value above Limit dB(A)	Impact Severity	Receptor Sensitivity	Impact Significance
Daytime Operational Impact Assessment											
SR1	Mixed Residential	60 (Federal)	36.2	49.1[1]	49.3	0.2	No	-	Slight	*Medium-High*	Minor
SR2	Mixed Residential	60 (Federal)	38.3	54.6[1]	54.7	0.1	No	-	Slight	*Medium-High*	Minor
SR3	Mixed Residential	60 (Federal)	55.0	54.6	57.8	3.2	No	-	Low	*Medium-High*	Minor
SR4	Mixed Residential	60 (Federal)	38.0	49.1	49.4	0.3	No	-	Slight	*Medium-High*	Minor
SR5	Mixed Residential	60 (Federal)	40.4	61.1[1]	61.1	0.0	Yes	1.1	No Change	*Medium-High*	Negligible
SR6	Institutional/ Educational	55 (IFC)	33.7	49.1[1]	49.2	0.1	No	-	Slight	*High*	Minor
SR7	Mixed Residential	60 (Federal)	43.6	54.6[1]	54.9	0.3	No	-	Slight	*Medium-High*	Minor
SR8	Mixed Residential	60 (Federal)	44.6	44.8	47.7	2.9	No	-	Slight	*Medium-High*	Minor
SR9	Mixed Residential	60 (Federal)	38.8	58.6[1]	58.6	0.0	No	-	No Change	*Medium-High*	Negligible
SR10	Mixed Residential	60 (Federal)	29.3	49.1[1]	49.1	0.0	No	-	No Change	*Medium-High*	Negligible
Night-time Operational Impact Assessment											
SR1	Mixed Residential	50 (Federal)	36.2	46.1[1]	46.5	0.4	No	-	Slight	*Medium-High*	Minor
SR2	Mixed Residential	50 (Federal)	38.3	52.8[1]	53.0	0.2	Yes	3.0	Slight	*Medium-High*	Minor
SR3	Mixed Residential	50 (Federal)	55.0	52.8	57.0	4.2	Yes	7.0	Low	*Medium-High*	Minor
SR4	Mixed Residential	50 (Federal)	38.0	46.1	46.7	0.6	No	-	Slight	*Medium-High*	Minor
SR5	Mixed Residential	50 (Federal)	40.4	49.3[1]	49.8	0.5	No	-	Slight	*Medium-High*	Minor
SR6	Institutional/ Educational	45 (IFC)	33.7	46.1[1]	46.3	0.2	Yes	1.3	Slight	*High*	Minor
SR7	Mixed Residential	50 (Federal)	43.6	52.8[1]	53.3	0.5	Yes	3.3	Slight	*Medium-High*	Minor
SR8	Mixed Residential	50 (Federal)	44.6	45.4	48.0	2.6	No	-	Slight	*Medium-High*	Minor
SR9	Mixed Residential	50 (Federal)	38.8	53.3[1]	53.5	0.2	Yes	3.5	Slight	*Medium-High*	Minor
SR10	Mixed Residential	50 (Federal)	29.3	46.1[1]	46.2	0.1	No	-	Slight	*Medium-High*	Minor

Notes:
[1] : Baseline values were assigned based on the closest monitored receptor

Based on the cumulative results presented in Table 6-45, the severity in the change of noise levels at the SRs due to the project operation can be quantified. The results show that during the day, the predicted impacts from the project are in the range of “no effect” to “slight” with the exception of SR3 where a “low” impact is predicted. In terms of night-time noise levels, the predicted impacts are largely “slight”, with the exception of SR3 where a “low” impact is also predicted. It should also be noted that the increase in noise levels at SR3 (day and night) is predicted to be in excess of the IFC guideline, which states that the project should not result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

As can be seen from Table 6-45, several of the cumulative noise levels at the SR’s are in exceedance of the most stringent noise limits defined in Table 3-8. With the exception of SR3, these exceedances can be entirely attributed to the relatively high baseline noise levels recorded in these areas, which are already exceeding the limits before the project contribution is added. SR3 already also has a baseline level that is above the limit, however, the project should not contribute noise that can significantly contribute further to this exceedance. Again, this relatively high project contribution at SR3 could be attributed to the close proximity of the receptor to this industrial site (170 m) and the conservative nature of the modelling assessment.

6.3.2.3.5. Summary of Operational Impacts

6.3.2.3.5.1. Impacts at the Project boundary

The impacts during operation are predicted to be an impact of Low severity, upon a receptor of Low sensitivity (as the boundary is considered to be an industrial receptor).

Therefore, it has been assessed that the impacts of operational noise at the boundary are of **negligible** significance. Nevertheless, mitigation measures have been developed to ensure that noise impacts are minimised.

6.3.2.3.5.2. Impacts upon sensitive receptors

The impacts during operation upon the identified SRs are as follows:

- SR3 - predicted to be an impact of Low severity, upon a receptor of Medium-High sensitivity - **Minor negative** significance; and
- All other SRs - predicted to be an impact of Slight severity, upon receptors of Medium-High and High sensitivity – **Minor negative** significance.

Given that an impact of minor significance has been identified, mitigation measures have been developed to ensure that noise impacts are minimised.

6.3.2.3.5.3. Summary

Predicted impacts at the Project boundary and upon the identified SR's associated with the operational phase are presented in Table 6-46 below.

Table 6-46: Noise impacts during operational phase

Impact	Environmental Aspects	Impact Significance prior to Mitigation Measures
Exceedance of noise limit of Project boundary/industrial receptors surrounding the Project site	Increase in noise levels at site boundary and off-site receptors.	Negligible
Impact upon all SRs	Increase in off-site noise levels due to operation of noisy equipment on-site.	Minor negative

6.3.3. Soil, Surface Water and Groundwater

6.3.3.1. Construction Phase

6.3.3.1.1. Soil Erosion

Soils can be negatively impacted during construction due to activities such as the removal of vegetation, grading and filling, excavation etc. Left unprotected, construction sites can be further degraded by erosion and may begin to affect the surrounding environment. It is likely that the majority of soil erosion would result from wind-blown dust and as sediments within surface run-off during storm events. However, due to the general paucity of the natural vegetative cover in most sections of the Project site, the impact of soil erosion is less significant in comparison to locations where significant vegetation would need to be removed exposing the topsoil.

It is expected that only minimal requirements for clearing vegetation from the site will occur. The impact severity associated with soil erosion is considered to be moderate, given the areas affected, and the receptor sensitivity as medium, given that there is already minimal vegetation cover and infrequent rainfall. The impact significance is therefore assessed to be of **moderate negative** significance in the absence of control measures.

6.3.3.1.2. Contamination from Construction Activities

6.3.3.1.2.1. Soil Contamination

6.3.3.1.2.1.1. Mobilisation of Existing Contamination

Based upon the results of the Phase II investigation undertaken as part of this ESIA, the soils at BH-05 are considered to have exceedances in levels of zinc and copper. Additionally, all areas tested throughout the Project site were observed to contain exceedances in levels of nickel. Any issues associated with the mobilisation of existing contaminants are therefore considered to be a moderate risk, which is considered to be an impact of **moderate negative** significance.

Additionally, areas of undiscovered contamination could further exist and therefore additional checks will be required to identify if additional existing contamination is present and appropriate measures implemented to remove any contamination in advance of disturbance to prevent the mobilisation of contaminants into the wider environment.

6.3.3.1.2.1.2. Contamination from Construction Activities

Overview

During the construction phase, there is possibility of soil contamination to occur due to a range of activities including spillage of fuels, spillages in vehicle maintenance areas, overflow at vehicle wash-down areas, overflow of sanitary effluent and general improper storage of hazardous materials. These are described below.

Storage, use and handling of hazardous materials

During the construction stage of the Project, the following types of materials are likely to be stored, handled and used on site:

- Fuels, lubricants and oils;
- Solvents and Paints; and
- Hazardous wastes.

Materials storage and handling will occur within the construction site laydown area but are likely to be used in smaller quantities throughout the Project site. The uncontrolled storage and handling of these chemicals can potentially cause pollution to the soil, surface water and subsequent groundwater if left unchecked or not appropriately managed.

Due to the nature of the construction works, the potential for major contamination events is generally limited and any contamination events would be expected to affect a highly localised area only. Therefore, the impact severity is low, although the receptor sensitivity is classified as high. The impact significance is therefore considered to be of **moderate negative** significance prior to the implementation of mitigation measures.

Storage and disposal of hazardous wastes

Hazardous waste generated during the construction phase will include:

- Waste oils, solvents, contaminated drums and containers, etc.
- Sewage waste from site offices, workers camps and construction sites.
- Wash down water from concrete trucks, etc.

Uncontrolled storage, handling and disposal of chemicals can lead to potential spills resulting in soil and eventual groundwater contamination.

The majority of these materials will be generated and stored at the main construction sites. Inappropriate storage and disposal of waste material can result in the contamination of soil, surface water and subsequent groundwater if left unchecked or not appropriately managed. Waste oils, etc, is likely to be generated in higher volumes at locations where servicing of plant and equipment is being undertaken, such as the main construction site laydown area.

Due to the nature of the construction works as well as the quantities of hazardous wastes, the potential for major contamination events is generally limited and any contamination events would be expected to affect a highly localised area only. Therefore, the impact severity is low, although the receptor sensitivity is classified as high. The impact significance is therefore considered to be of **moderate negative** significance prior to the implementation of mitigation measures.

Generation of sanitary effluents

Temporary sanitary facilities are likely to be included within the main construction site. Sewage waste generated from the workers contains high levels of bacteria such as coliforms and high levels of nutrients which can contaminate soil. Soil and groundwater contamination is possible in the event of leakages or poor maintenance of onsite wastewater infrastructure.

This impact is likely to be temporary in nature and will only be applicable during the construction phase and any contamination events would be expected to affect a highly localised area only. Therefore, the impact severity is low, although the receptor sensitivity is classified as high. The impact significance is therefore considered to be of **moderate negative** significance prior to the implementation of mitigation measures.

Disposal of washdown effluents

Vehicle and plant washdown as well as concrete wash out has the potential to contaminate soils and eventually groundwater within the Project area if not carried out using appropriate methods.

Vehicle and plant washdown water can carry traces of lubricants and other contaminates. Concrete washout is alkaline in nature due to the materials involved. The incorrect or improper disposal of these liquids on site can negatively impact local soil and groundwater.

This impact is likely to be temporary in nature and will only be applicable during the construction phase. Any contamination events would be expected to affect a highly localised area only. Therefore, the impact severity is low, although the receptor sensitivity is classified as high. The impact significance is therefore considered to be of **moderate negative** significance prior to the implementation of mitigation measures.

6.3.3.1.2.2. Importation of Fill Material

Significant amounts of material may need to be imported to the Project site for levelling purposes as well as topographic variations for the Project design. This presents a risk of importing potentially contaminated material into the Project site. This risk level is very much reliant on the contamination type and concentrations within the imported material.

The risk of importing fill material which is contaminated is considered to be low. Nevertheless, the importation of contaminated materials would be considered to be a potential impact of medium severity upon a receptor of high sensitivity and therefore the impact is considered to be potentially of **major negative** significance prior to the implementation of control measures.

6.3.3.1.2.3. Asbestos in Existing Building and Structures

Asbestos may be present in existing structures or buildings within the Project site, and the demolition and removal of these buildings, if asbestos materials are present, could result in asbestos exposure to the construction workforce if not removed and disposed of in accordance with best practice.

One area has been identified where existing asbestos cement sheeting are present. The location of these cement sheets does create the necessity of construction phase interaction during site cleaning or demolition. In this event, workers are likely to come into contact with disturbed asbestos fibres which presents a significant risk to soil contamination and worker's health. With this confirmed location as well as the possibility for further unidentified volumes of asbestos within existing buildings and structures the impact magnitude is high, and the receptor sensitivity is classified as high. The impact significance is therefore considered to be **major negative** significance prior to the implementation of mitigation measures.

6.3.3.1.3. Groundwater Contamination

During the construction phase, there is possibility of groundwater contamination to occur due to spillage of fuels, spillages in vehicle maintenance areas, overflow at vehicle wash-down areas, overflow of sanitary effluent and the general improper storage of hazardous materials. The shallow depth of the water table at some locations means that these areas will be particularly vulnerable to impacts from surface spills.

The potential for major contamination spillages is generally limited; however, if entering the groundwater there is the potential for contamination over a wider area and a long timeframe and therefore, the impact severity is assessed as potentially high. The sensitivity of the receptor is considered to be medium throughout the Project site although would be considered as high in areas closest to the coastal shore as this has the potential to directly impact the marine environment. The impact significance is therefore considered to be of **major negative** significance prior to the implementation of mitigation measures.

6.3.3.1.4. Summary of Construction Impacts

A summary of the identified impacts is presented within Table 6-47 below.

Table 6-47: Soil, groundwater and surface water impacts during construction phase

Impact	Environmental Aspects	Impact significance prior to mitigation measures
Soil erosion	Loss of soil and aggregate reserves within the Project site	Moderate negative
Mobilisation of existing Contamination	Soil and groundwater contamination from improper storage and handling causing spills and leaks	Moderate negative
Storage, use and handling of hazardous materials		Moderate negative
Storage and disposal of hazardous wastes		Moderate negative
Generation of sanitary effluents	Potential for groundwater contamination as a result of improper storage, handling and processing	Moderate negative
Disposal of washdown effluents		Moderate negative
Importation of fill material	Importation of contaminants to local soil and groundwater	Major negative
Groundwater contamination	Contamination of local groundwater levels	Major negative
Asbestos in existing buildings and structures	Risk of soil contamination and the potential inhalation of asbestos fibres located within existing buildings and structures found within the Project site	Major negative

6.3.3.2. Operational Phase

6.3.3.2.1. Operational Leakages and Accidental Discharges

During the operation of the Project, the key contamination issues are likely to be associated with potential leaks and spills associated with the plant operations and storage of hazardous materials on-site. The materials with potential to cause contamination include: fuels (such as associated with diesel generator operation); oils (such as associated with the maintenance and repair of equipment); lubricants (such as those associated with plant equipment maintenance and repair): and chemicals (such as those associated with the chemical dosing system).

Prior to mitigation measures being implemented, the use and storage of materials on site with hazardous properties and the potential to cause contamination is likely to result in a **moderate negative** impact. However, adequate handling and storage arrangements complemented by appropriate procedural control measures would diminish such an impact substantially.

6.3.3.2.2. Summary of Operational Impacts

A summary of the identified impacts is presented within Table 6-48 below.

Table 6-48: Soil, groundwater and surface water impacts during operational phase

Impact	Environmental Aspects	Impact significance prior to mitigation measures
Operational Leakages and Accidental Discharges	Potential leaks and spills associated with the plant operations and storage of hazardous materials on-site	Moderate negative

6.3.4. Terrestrial Ecology

6.3.4.1. Assessment Approach

6.3.4.1.1. Sensitive Areas

Due to fact that no natural habitats remain on the study area, no ecologically sensitive areas occur within or adjacent to the study area.

6.3.4.1.2. Performance Standard 6

Performance Standard 6 (PS6) recognises that protecting and conserving biodiversity—the variety of life in all its forms, including genetic, species and ecosystem diversity—and its ability to change and evolve, is fundamental to sustainable development. The components of biodiversity, as defined in the Convention on Biological Diversity, include ecosystems and habitats, species and communities, and genes and genomes, all of which have social, economic, cultural and scientific importance. This Performance Standard reflects the objectives of the Convention on Biological Diversity to conserve biological diversity and promote use of renewable natural resources in a sustainable manner. This Performance Standard addresses how clients can avoid or mitigate threats to biodiversity arising from their operations as well as sustainably manage renewable natural resources.

The objectives of Performance standard 6 are:

- To protect and conserve biodiversity; and
- To promote the sustainable management and use of natural resources through the adoption of practices that integrate conservation needs and development priorities.

The scope of application of PS6 is described as follows:

- The applicability of this Performance Standard is established during the Social and Environmental Assessment process, while implementation of the actions necessary to meet the requirements of this Performance Standard is managed through the client's Social and Environmental Management System as per Performance Standard 1; and
- Based on the Assessment of risks and impacts and the vulnerability of the biodiversity and the natural resources present, the requirements of this Performance Standard are applied to projects in all habitats, whether or not those habitats have been previously disturbed and whether or not they are legally protected.

The requirements of PS6 are as follows:

- **Protection and Conservation of Biodiversity**
  - In order to avoid or minimize adverse impacts to biodiversity in the project's area of influence, the client will assess the significance of project impacts on all levels of biodiversity as an integral part of the Social and Environmental Assessment process;
  - The Assessment will consider the differing values attached to biodiversity by specific stakeholders, as well as identify impacts on ecosystem services; and
  - The Assessment will focus on the major threats to biodiversity, which include habitat destruction and invasive alien species.

- **Habitat**

  Habitat destruction is recognized as the major threat to the maintenance of biodiversity. Habitats can be divided into natural habitats (which are land and water areas where the biological communities are formed largely by native plant and animal species, and where human activity has not essentially modified the area's primary ecological functions) and modified habitats (where there has been apparent alteration of the natural habitat, often with the introduction of alien species of plants and animals, such as agricultural areas). Both types of habitat can support important biodiversity at all levels, including endemic or threatened species.

- **Modified Habitat**

  In areas of modified habitat, the client will exercise care to minimize any conversion or degradation of such habitat, and will, depending on the nature and scale of the project, identify opportunities to enhance habitat and protect and conserve biodiversity as part of their operations.

- **Natural Habitat**

  In areas of natural habitat, the client will not significantly convert or degrade such habitat, unless the following conditions are met:
  - There are no technically and financially feasible alternatives;
  - The overall benefits of the project outweigh the costs, including those to the environment and biodiversity; and
  - Any conversion or degradation is appropriately mitigated.

  Mitigation measures will be designed to achieve no net loss of biodiversity where feasible, and may include a combination of actions, such as:
  - Post-operation restoration of habitats;
  - Offset of losses through the creation of ecologically comparable area(s) that is managed for biodiversity; and
  - Compensation to direct users of biodiversity.

- **Critical Habitat**

  Critical habitat is a subset of both natural and modified habitat that deserves particular attention. Critical habitat includes areas with high biodiversity value, including habitat required for the survival of critically endangered or endangered species; areas having special significance for endemic or restricted-range species; sites that are critical for the survival of migratory species; areas supporting globally significant concentrations or numbers of individuals of congregatory species; areas with unique assemblages of species or which are associated with key evolutionary processes or provide key ecosystem services; and areas having biodiversity of significant social, economic or cultural importance to local communities.
  In areas of critical habitat, the client will not implement any project activities unless the following requirements are met:
  - There are no measurable adverse impacts on the ability of the critical habitat to support the established population of species described above or the functions of the critical habitat described above;
  - There is no reduction in the population of any recognized critically endangered or endangered species;
  - Any lesser impacts are mitigated in accordance with accepted best practices.

- **Legally protected Areas**

  In circumstances where a proposed project is located within a legally protected area, the client, in addition to the applicable requirements above, will meet the following requirements:
  - Act in a manner consistent with defined protected area management plans;
  - Consult protected area sponsors and managers, local communities, and other key stakeholders on the proposed project; and
  - Implement additional programs, as appropriate, to promote and enhance the conservation aims of the protected area.

- **Invasive Alien Species**

  Intentional or accidental introduction of alien, or non-native, species of flora and fauna into areas where they are not normally found can be a significant threat to biodiversity, since some alien species can become invasive, spreading rapidly and out-competing native species.

The client will not intentionally introduce any new alien species (not currently established in the country or region of the Project) unless this is carried out in accordance with the existing regulatory framework for such introduction, if such framework is present, or is subject to a risk assessment (as part of the client's Social and Environmental Assessment) to determine the potential for invasive behaviour. The client will not deliberately introduce any alien species with a high risk of invasive behaviour or any known invasive species and will exercise diligence to prevent accidental or unintended introductions.

- **Management and Use of Renewable natural resources**

  The client will manage renewable natural resources in a sustainable manner. Where possible, the client will demonstrate the sustainable management of the resources through an appropriate system of independent certification.
  In particular, forests and aquatic systems are principal providers of natural resources, and need to be managed as specified below.

- **Natural and Plantation Forests**

  Clients involved in natural forest harvesting or plantation development will not cause any conversion or degradation of critical habitat. Where feasible, the client will locate plantation projects on unforested land or land already converted (excluding land that is converted in anticipation of the project). In addition, the Client will ensure that all natural forests and plantations over which they have management control are independently certified as meeting performance standards compatible with internationally accepted principles and criteria for sustainable forest management. Where a pre-assessment determines that the operation does not yet meet the requirements of such an independent forest certification system, the client will develop and adhere to a time-bound, phased action plan for achieving such certification.

- **Freshwater and Marine Systems**

  Clients involved in the production and harvesting of fish populations or other aquatic species must demonstrate that their activities are being undertaken in a sustainable manner, through application of an internationally accepted system of independent certification, if available, or through appropriate studies carried out in conjunction with the Social and Environmental Assessment process.

6.3.4.2. Construction Phase

6.3.4.2.1. Impact 1: Vegetation clearing

During the construction phase the entire study area will be cleared of vegetation in order to make way for the Project. Loss of flora will therefore be complete. Due to the already degraded nature of the study area, the fact that the area was previously cleared and has little or no ecological value this impact is likely to be **negligible**.

6.3.4.2.2. Impact 2: Landscaping and construction

Due to the fact that the entire area is likely to be cleared of any natural habitats there will be no natural fauna and flora to be impacted upon by the landscaping. The impact will therefore be **negligible**.

6.3.4.2.3. Impact 3: Vibration and noise disturbance

Due to the fact that the entire area is likely to be cleared of any natural habitats and the fact that the surrounding and adjacent areas are currently occupied by industry, there will be no natural fauna and flora to be impacted upon by the vibration and noise. The impact will therefore be **negligible**.

6.3.4.2.4. Impact 4: Chemical pollution

Due to the fact that the entire area is likely to be cleared of any natural habitats and the fact that the surrounding and adjacent areas are currently occupied by industry, there will be no natural fauna and flora to be impacted upon by any chemical pollution that will take place. The impact will therefore be **negligible**.

6.3.4.2.5. Impact 5: Dust deposition

Due to the fact that the entire area is likely to be cleared of any natural habitats and the fact that the surrounding and adjacent areas are currently occupied by industry, there will be no natural fauna and flora to be impacted upon by any dust deposition that occurs. The impact will therefore be **negligible**.

6.3.4.2.6. Summary of Construction Impacts

A summary of the identified impacts is presented within Table 6-49 below.

Table 6-49: Terrestrial ecology impacts during construction phase

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures
Impact 1: Vegetation clearing	Loss of Vegetation and Habitat	Negligible
Impact 2: Landscaping and construction		
Impact 3: Vibration and noise disturbance	Disturbance to Fauna	
Impact 4: Chemical pollution	Disturbance to Fauna and Flora	
Impact 5: Dust deposition	Disturbance to Fauna and Flora	

6.3.4.3. Operational phase

6.3.4.3.1. Operational Impacts

Due to the fact that, during the operational phase, the entire study area will have been transformed and further ecological impacts are not predicted and the impact will therefore be **negligible**.

6.3.4.3.2. Summary of Operational Impacts

A summary of the identified impacts is presented within Table 6-50 below.

Table 6-50: Terrestrial ecology impacts during operational phase

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures
Impacts to Flora and Fauna	N/A	Negligible

6.3.5. Marine Water & Sediment

6.3.5.1. Construction Phase

6.3.5.1.1. Sedimentation from construction activities

Construction activities that disturb the substrate will result in sediment plumes which increase turbidity and could release metals and nutrients from within the sediments. Construction of the pipelines and digging/dredging in the shallow areas/shoreline will disturb sediments and release plumes with any associated contaminants into the water. Due to the construction of the pipelines the likelihood is high, but impacts are at a local scale. The impact is of low severity on receptors of medium sensitivity, resulting in an impact of **minor negative** significance.

6.3.5.1.2. Spill of hazardous material to the marine environment

A number of hazardous materials will be required on the site to complete the construction including paints, oils, fuels and solvents. Should inadequate procedures and controls be in place for storage, transport and handling of these hazardous materials, there is potential for leaks and spills into the marine environment. Spills of hazardous materials particularly liquid wastes, chemicals and fuels will negatively impact the water and sediment quality. A spill into the marine environment (depending on the volume and substance) would have a medium impact at a local scale upon receptors of medium sensitivity. The likelihood is however unlikely and of **minor negative** significance.

6.3.5.1.3. Summary of Construction Impacts

A summary of the identified impacts is presented within Table 6-51 below.

Table 6-51: Marine water and sediment impacts during the construction phase

Impact	Environmental Aspects	Impact significance prior to mitigation measures
Sedimentation from construction activities	Increased turbidity, metals and nutrients	Minor
Spill of hazardous materials to marine environment	Pollution to marine water and sediments	Minor

6.3.5.2. Operational Phase

6.3.5.2.1. Thermal discharge

The Project will utilise seawater as the cooling medium with an expected discharge into the marine environment at 5°C higher than the ambient environment.

The discharge of cooling water and the subsequent overall increased seawater temperature in the ambient environment has the potential to alter the water quality.

A detailed hydrodynamic study has been undertaken, which is presented within **Appendix 2.4**. This study showed no exceedance of temperature (>3°C to ambient temperature) for the 95th percentile in the Regulatory Mixing Zone (RMZ) on the seabed (highest concentration in the water column), as shown in Figure 6-21. The impact is of a high likelihood at a local scale and of low severity. The potential receptor of water quality and sediment are considered to be of medium sensitivity due to impacts from existing outfalls, resulting in an impact of **minor negative** significance.

6.3.5.2.2. Chlorine discharge

Chlorine is a biocide which is commonly added to seawater cooling systems to control the growth of fouling organisms. Biota responsible for fouling are commonly broken down into two groups, microfouling organisms and macrofouling organisms, the former includes bacteria, fungi and algae. These microorganisms form slime on surfaces, which can inhibit heat transfer and reduce efficiency of the cooling system.

Macrofouling organisms include barnacles, bivalve molluscs, bryozoans, chordates and sponges. The organisms can form within cooling pipes and inhibit water flow, which again reduces cooling efficiency. Focus on controlling bivalve growth is generally prioritised as once bivalves are controlled (being more resilient), additional organisms do not cause any additional issues (55).

Toxicity of residual chlorine is dependent upon concentration of the toxic species of residual chlorine and time of exposure. The relationship between chlorine and other factors in the marine environment (e.g. temperature, salinity and COD) cause it to be rapidly converted to hypochlorous acid and hydrochloric acid in receiving water (56). The term free chlorine refers to Cl2, HOCl and hypochlorite ion (OCl-) in equilibrium. The relative amounts of these chemical species are dependent on pH, temperature and ionic strength. In addition, chlorine reacts readily with nitrogenous substances such as ammonia to form chlorinated compounds. These compounds are more persistent in the marine environment than free chlorine and are known as combined chlorine. The sum of combined and free chlorine is referred to as total residual chlorine (57).

Specific studies on the decay rate of residual chlorine within seawater cooling systems have been conducted in order to provide guidance on residual concentrations and associated environmental impacts for facilities such as power plants and desalination plants (58) (59), refer to Table 6-52. Under laboratory conditions the decay rate was shown to be highly dependent on seawater salinity (with decay rate increasing with increased salinity), temperature (with decay rate increasing with increased temperature), and COD (with decay rate increasing with increases COD concentration). In addition, in practical conditions (i.e. within the receiving marine environment), residual chlorine concentrations were shown to rapidly decay within the first minute, with decay slowing thereafter and achieving an equilibrium after approximately 20 minutes. The total percentage of decay before reaching equilibrium increases with a reduction in initial dosing concentration.

Table 6-52: Approximate decay rate of residual Chlorine (58)

Initial Dosing Concentration (mg/l)	Concentration Remaining at Equilibrium (mg/l)	Percentage of Initial Dosage Remaining at Equilibrium (%)
5.90	2.50	42%
4.74	1.80	38%
3.53	1.20	34%
2.35	0.40	17%
1.23	<0.01	<1%

The expected residual chlorine levels in the effluent discharge was supplied by the Marubeni and the planned initial dosage of residual chlorine used within the cooling water intake is proposed at 0.2mg/l for normal operations with intermittent shock dosing of 2.0 mg/l that will not be repeated in a 24 hour cycle. However, as the decay rate depends on multiple other variables (at least temperature, salinity and COD), for the purposes of the impact assessment a conservative decay rate has been assumed which results in 30% of the initial concentration remaining after 20 minutes of discharge, after which it is assumed that the residual chlorine reaches equilibrium and does not undergo any further chemical decay. Any reduction in concentration after 20 minutes is caused by dilution only.

Figure 6-22 presents the 95th percentile at the surface (highest concentration within the water column) concentration of chlorine considering a dosage of 0.2 mg/l. It is predicted that at these discharge concentrations no exceedance (>0.01mg/l) of the regulatory guidelines for residual chlorine will occur inside or beyond the RMZ.

The impact is of a high likelihood at a local scale and low severity. The potential receptor of water quality and sediment are considered to of medium sensitivity due to impacts from existing outfalls, resulting in an impact of **minor negative** significance.

6.3.5.2.3. Salinity

The cooling water effluent, rejected from the diffusers, will be warmer than the ambient environment. Due to various processes within each of the facilities, the salinity of the cooling water from each facility will also be higher than the ambient. It is expected the discharge water to have an increase of 0.1 PSU salinity compared to ambient temperatures.

Figure 6-23 displays the hydrodynamic model for salinity at the seabed (highest concentration in the water column) for the 95th percentile. The results indicate that salinity discharges within the RMZ will not exceed the maximum allowable increase of 5% salinity from the ambient (background) salinity levels.

The impact is of a high likelihood during operations but at a local scale. The impact severity is considered low and this will impact a receptor of medium sensitivity due to existing outfalls in the area and the impact significance is therefore assessed as being **minor negative**.

6.3.5.2.4. Summary of Operational Impacts

A summary of the identified impacts is presented within Table 6-60 below.

Table 6-53: Marine water and sediment impacts during the operational phase

Impact	Environmental Aspects	Impact significance prior to mitigation measures
Thermal discharge	Increase in temperature over ambient levels	Minor
Chlorine discharge	Increase in chlorine over ambient levels	Minor
Salinity discharge	Increase in salinity above ambient levels	Minor

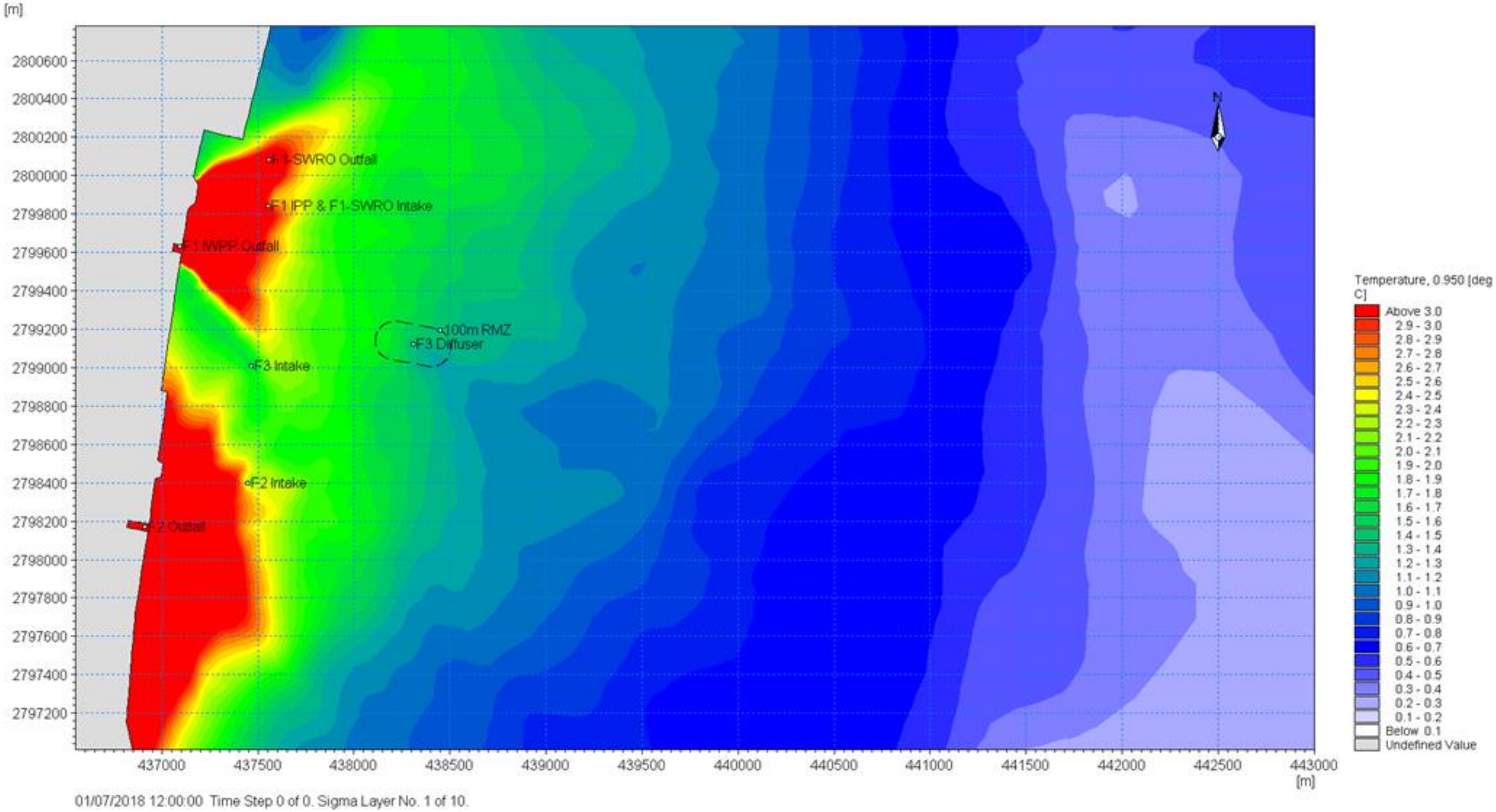

Figure 6-21: Hydrodynamic modelling of temperature on seabed for the 95th percentile (highest concentration in water column)

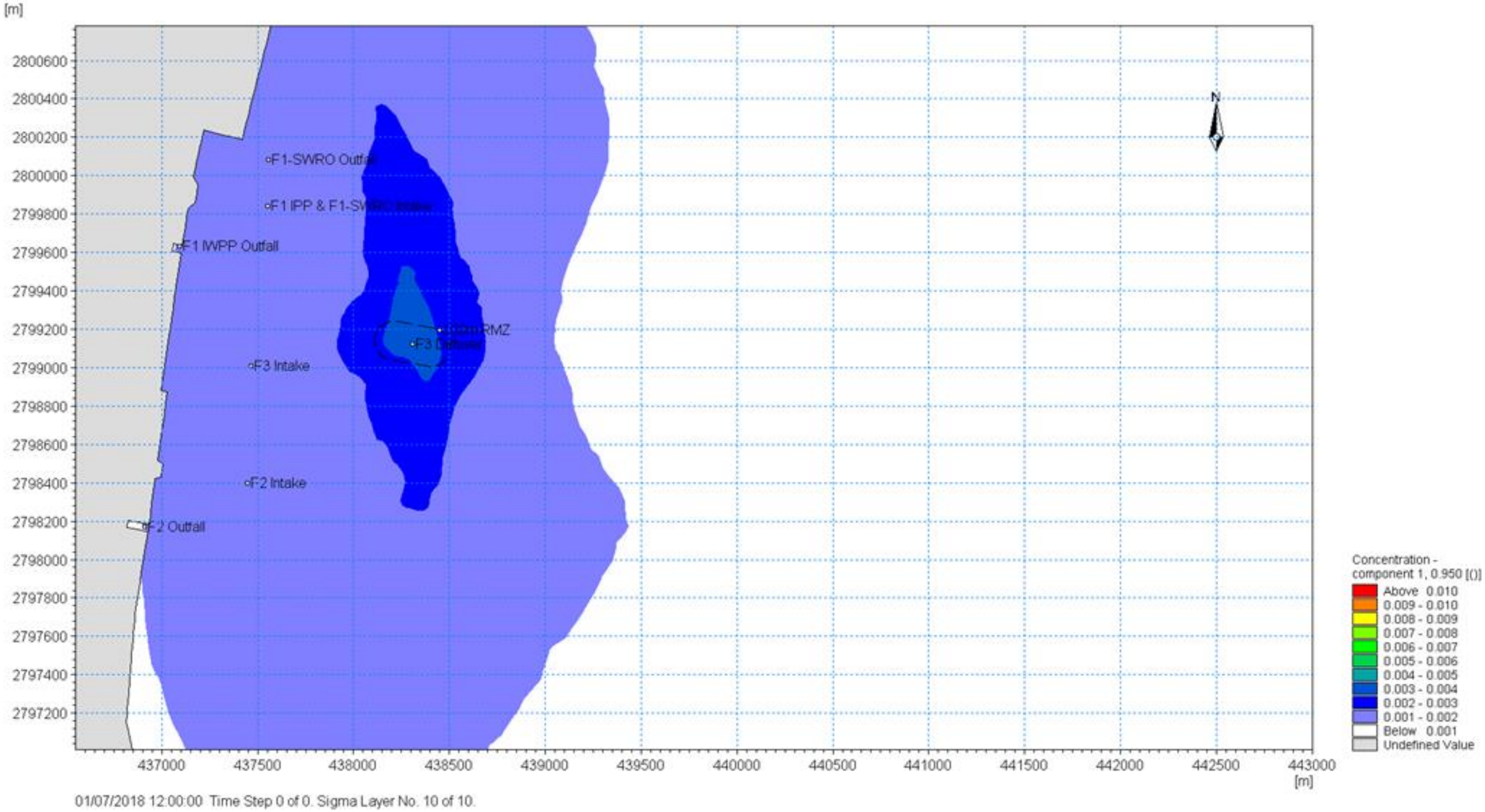

Figure 6-22: Residual chlorine of the 95th percentile for surface water (highest concentration in water column)

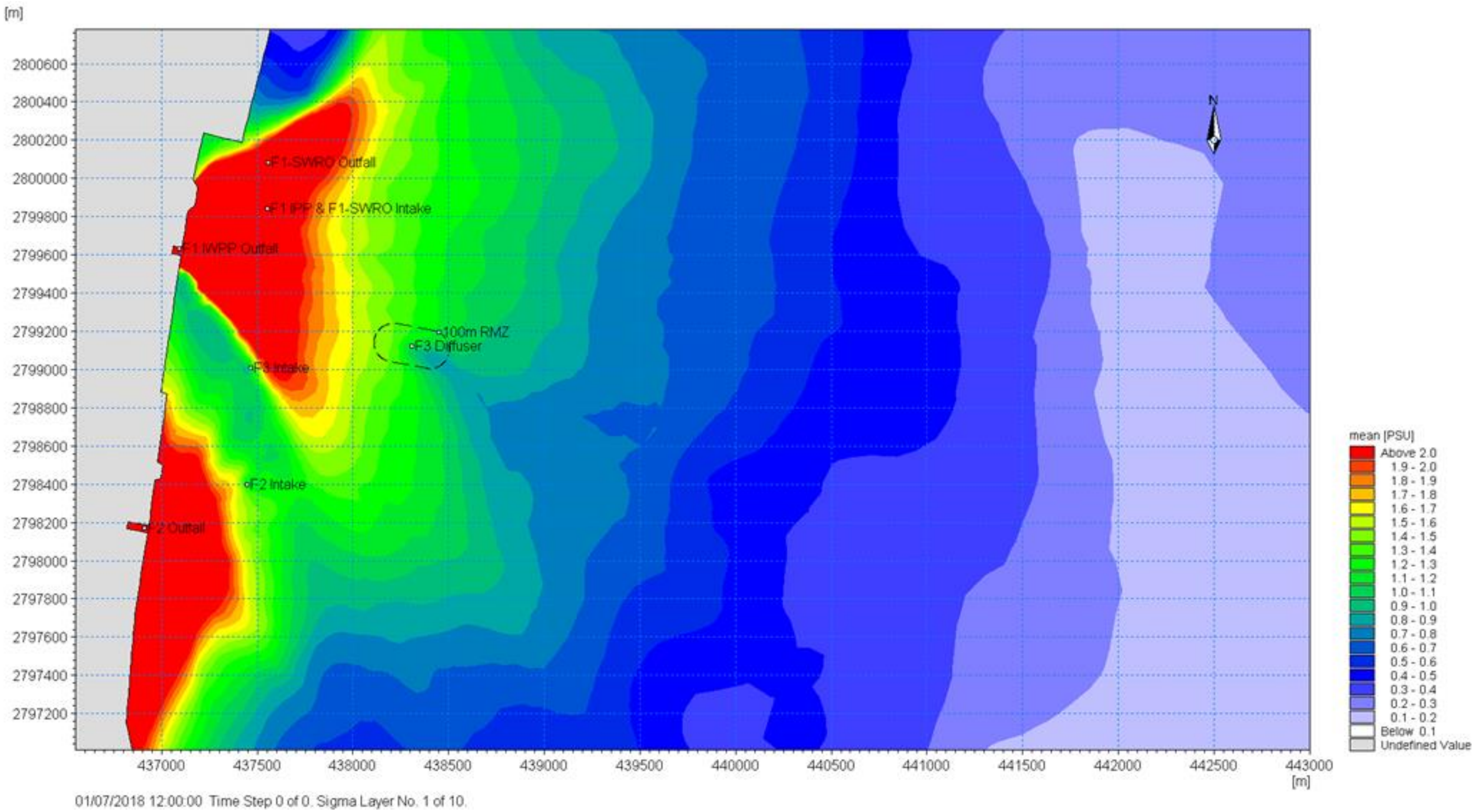

Figure 6-23: Salinity of the 95th percentile for seabed (highest concentration in water column)

6.3.6. Marine Ecology

6.3.6.1. Construction Phase

6.3.6.1.1. Loss of habitat

During the construction phase some habitats will be directly impacted, particularly by the construction of the inlet and outfall pipelines. The baseline survey showed that the dominant habitat type was unconsolidated sediments which are of low conservation concern due to the expanse of this habitat. Patches of seagrass were identified in the pipeline corridor in the shallow sections. The species occurring on the site *Halophila ovalis* is considered a pioneering species and should recover in suitable areas post pipeline construction (60). While corals were observed during the baseline survey none were found in the pipeline corridor and are unlikely to be affected directly by construction.

The impact is considered to be short-term limited to the construction period of the pipelines and on a localised scale only. The impact severity is therefore low and receptor sensitivity is classified as medium. The impact significance is therefore considered to be of **minor negative** significance.

6.3.6.1.2. Collision with marine mammals and reptiles

In order to complete construction activities related to the outfall and inlet pipelines there will be construction vessels active in the water. Although boat traffic (mainly fishermen) already occurs in the study area, there will be an increase in large construction vessels. It is envisioned that the slow and limited movement by construction vessels will restrict collisions.

The observation of Spinner Dolphins during the marine baseline survey highlights the potential presence of ecologically important marine species in the area. In the instance of a collision occurring the animal is likely to be seriously injured or killed, resulting in a high impact severity. The impact is considered to be temporary and limited to the construction period and an event unlikely to occur. The impact severity is considered medium and therefore the impact significance is considered to be of **moderate negative** significance prior to the implementation of mitigation measures.

6.3.6.1.3. Sedimentation from construction activities

Construction of the pipelines will require some digging in the shallow areas and dredging further offshore, disturbing the sediment along the proposed pipeline corridor. The construction activities will result in sediment plumes, albeit to a limited extent. Seagrass habitat which was reported in the pipeline corridor is highly susceptible to increased Total Suspended Solids (TSS) and sedimentation. It is expected that the effects of higher TSS and sedimentation is the reduction of ambient light levels and its penetration capacity in the water column. The resuspension of sediment due to construction activities ultimately will reduce the level of light available for seagrass photosynthesis. Halophila ovalis was the only species of seagrass observed in the study area and is a resilient species able to survive for periods up to 1 month at 0% optimum light conditions (61).

In addition to reduced light attenuation, increased sedimentation during construction activities has the potential to smother habitats when the suspended material is deposited on the seabed in a layer of soft silt. Sedimentation will reduce photosynthetic rates and incur an energy cost as the photosynthetic species may need to grow through the layer of sediment deposited. However, this ability to grow through the sediment layer means seagrass habitats are generally more resilient to sedimentation than other sessile benthic epifauna such as corals (62).

The level of impact is dependent on sedimentation rates and is summarised below in Table 6-54.

Table 6-54: Impact severity of sedimentation on seagrass in turbid environment

Severity	Definition
None	Sedimentation <0.10kg/m^2/day (<0.25 mm/day)
Slight	Sedimentation <0.25kg/m^2/day (<0.63 mm/day)
Minor	Sedimentation <0.50kg/m^2/day (<1.25 mm/day)
Moderate	Sedimentation <1.00kg/m^2/day (<2.50 mm/day)
Major	Sedimentation >1.00kg/m^2/day (>2.50 mm/day)

Coral species are also highly sensitive to sedimentation especially from smothering (63). No coral species were directly observed along the pipeline corridors and as long as suitable mitigation is taken to contain the sediment plumes corals should not be affected by this activity.

The impacts from sedimentation is temporary limited to the construction phase and limited to a local scale. The impact severity is considered to be low due to the low cover of seagrass recorded in the study area and of medium likelihood. Therefore, the impact is considered to be **minor negative** significance prior to the implementation of mitigation measures.

6.3.6.1.4. Summary of Construction Impacts

A summary of the identified impacts is presented within Table 6-55 below.

Table 6-55: Marine ecology impacts during construction phase

Impact	Environmental Aspects	Impact significance prior to mitigation measures
Loss of habitat	Loss of seagrass habitat	Minor
Collisions with marine mammals and reptiles	Injury or death to marine fauna	Moderate
Sedimentation	Loss of seagrass habitat	Minor

6.3.6.2. Operational Phase

6.3.6.2.1. Thermal discharge

The project will utilise seawater as the cooling medium with an expected discharge into the marine environment at 5°C higher than the ambient environment.

The discharge of cooling water and the subsequent overall increased seawater temperature in the ambient environment has the potential to alter the optimal growth conditions of various marine species. Corals in particular, being immobile benthic species, and already existing at the extreme of their thermal range around the UAE, are particularly sensitive to changes on seawater temperature (64; 65). Increases in ambient seawater temperatures have caused past bleaching events.

Seagrass is also known to be sensitive to thermal changes, with temperature being considered the overall parameter controlling the geographical distribution of seagrass in general. Seagrass generate energy through photosynthesis and all enzymatic processes related to plant metabolism are temperature dependent. Photosynthesis and respiration both increase in seagrass with higher temperature until a point where enzymes associated with these processes are inhibited. Beyond a certain threshold, temperature rise will result in the rate of respiration being greater than the rate of energy produced by photosynthesis resulting in a negative energy balance (66). Temperature tolerance is dependent on species and tolerance built up within a specific population within a given latitude. *Halophilis ovalis* seagrass was located on site and is a known species for a broad tolerance and ability to recover (60). The optimal temperature range for tropical seagrass species is thought to lie between 25 and 37 °C, with temperatures over 40 °C considered lethal for extended periods of time (60).

Seagrass habitats and corals were observed in the study area and could potentially be impacted by increased temperatures from the outfall. The hydrodynamic study showed no exceedance (>3°C to ambient temperature) in the RMZ on the seabed (Figure 6 1). The impact is of a high likelihood at a local scale and low severity. The potential receptors of corals and seagrass are medium-high resulting in an impact of **minor negative** significance.

6.3.6.2.2. Chlorine discharge

Chlorine is a biocide which is commonly added to seawater cooling systems to control the growth of fouling organisms. The increase in residual chlorine at the outfall could negatively affect marine species. Eco-toxicity testing on total residual chlorine is highly variable and depends on the chemical make-up of the water and the temperature (with toxicity generally reducing at higher temperatures (67). Eco-toxicity testing has demonstrated that the predicted LC_{50} concentration (above which half the sample population experienced mortality after chronic, long-term exposure (8-hours)) for marine fish lay between 0.128 and 0.25 mg/l and for marine crustaceans lay between 0.073 and 0.268 mg/l. However, the predicted no observed effect concentration (NOEC) ranged between 0.087 and 0.186 mg/l for marine fish and 0.02 and 0.087 mg/l for marine crustaceans (both measured for 7 days of exposure) (57). The NOEC concentration is a conservative tested concentration below the lowest observed effect concentration (LOEC) that has no statistically significant effect within the given exposure time. The DM AWQO is 0.01 mg/l which is likely to be derived as a preferred natural background level, however, it must be noted that acute or chronic impacts to eco-systems would not be expected until concentrations exceed the NOEC values for extended periods of time.

In consideration that eco-toxicity decreases with temperature and the fact that the laboratory experiments were conducted in Australia and New Zealand, where water temperatures are lower than the Arabian Gulf, the median between the values have been selected for the acute exposure (LC_{50}) and no effect concentrations (NOEC) as summarised in Table 6-56 below.

Table 6-56: Eco-toxicity of residual chlorine

Family	LC_{50} Range (57) (mg/l)	LC_{50} Median (mg/l)	NOEC Range (57) (mg/l)	NOEC Median (mg/l)	DM AWQO (68) (mg/l)
Fish	0.13 – 0.25	0.18	0.09 – 0.19	0.14	0.01
Crustacea	0.07 – 0.27	0.17	0.02 – 0.09	0.05	0.01

Figure 6-22 presents the hydrodynamic model for the 95th percentile surface water (highest concentration within the water column) concentration of residual chlorine considering a dosage of 0.2 mg/l. It is predicted that at these discharge concentrations, the DM AWQO would not be exceeded. Therefore, concentrations sufficient to induce a chronic or acute impact to local wildlife is not expected for extended periods.

The impact severity is considered to be low as the DM AWQOs will not be exceeded over the RMZ boundary. The impact is of a high likelihood and at a local scale. The significance of impact is considered as a **minor negative** impact as chronic or acute eco-toxicity values will not be exceeded for long periods of time.

6.3.6.2.3. Salinity

The cooling water effluent, rejected from the diffusers, will be warmer than the ambient environment. Due to various processes within each of the facilities, the salinity of the cooling water from each facility will also be higher than the ambient. It is expected the discharge water to have an increase of 0.1 PSU salinity compared to ambient temperatures.

Increased salinity can negatively affect marine species including growth, reproduction and physiological functions like osmoregulation. The optimum salinity range for coral growth lies between 34 – 36 ppt, therefore coral within the Project area is already existing under within their optimal growth range (69) (70). The corals at the project location are likely adapted to existing high levels of salinity from the F1 and F2 outfalls to some degree, however as the corals are existing at the extreme of their tolerance, minor variations in ambient salinity may be detrimental.

Figure 6-23 displays the hydrodynamic model for salinity at the seabed (highest concentration in the water column) for the 95th percentile. The results indicate that salinity discharges within the RMZ will not exceed the maximum allowable increase of 5% salinity from the ambient (background) salinity levels.

The impact is of a high likelihood during operations but at a local scale. The impact severity is considered low and will impact a medium sensitivity receptor due to existing outfalls in the area. The impact significance is therefore predicted to be **minor negative**.

6.3.6.2.4. Habitat creation

Baseline studies have determined that the majority of habitat in the study area was unconsolidated bottom habitat. This habitat is common but creates few opportunities for benthic sessile fauna to colonise due to its unstable nature, apart from specialist species. The inlet and outfall pipelines will provide some hard substrate habitat that can be colonised by a number of invertebrate benthic species including corals. This habitat will also provide refuge and food for reef dwelling fish.

The habitat creation would be limited to a local scale and would be an impact of low severity. The event is of a high likelihood and would therefore result in an impact of **minor positive** significance.

6.3.6.2.5. Entrainment of faunal species

During the operational phase the inlet pipeline could directly impact upon marine fauna due to entrainment of organisms. This impact could affect a number of species from fish and invertebrates such as jelly fish, as well as sensitive species such as turtles.

The impact will be long-term as it will occur for as long as the plant is operational and pumping in seawater. The impact will be restricted to a localised area directly around the inlet pipeline but of a medium severity and likelihood. Due to the potential for sensitive species to be impacted the significance of impacts is predicted to be **moderate negative** prior to the implementation of mitigation measures.

6.3.6.2.6. Summary of Operational Impacts

A summary of the identified impacts is presented within Table 6-57 below.

Table 6-57: Marine ecology impacts during operational phase

Impact	Environmental Aspects	Impact significance prior to mitigation measures
Thermal discharge	Increase in temperature above ambient levels	Minor negative
Chlorine discharge	Increase in residual chlorine above ambient levels	Minor negative
Salinity	Increase in salinity above ambient levels	Minor negative
Placement of intake and outfall pipelines	Provision of hard substrate habitat	Minor positive
Pumping water from inlet pipeline	Entrainment of faunal species	Moderate negative

6.3.7. Waste

6.3.7.1. Construction Impacts Prior to Mitigation Measures

6.3.7.1.1. Overview

Significant amounts of solid waste can be generated as a result of construction activities. The type and amount of waste generated is however dependent upon the type and scale of development, the construction techniques employed and the specific design of the development. The estimated types and quantities of waste which will be generated during the construction phase are presented in Table 6-58 below.

Table 6-58: Types and Quantities of waste generation

-	Type of waste	Quantity of Generation (Approx.)	Management
1	Domestic solid waste	50 – 70 CBM/month	Disposed to Fujairah authorised service providers
2	Construction & demolition waste	30 – 50 Tons/month	
3	Hazardous waste (paint drums, construction chemicals oil-soaked rags, cotton etc.)	1.0 – 2 Tons/month	Disposed to Fujairah Authorized hazardous waste service providers after obtaining NOC
4	Domestic wastewater (sewage)	70 – 120 m^3/ day	Collected in the septic tank and discharged to Fujairah drainage system
5	Dredged waste from dredging activity	50,000 m^3	Disposed to Fujairah authorized service providers

6.3.7.1.2. Pressure on Waste Facilities due to Waste Generation

6.3.7.1.2.1. Construction Wastes

It is anticipated that the following construction wastes other than excavation, hazardous and liquid waste, will arise as a result of construction of the Power Plant main items of equipment (Gas turbines, HRSGs, Steam turbines etc.) and associated temporary infrastructure such as access roads, offices, workshops, equipment storage areas, and services distribution:

- Site clearance wastes including existing litter and cleared vegetation;
- Demolition wastes from existing structures, which could also include asbestos containing materials;
- Demolition wastes from existing roads and utilities;
- Construction materials including packaging materials, timber, concrete, metals and plastics; and
- Domestic and office wastes from on-site office and welfare facilities.

It is anticipated that the quantity of construction waste materials generated by the Project will be of medium severity, due to the size of the Project, upon a receptor of medium-high sensitivity (waste management infrastructure in Fujairah, in which generation is exceeding capacity for treatment, recycling and disposal), thereby resulting in an impact of **moderate negative** significance upon existing waste management infrastructure in the absence of mitigation measures.

6.3.7.1.2.2. Generation of Excavation Waste

The Project will involve significant excavation work on site. It is expected that the majority of excavated material will comprise of natural ground, which is likely to be classified as non-hazardous. However, there is the possibility of areas of contamination of hydrocarbons or quantities of metal and poly aromatic hydrocarbons. This is further discussed in **Section 6.3.3**.

The sources of the excavation material will include:

- Excavated material associated with construction of access roads;
- Excavated material associated with dredging activity;
- Excavated material associated with construction of foundations and pile arisings; and
- Excavated material associated with service trenches.

It is expected that the impact of the project's excavation waste will be of *medium severity*, due to the size of the project, upon a receptor of medium high sensitivity. Therefore, the impact will result in **moderate** significance upon existing waste management infrastructure in the absence of mitigation measures.

6.3.7.1.2.3. Generation of Hazardous Waste

At this stage the construction methodology is not known and the volumes of hazardous wastes cannot be determined. It is anticipated that hazardous waste streams are likely to include the following:

- Paints;
- Thinners;
- Chemical waste (e.g. adhesives) and chemical waste containers;
- Used oils
- Asbestos containing materials; and
- Construction chemicals.

Given the fact that there is only one licensed disposal or recycling facility for hazardous wastes within the Emirate of Fujairah, hazardous waste generation and disposal is anticipated to represent an impact of medium severity (due to the relatively low amounts expected) upon a receptor of medium-high sensitivity therefore resulting in an impact of **moderate negative** significance in the absence of mitigation measures.

Alternatively, hazardous wastes may require inter-Emirate transfer for disposal at a licensed facility within another Emirate, which would require appropriate approvals from the relevant Emirate Authorities and the Ministry of Climate Change and Environment. As there are a number of disposal options this case will also be considered as an impact of medium severity (due to the relatively low amounts expected) upon a receptor of medium-high sensitivity, therefore resulting in an impact of **moderate negative** significance in the absence of mitigation measures.

6.3.7.1.2.4. Generation of Wastewater

The expected wastewater that is likely to be generated during the construction phase of the Project will include:

- Stormwater;
- Dewatering effluents associated with foundation construction, where relevant;
- Equipment and vehicle wash-down (e.g. concrete/cement trucks); and
- Wastewater from offices and welfare facilities, including sanitary effluents.

At this stage the construction methodology is not known. The nature of the liquid waste generated has the potential to include both hydrocarbons and sanitary waste which can impact on both the surrounding environment and worker welfare. Liquid waste generation is considered to represent an impact of *medium* severity upon a receptor of *medium* sensitivity, therefore resulting in an impact of **minor negative** significance upon the existing waste management infrastructure in the absence of mitigation measures.

6.3.7.1.3. Impacts due to Improper Storage and Handling of Wastes

One of the key issues at the Project site level associated with the generation of waste is storage, which if inadequate or incorrect could result in several impacts which are detailed in the sub-sections below.

6.3.7.1.3.1. Soil and Groundwater

The storage of waste generated from construction activities, which, if inadequate or incorrect can result in the direct contamination of land and groundwater through storm events where surface run-off is present.

There is however also the potential for hazardous wastes to impact the immediate Project site, associated with emergency conditions such as a fuel spillages and subsequent clean-up. If not stored correctly prior to transportation off site, hazardous waste has the potential to contaminate soil, surface water and ground water. This is considered and assessed further is **Section 6.3.3**.

Due to the nature of the construction works as well as the quantities of hazardous wastes, the potential for major contamination events is generally limited and any contamination events would be expected to affect a highly localised area only. Therefore, the impact severity is *low*, although the receptor sensitivity is classified as *medium*. The impact significance is therefore considered to be of **minor negative significance** prior to the implementation of mitigation measures. This is further discussed in **Section 6.3.3**.

6.3.7.1.3.2. Health and Safety

There are three primary health and safety concerns associated with the improper management, storage and treatment or disposal of waste materials, as set out below.

6.3.7.1.3.2.1. Exposure to Harmful Substances

There is the potential for exposure of members of the construction workforce to harmful substances, which could include skin contact and inhalation of harmful fumes. The impact magnitude is high, and the receptor sensitivity is classified as high. The impact significance is therefore considered to be of **major negative** significance prior to the implementation of mitigation measures.

6.3.7.1.3.2.2. Exposure to Asbestos in Existing Buildings and Structures

Asbestos has been found in piles on site and may be present in existing structures or buildings within the site area, and the demolition and removal of these buildings, if asbestos materials are present, could result in asbestos exposure to the construction workforce if not removed and disposed of in accordance with best practice. The impact magnitude is *high*, and the receptor sensitivity is classified as *high*. The impact significance is therefore considered to be **major negative** significance prior to the implementation of mitigation measures.

6.3.7.1.3.2.3. Potential Fire Hazards

The potential fire hazard present onsite due to flammability of some material (timber, paper, plastic, fuel storage etc.). It is expected that the potential of a fire will have a high severity upon a receptor of high sensitivity therefore resulting in an impact of **major negative** significance in the absence of mitigation measures.

6.3.7.1.3.3. Terrestrial Ecology

Improper storage and handling of waste generated from construction can impact the flora and fauna of the Project area through ingestion of contaminated materials, vermin infestations and contamination of habitats through contaminated run off or spillages. This is further discussed in **Section 6.3.4**. It is expected that the impact would be highly localised and will therefore be of *low* severity upon a receptor of *medium* sensitivity, resulting in an impact of **negligible** significance in the absence of mitigation measures.

6.3.7.1.3.4. Marine Ecology

Improper storage and handling of waste generated from construction can impact the flora and fauna of the Project area through ingestion of contaminated materials and contamination of habitats through contaminated run off or spillages. This is further discussed in **Section 6.3.3**. It is expected that the impact would be localised and will therefore be of *medium* severity upon a receptor of *medium* sensitivity, resulting in an impact of **minor negative** significance in the absence of mitigation measures.

6.3.7.1.3.5. Aesthetic

Improper storage of large quantities of construction materials will have a negative impact on landscape aesthetics. It is expected that the impact would be highly localised and will therefore be of *low* severity upon a receptor of *low* sensitivity, resulting in an impact of **negligible** significance in the absence of mitigation measures.

6.3.7.1.3.6. Odour

The improper storage and handling of waste, if inadequate can result in the uncontrolled release of odour into the Project site and potentially the surrounding area. It is expected that the severity of the odour will be *low* severity upon a receptor of *low* sensitivity therefore resulting in an impact of **negligible** significance in the absence of mitigation measures.

6.3.7.1.4. Transportation of Construction Waste

The potential impact of the off-site movement and disposal of wastes, either to a designated landfill site or to a recycling centre, will result in increased traffic movements both within and from the Project site. The increased truck movements associated with this waste transport can result in traffic congestion, noise and air quality impacts.

It is considered that the transportation of construction waste is likely to be of *medium* severity upon receptors of *medium* sensitivity (e.g. sensitive receptors within residential areas which will be sensitive to cumulative direct and indirect impacts relating to air quality, dust and congestion impacts resulting from such waste transportation over an extended period of time). The overall impact is therefore assessed to be of **minor negative** significance in the absence of mitigation measures.

6.3.7.1.5. Summary of Construction Impacts

A summary of the identified impacts is presented within Table 6-59 below.

Table 6-59: Waste impacts during construction

Environmental Impacts	Environmental Aspects	Impact significance prior to mitigation measures
Pressure on Waste Facilities	Generation of construction and demolition waste	Moderate negative
	Generation of excavation waste	Moderate negative
	Generation of hazardous waste	Moderate negative
	Generation of wastewater	Minor negative
Impacts on Surrounding Receptors due to Improper Storage and Handling of Wastes	Soil and groundwater contamination from improper storage and handling causing spills and leaks	Minor negative
Health and Safety impacts on workers and surrounding human receptors	Workforce exposure to harmful substances	Major negative
	Workforce exposure to onsite asbestos & asbestos from demolition of structures containing asbestos	Major negative
	Fire hazard due to flammability of some waste material	Major negative
Impact on terrestrial ecology	Improper storage and handling of waste	Negligible
Impact on Marine ecology	Improper storage and handling of waste	Minor negative
Impact on aesthetics	Improper storage and handling of waste	Negligible
Impact on odour	Improper storage and handling of waste	Negligible
Transportation of construction and demolition waste	Direct / indirect impacts relating to air quality, dust and congestion resulting from waste transportation	Minor negative

6.3.7.2. Operation Impacts Prior to Mitigation Measures

6.3.7.2.1. Overview

Operational waste impacts are associated with the operation of the plant itself and associated facilities. It is expected that wastewater, solid waste and hazardous wastes will be generated.

6.3.7.2.2. Pressure on Waste Facilities due to Waste Generation

6.3.7.2.2.1. Generation of Wastewater

All waste waters will be treated on-site, with the exception of RO wastewater (refer to **Section 6.3.7.2.2.3** below) and chemical wastewater which will be collected and removed by a licensed waste operator. The impact upon existing wastewater treatment facilities is therefore predicted to be **negligible**.

6.3.7.2.2.2. Generation of Solid Waste

At this stage, it is not possible to quantify the amounts of solid waste. Nevertheless, the expected types of solid waste anticipated to be generated during the operational phase of the Project are as follows:

- Solid wastes from offices, including paper, printer cartridges, waste electrical and electronic equipment etc.; and
- Municipal solid waste arisings from offices and facilities, including waste packaging, food etc.;

Impacts associated with solid waste generated during the operation phase are considered to be of *medium* severity upon a receptor of *low-medium* sensitivity, thereby representing a potential impact of **minor negative** significance in the absence of mitigation measures.

6.3.7.2.2.3. Generation of Hazardous Waste

The expected sources of hazardous waste to be generated during the operational phase of the Project are as follows:

- Chemical packaging;
- Process residuals;
- RO Spent filter media;
- RO Sludge arising from treatment works;
- RO Cleaning effluents;
- Hydrocarbons and oils;
- Solvents;
- Contaminated rags;
- Filters;
- Paints;
- Greases;
- Chemical dosing remnants
- Waste associated with operation and maintenance works include pipe work, metals and plastics associated with plant maintenance; and

- Hazardous waste streams generated from the administration buildings, such as batteries etc.

The amounts of hazardous waste materials generated are expected to be of *medium* severity upon a receptor of *medium-high* sensitivity, thereby representing a potential impact of **moderate negative** significance in the absence of mitigation measures.

Furthermore, it is understood from Fujairah Municipality that certain waste types associated with ongoing maintenance of the RO facility cannot be effectively treated within Fujairah. This would include the following waste types:

- Lime waste;
- RO sludge; and
- Spent filters.

Fujairah Municipality has therefore recommended that these waste types are treated within waste management facilities within Abu Dhabi.

6.3.7.2.3. Impacts on Surrounding Receptors due to Improper Storage and Handling

One of the key issues at the Project site level associated with the generation of waste is storage, which if inadequate or incorrect could result in several impacts which are detailed in the below sub-sections.

6.3.7.2.3.1. Soil and Groundwater

The storage of waste generated from operational activities within the Project site, which, if inadequate or incorrect can result in the direct contamination of soil and groundwater through storm events where surface run-off is present.

There is however also the potential for hazardous wastes to impact the immediate Project site, associated with emergency conditions such as a fuel spillage (from storage or operational activities) and subsequent clean-up. If not stored correctly prior to transportation off site, hazardous waste has the potential to contaminate soil, surface water and ground water. This is considered and assessed further is **Section 6.3.3**.

The potential for major contamination events is moderate due to the nature of the operations. However, any contamination events would be expected to affect a highly localised area only. Therefore, the impact severity is *medium*, although the receptor sensitivity is classified as high. The impact significance is therefore considered to be of **major negative** significance prior to the implementation of mitigation measures. This is further discussed in **Section 6.3.3**.

6.3.7.2.3.2. Terrestrial Ecology

Improper storage and handling of waste generated from operation can impact the flora and fauna of the Project area through ingestion of contaminated materials, vermin infestations and contamination of habitats through contaminated run off or spillages. This is further discussed in **Section 6.3.4**.

It is expected that the impact would be highly localised and will therefore be of *low* severity upon a receptor of *low* sensitivity, resulting in an impact of **negligible** significance in the absence of mitigation measures.

6.3.7.2.3.3. Marine Ecology

Improper storage and handling of waste generated from operation can impact the flora and fauna of the Project area through ingestion of contaminated materials and contamination of habitats through contaminated run off or spillages. This is further discussed in **Section 6.3.5**. It is expected that the impact would be localised and will therefore be of *medium* severity upon a receptor of *medium* sensitivity, resulting in an impact of **minor negative** significance in the absence of mitigation measures.

6.3.7.2.3.4. Aesthetic

Improper storage of large quantities of operational materials will have a negative impact on landscape aesthetics. It is expected that the impact would be highly localised and will therefore be of *low* severity upon a receptor of *low* sensitivity, resulting in an impact of **negligible** significance in the absence of mitigation measures.

6.3.7.2.3.5. Odour

The improper storage and handling of waste, if inadequate can result in the uncontrolled release of odour into the Project site and potentially the surrounding area. It is expected that the severity of the odour will be *low* severity upon a receptor of *low* sensitivity therefore resulting in an impact of **negligible** significance in the absence of mitigation measures.

6.3.7.2.3.6. Health and Safety

There is a potential fire hazard present onsite due to flammability of some material (timber, paper, plastic, Fuel storage etc.). It is expected that the potential of a fire will have a *high* severity upon a receptor of *high* sensitivity therefore resulting in an impact of **major negative** significance in the absence of mitigation measures.

6.3.7.2.4. Transportation of Operational Waste

The potential impact of the off-site movement and disposal of wastes, either to a designated landfill site or to a recycling centre, relates to the increased traffic movements both within and from the Project site.

It is considered that the transportation of operation waste is likely to be of *low* severity upon receptors of *medium-high* sensitivity (e.g. sensitive receptors within residential areas which will be sensitive to cumulative direct and indirect impacts relating to air quality, dust and congestion impacts resulting from such waste transportation). The overall impact is therefore assessed to be of **minor negative** significance in the absence of mitigation measures.

6.3.7.2.5. Summary of Operational Impacts

A summary of the identified operational impacts is presented within Table 6-60 below.

Table 6-60: Waste impacts during operation

Environmental Impacts	Environmental Aspects	Impact significance prior to mitigation measures
Pressure on Waste Facilities	Generation of wastewater	Minor negative
	Generation of solid waste	Minor negative
	Generation of hazardous	Moderate negative
Impact on soil and groundwater	Improper storage and handling of waste	Major negative
Impact on terrestrial ecology	Improper storage and handling of waste	Negligible
Impact on marine ecology	Improper storage and handling of waste	Minor negative
Impact on aesthetics	Improper storage and handling of waste	Negligible

Environmental Impacts	Environmental Aspects	Impact significance prior to mitigation measures
Impact on odour	Improper storage and handling of waste	Minor negative
Health and Safety impacts on workers and surrounding human receptors	Fire hazard due to flammability of some waste material	Major negative
Transportation of operational waste	Direct / indirect impacts relating to air quality, dust and congestion resulting from waste transportation	Minor negative

6.3.8. Socio-Economy

6.3.8.1. Construction Phase

6.3.8.1.1. Disruption to the local economy and population

Construction activities have the potential to result in disruption to businesses, schools, services and residential areas located within close proximity of the Project area. These impacts may include temporary traffic disruptions and congestion, a reduction in air quality resulting from dust and PM_{10} generation, noise impacts resulting from construction traffic and general loss of amenity. These impacts have been assessed as follows:

6.3.8.1.1.1. Construction dust impacting on Sensitive Receptors

As identified within **Section 6.3.1: Ambient Air Quality**, air quality impacts upon sensitive receptors are expected to be of **moderate negative** significance in relation to dust emissions prior to the implementation of mitigation measures.

6.3.8.1.1.2. Emissions from construction equipment and vehicles

As identified within **Section 6.3.1: Ambient Air Quality**, air quality impacts upon sensitive receptors are expected to be of **negligible** significance in relation to vehicle exhaust emissions prior to the implementation of mitigation measures.

6.3.8.1.1.3. Disturbance from Construction noise

As identified within **Section 6.3.2: Ambient Noise**., noise impacts upon sensitive receptors are expected to be of **minor to major significance** in the absence of mitigation measures.

6.3.8.1.1.4. Construction impact on fishing activity

As identified in **Section 6.3.5**: **Marine Water & Sediment**, the impact of construction activities is generally expected to be limited. Sediment plumes from dredging activities and potential spillages are expected to be highly localised and not likely to impact the wider marine environment.

Given that the local area is already affected by the existing power facilities, it is not considered likely that the area within the immediate surroundings of the Project site is used for either commercial or recreational fishing. It is therefore concluded that any impacts upon fisheries or fishing activities would be of **negligible** significance.

6.3.8.1.2. Landscape and visual impacts

During the construction phase there is the potential for a loss of visual amenity upon sensitive receptors. Construction activities taking place within the viewpoint from residential buildings within the wider agricultural area, for example, may result in a reduction in visual quality of the landscape. The severity and extent of impacts will be of **negligible** significance due to the already industrial setting of the Project.

6.3.8.1.3. Health related impacts associated with construction activities

6.3.8.1.3.1. Health and Safety

The main issues to be considered are associated with the labour force during the construction, which includes the following:

- Health and safety at work;
- Access to medical facilities where required;
- Reasonable working hours, wages and other benefits;
- Provision of suitable and safe accommodation and sanitation; and
- Access to welfare and recreation facilities.

With respect to health and safety at work, construction sites are considered to be a relatively dangerous working environment and without proper health and safety controls there is a considerable risk of serious injury or fatalities. Access to medical facilities is also crucial with respect to accidents and illness either in the workplace or outside. In the absence of mitigation measures, the potential impacts are therefore considered to be of **major negative** significance.

Other working conditions such as reasonable working hours, wages and other benefits are considered to be good working practices and should be employed at all times. In the absence of mitigation measures, this has the potential to be an impact of **moderate negative** significance.

In addition, a large number of labourers may be housed temporarily on or near the site. It must be ensured that the labour and working conditions are of an acceptable standard. Housing must be adequately designed with adequate sanitary and safety facilities such as fire suppressants. Issues such as retrenchment policies must be clearly defined prior to work beginning

6.3.8.1.3.2. Exposure to Asbestos in Existing Buildings and Structures

Asbestos may be present in existing structures or buildings within the Project site, and the demolition and removal of these buildings, if asbestos materials are present, could result in asbestos exposure to the construction workforce if not removed and disposed of in accordance with best practice.

One area has been identified where existing asbestos cement sheeting are present. The location of these cement sheets does create the necessity of construction phase interaction during site cleaning or demolition. In this event, workers are likely to come into contact with disturbed asbestos fibres which presents a significant risk to health. With this confirmed location as well as the possibility for further unidentified volumes of asbestos within existing buildings and structures the impact magnitude is high, and the receptor sensitivity is classified as high. The impact significance is therefore considered to be **major negative** significance prior to the implementation of mitigation measures.

6.3.8.1.4. Enhancement of the local economy

Due to the influx of construction workers during the construction phase, significant skilled and unskilled employment opportunities are represented by the development of the Project. This will also generate revenue for local surrounding businesses, thereby resulting in a positive impact upon the local economy. At the time of writing, the expected number of construction workers required for the Project is not available.

The majority of the workforce during the construction phase will be expatriate migrant workers. This is also expected to generate local revenue. Additionally, construction materials can be purchased from local business or UAE suppliers generating further economic benefit. These impacts are considered to be short term in nature but of **minor positive** significance within all three emirates.

6.3.8.1.5. Summary of Construction Impacts

Table 6-61: Socio-economy impacts during construction

Environmental Impacts	Environmental Aspects	Impact significance prior mitigation measures
Disruption to local economy and population		
Construction dust impacting on Sensitive Receptors	Generation of dust emissions via construction activities	Moderate negative
Disturbance of construction traffic	Generation of vehicle exhaust emissions via construction activities	Negligible
Construction noise impacts	Generation of noise emissions via construction activities	Minor to Major significance
Construction impacts on fishing activities	Generation of sediment plumes and potential spillages	Negligible
Landscape and visual impacts	Impact of visual amenity from construction	Negligible
Health related impacts associated with construction activities		
Health and safety impacts upon construction workers	Working outside in high temperatures and site based working hazards	Major negative
	Reasonable working hours, wages and other benefits	Moderate negative
Exposure to Asbestos in Existing Buildings and Structures	Demolition of existing structures and existing asbestos	Major negative
Enhancement of the local economy		
Enhancement of the local economy	Generation of revenue from the influx of workers and creation of jobs	Minor positive

6.3.8.2. Operational Phase

6.3.8.2.1. Disruption of the local economy and population

6.3.8.2.1.1. Ambient air quality degradation due to operational activities

A full assessment of air quality impacts associated with the operation of the Project has been undertaken within **Section 6.3.1: Ambient Air Quality**.

The operational impact on air quality relates principally to stack emissions of nitrogen oxides (NO_x) associated with normal and abnormal operations of the facility. As specified within **Section 6.3.1: Ambient Air Quality** the significance of the operational impacts are considered to be as follows:

- Cumulative increase in long term ambient concentrations of NO_2 Sensitive Receptor locations – **moderate negative**;
- Cumulative increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project (Federal Standards) – **major negative**; and
- Cumulative increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project (EU Standards) – **moderate negative**.

The potential impacts associated with operations on liquid fuel (i.e. distillate diesel oil) (SC4), which will only be used for emergency backup or maintenance testing (20 hours in a year) are expected to be of **Negligible** impact significance.

6.3.8.2.1.2. Operational noise

The impacts during operation are predicted to be an impact of Low severity, upon a receptor of Low sensitivity (as the boundary is considered to be an industrial receptor). Therefore, it has been assessed that the impacts of operational noise at the boundary are of **negligible significance**. Nevertheless, mitigation measures have been developed to ensure that noise impacts are minimised.

This is discussed fully in **Section 6.3.2: Ambient Noise**.

6.3.8.2.1.3. Impacts on Local Businesses and Social Issues

The influx of professional workers, labourers, and other staff members into the area will generate economic opportunities and rewards for the local population of Mirbah, Qidfa and other surrounding areas, enhancing social and economic development. This is deemed to be a **minor positive** impact on a long-term basis.

Indirect opportunities for various support service providers including guards, cleaners, catering and other site management will provide employment and a further source of income for these services giving a **minor** to **moderate positive** impact.

The employment of local workers on such a project of national importance with the requisite training which will be included within their contracts will improve their capabilities and skill. This will also result in improving their employability should they move on from the Project. This is deemed to be a **negligible** to **minor positive** impact;

The additional employees required for the operation of the proposed facility will put additional pressure on local services which is deemed to be a **negligible** impact.

Similar to the construction phase, a potentially positive economic impact will result from any local employment created by the operational phase of the Project. Whilst the likely nature of these impacts, and the effect of expatriate workers, is largely unchanged from the construction phase, they are likely to be amplified by the greater time-scales involved in the operation of the site.

The relatively small workforce required during the operational phase means that potential impacts are likely to be less significant. However, all relevant labour and working condition laws and guidelines must still be adhered to during this phase.

6.3.8.2.1.4. Operational impacts of fisheries

As identified in **Section 6.3.5** & **Section 6.3.6,** the impact of operational activities on fisheries is expected to be low. Thermal, chlorine and saline discharges through operational processes are highly localised and not likely to impact the wider marine environment. The severity and extent of impacts will be of **negligible** significance due to the area already being affected by the existing industrial areas surrounding the project site.

6.3.8.2.2. Landscape and visual impacts

During the operational phase there is the potential for a loss of visual amenity upon sensitive receptors. However, the landscape value is considered to be low due to the area being heavily disturbed and previously developed on. The severity and extent of impacts will be of **negligible** significance due to the agricultural area being the nearest visual receptor with the line of site to the Project area involving the existing F1 and F2 industrial areas.

6.3.8.2.3. Health and Safety

6.3.8.2.3.1. Operation Worker Welfare

One of the key issues is ensuring that operational staff and contractors are protected from workplace incidents and illness through appropriate health and safety systems both during normal operation and other tasks such as maintenance and repair. Appropriate safety systems such as fire protection, detection of leaks from turbines and emergency procedures will also be required.

The potential health and safety impacts are considered to be of **moderate negative** significance in the absence of suitable control measures.

6.3.8.2.4. Summary of Operational Impacts

Table 6-62: Socio-economy impacts during operation

Environmental Impacts	Environmental Aspects	Impact significance prior mitigation measures
Disruption to local economy and population		
Impact on ambient air quality	Cumulative increase in long term ambient concentrations of NO_2 Sensitive Receptor locations	Moderate to Major negative
Operational noise	Generation of operational noise emissions	Negligible
Operational impacts on fishing activities	Impact of operational discharge to the marine environment	Negligible
Impacts on Local Businesses and Social Issues	Enhancement of the local economy through generation of revenue from the influx of workers.	Minor positive
	Indirect job opportunities	Moderate positive
	Enhancement of employer skill	Negligible to minor positive
	Impact on local services	Negligible
Landscape and visual impacts	Impact of visual amenity from operational activities	Negligible
Health related impacts associated with construction activities		
Health and safety impacts upon workers	Working outside in high temperatures and site based working hazards	Moderate negative

6.3.9. Archaeology and Cultural Heritage

6.3.9.1. Construction Impacts Prior to Mitigation Measures

As discussed in **Section 5.1.10: Archaeology and Cultural Heritage**, no evidence has been detected of any archaeological and/or cultural heritage features within the Project site. However, there is a low potential for impacts upon unknown buried archaeological remains during construction activities, including site clearance, grading and excavations. There is a risk of disturbance and/or loss of archaeological features which, if they are of significant cultural heritage value, could result in a permanent impact of **moderate** to **major negative significance** in the absence of appropriate control measures.

6.3.9.2. Operational Impacts Prior to Mitigation Measures

It is not expected that any operational impacts would occur.

6.3.9.2.1. Summary of Construction and Operational Impacts

A summary of the identified construction and operational impacts is presented within Table 6-63 below.

Table 6-63: Archaeological impacts and potential mitigation measures

Description of the Impacts	Environmental Aspects	Impact Significance Prior Mitigation Measures
Construction Phase		
Construction impacts on unknown buried archaeological remains	Disturbance to archaeological finds	Moderate to Major
Operation Phase		
None	N/A	Negligible

7. MITIGATION MEASURES

7.1. Recommendations

The key mitigation measures which have been identified as part of this ESIA are presented below, with further details provided within **Section 7.2: Additional Mitigation Measures** and the respective technical sections:

- Construction Control Measures:
  - Development and Implementation of a Construction Environmental and Social Management Plan (CESMP) by the EPC Contractor;
  - Installation of silt curtains prior to construction activities to contain sediment plume and prevent wider impacts upon the marine environment;
  - Pre-demolition surveys of all structures and removal of asbestos where encountered prior to demolition. and
  - Environmental monitoring to ensure that significant effects do not occur and, if significant impacts do occur, will serve to provide a trigger for the implementation of enhanced mitigation measures, including:
    - Noise monitoring at the nearest sensitive receptors;
    - Air quality monitoring at the nearest sensitive receptors;
    - Ambient sea water quality monitoring;
    - Ongoing sediment plume monitoring during dredging operations;
    - Marine habitat monitoring;
    - Records of complaints from local community and how complaints have been addressed and resolved;

- Operation Design Measures:

- Installation of environmental control systems including Selective Catalytic Reduction (SCR) which can reduce emissions of nitrogen oxides in the range of 80 to 95%;
- Design of barriers to prevent large (e.g. turtles) and small (e.g. fish/snakes) fauna from entering sea water intake inlets;
- The design of the seawater outfall pipelines, which extend approximately 1.4km offshore, will include diffuser sections which will be staggered to distribute the cooling water across the main direction of ambient flow an ensure that the mixing zone is minimised as far as reasonably practicable;
- An update of all predictive noise models (Occupational and Environmental studies), based upon vendor equipment data during the EPC phase to confirm if noise levels are likely to be exceeded at the nearest sensitive receptor locations;
- If the detailed predictive noise models identify that acceptable noise levels will be exceeded, the design will incorporate a range of best practice noise abatement measures, if required, to ensure that noise is attenuated to acceptable levels at the nearest sensitive receptor;

- Operational Control Measures:

- Operation of Continuous Emissions Monitoring Systems (CEMS) to ensure that emissions to air are known at all times and any issues rectified immediately; and
- Implementation of an Operational Environmental and Social Management Plan (CESMP).

7.2. Additional Mitigation Measures

7.2.1. Ambient Air Quality

7.2.1.1. Construction Phase

- The construction contractor will produce a Construction Environmental Management Plan (CESMP) including the mitigation measures set out within this EIA;
- The CESMP will set specific mitigation and monitoring measures to follow during the Project construction in order to reduce the sources of PM_{10} and dust;
- Ensure the CESMP mitigation and monitoring measures are implemented on-site;
- It is recommended that fugitive dust is monitored (visual assessment) and further mitigation measures are implemented in the event of dust episodes impacting upon nearby receptors;
- Adoption of best working practices to reduce the emissions of dust;
- Careful management of construction activities located within close proximity to existing residential receptors;
- Setting maximum speed limits for vehicles using unpaved roads to access the site;
- Watering along unpaved roads during periods of high visible dust;
- Consider paving / hard surfacing the main access routes in the event that these are the selected access routes are unsurfaced; and
- Ensuring the proper use and maintenance of construction equipment.

With regards to the potential impacts to the turbine air intakes at the existing F1 and F2 plants, the following is recommended in consultation with the F1 and F2 operators / owners:

- Undertake dust suppression watering in the areas adjacent to the F1 and F2 during episodes of high winds or visible dust formation;
- Install real time ambient air quality particulate monitors in vicinity of intakes prior to commencement of constriction to establish existing PM concentrations;
- Consult with F1 and F2 operators, and potentially explore management options at F1 and F2 during F3 construction including:
  - Increasing filter inspection frequency;
  - Where necessary optimising filter pulse system settings on filters; and
  - F1 and F2 operators to consider aligning filter maintenance (filter swaps) prior to F3 commencing construction.

7.2.1.2. Operations Phase

The Project design basis includes the use of combined cycle gas turbines with low NO_x technology operating on natural gas as a main fuel. In addition, SCR systems are included in all HRSGs, including ammonia injection and storage systems with a five-day storage capacity, to guarantee the NO_x emission limit of 20 mg/Nm^3 at 15% O_2. The IFC recommended secondary mitigation measures to prevent, minimise, and control NO_x emissions include the use of SCR for combustion turbines burning gaseous or liquid fuels.

Based on the results of the dispersion model, additional measures may be investigated through cost benefit analysis (in addition to the SCR which is advocated by the IFC), in order to address the potential cumulative impacts (project + background emission sources), however it should be emphasised that the high 1 hour NO_2 model results are based on the 100th percentile (worst case) value and therefore not in accordance with international best practice (deemed overly conservative).

The approach with regards to the cumulative assessment was considered conservative in that F1 and F2 plants were modelled and background measured data was added to the model results. Potentially consider undertaking long term diffusion tube measurements at SR locations and update assessment accordingly to reduce degree of conservatism.

Additional mitigation measures potentially include:

- The facility will not be operated in combined cycle mode without SCR in operation;
- Adopting an international ambient air quality standard for the Project that allows for exceedances and accounts for international best practice (e.g. EU AAQS); and
- The adoption of more stringent emission limits for the neighbouring F1 and F2 facilities, thereby lowering background pollutant concentrations in the vicinity of the three plants.

In terms of the abnormal operations (fuel oil / diesel) for short periods during maintenance and emergency conditions, this case is not likely to lead to significant breaches of air quality standards. In addition, the Project has committed to using low sulphur (10ppm) fuel oil, which will minimise potential SO_2 emissions. No additional mitigation is required for the fuel oil case subject to the use of fuel oil being limited to emergency and maintenance testing.

7.2.2. Ambient Noise

7.2.2.1. Construction Phase

Noise and vibration from construction activities can be controlled through the Health, Safety and Environmental (HSE) Management Plans, such as the Construction Environmental Management Plan (CESMP). Due to the potential of exceedances at locations within close proximity to the project site, the following general mitigation measures should be considered and commitments to good site practices should be incorporated into the CESMP:

- Compliance monitoring at receptor locations;
- Site inductions to cover the importance of noise control and available noise reduction measures;
- Construction contractors should be required to use equipment that is in good working order, is properly maintained according to the equipment's manufacturer requirements and that meets current best practice noise emission levels. This should be achieved by making it a component of contractual agreements with the construction contractions;
- As far as reasonably practicable, sources of significant noise should be enclosed. The extent to which this can be done depends on the nature of the machines to be enclosed and their ventilations requirements;
- All mobile or fixed noise-producing equipment used on the project, which is regulated for noise output by a local, state, or federal agency, shall comply with such regulation while in the course of project activity;
- Electrically powered equipment instead of pneumatic or internal combustion powered equipment shall be used, where feasible;
- Construction site speed limits shall be established and enforced during the construction period;
- A gradual start to noisy activities and as far as it is feasible, establish a schedule for noisy activities to reduce overlapping of works;
- Community grievance mechanism and active information dissemination regarding the construction schedule and noisy activities;
- The on-site construction supervisor shall have the responsibility and authority to receive and resolve noise complaints. A clear appeal process to the Owner shall be established prior to construction commencement that will allow for resolution of noise problems that cannot be immediately solved by the site supervisor;
- The Engineering, Procurement and Construction (EPC) contractor shall develop a project construction noise control plan, which shall be approved and implemented prior to commencement of any construction activity;
- The EPC contractor shall limit the hours of operation for specific equipment or construction activities; and,
- Contract incentives may be offered to the construction contractor to minimise or eliminate noise complaints resulting from project activities where project construction would result in significant noise impacts.

7.2.2.2. Operational Phase

As exceedances of the most stringent standards are predicted to be exceeded at a number of SRs as a result of the Project noise contribution, clear measures to resolve any exceedances need to be in place. This will be undertaken through the adoption of the following:

- An update of all predictive noise models (Occupational and Environmental studies), based upon vendor equipment data during the EPC phase, and also refer to recommendations set in the Front-End Engineering Design (FEED) Contractor Noise Studies (individual units and global Occupational models);
- Application of various noise abatement measures as follows:
  - Apply acoustic lagging to the connecting suction and discharge piping;
  - Application of inlet and outlet noise silencers;
  - Apply an acoustic enclosure to the compressor(s) where operationally feasible;
  - Partial screening between the compressor and site boundary;
  - Installing silencers for fans;
  - Installing suitable mufflers on engine exhausts and compressor components;
  - Installing acoustic enclosures for equipment casing radiating noise;
  - Improving the acoustic performance of constructed buildings, apply sound insulation;
  - Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m^2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective;
  - Installing vibration isolation for mechanical equipment;
  - Limiting the hours of operation for specific pieces of equipment or operations;
- Measure the baseline noise at the most impacted sensitive receptors during EPC and model it along with the noisy equipment with the final vendor data; and,
- Developing a mechanism to record and respond to complaints.

7.2.3. Soil, Surface Water and Groundwater

7.2.3.1. Construction Phase

7.2.3.1.1. Soil Erosion

Prior to construction, an Erosion Control Plan along with best practice management measures on-site shall be implemented as part of the CESMP which will include the following measures:

- Avoidance of activities that will mobilise soils before or during the wet season;
- Minimisation of clearance of existing vegetation and removal of existing topsoil;
- Stabilisation of bare soils/aggregates on the site damping down or covering with gravel;
- Implementation of wheel cleaning for construction traffic leaving the site;
- Identification of natural drainage channels and implement control measures, such as screens or sedimentation basins to reduce sediments leaving the site; and
- Appropriate stormwater management procedures to be implemented.

7.2.3.1.2. Mobilisation of Existing Contaminants

As far as practically possible, the Project will avoid contaminated areas, both known and suspected. In the event of suspected contaminated soils being located within the Project site, depending on significance of contamination, hazardous soil remediation measures will be implemented by the EPC Contractor to remove the suspected contaminated soil and aggregates from site, which will reduce the risk of mobilisation during construction.

The CESMP will include an excavated materials management plan. This will describe how uncontaminated and contaminated materials will be dealt with (excavated, temporarily stockpiled and stored and disposed) during construction.

7.2.3.1.3. Contamination from Construction Activities

In order to avoid and minimise the risk and likelihood of contamination on-site, the following measures shall be implemented and incorporated within the CESMP prepared for the Project, which promotes on-site environmental good practice:

- Adequate hazardous waste and hazardous material management facilities and practices, which is to be clearly labelled and segregated to avoid contamination;
- Potentially hazardous material to be used away, as far as practical, from high risk areas;
- Any hazardous substances to be substituted with safer alternatives;
- No discharge or overflow of sanitary waste on site. Modular wastewater storage tanks will be introduced to the Project site to provide adequate containment facilities for the construction workforce;
- Fuel storage tanks to be located above ground and be fully bunded with an impermeable barrier of at least 110% of the tank capacity;
- Regular vehicle and equipment maintenance to be undertaken in hard-standing areas with isolated drainage and oil-interceptors;

- Vehicle and equipment refuelling to be undertaken in hard-standing areas with isolated drainage and oil-interceptors – where this is not possible drip-trays must be used;
- Spill clean-up kits to be readily available on site and staff trained in their appropriate use;
- Spills to be cleaned up immediately and any waste materials generated, including excavated soils or aggregates, must be disposed of appropriately as hazardous waste;
- Environmental incident reports to be prepared for any spills on site;
- Appropriate housekeeping precautions to be implemented to prevent construction workers from having contact with potentially contaminated soils/aggregates;
- Construction workers to be required to wear appropriate personal protective equipment (PPE) and to have undertaken adequate training / awareness;
- Appropriate stormwater management procedures to be implemented to ensure that contaminants are not mobilised into the wider environment; and
- Washout from concrete mixing plant or from cleaning ready-mix concrete lorries is contaminated with cement and therefore is highly alkaline. This should not be allowed to enter the aquatic environment and should be re-used on site where possible or disposed of appropriately.

7.2.3.1.4. Storage, use and handling of Hazardous Materials

7.2.3.1.4.1. General

- Training material on proper management of hazardous waste to be kept on record, along with signatures of workers who have been trained. Only these workers are authorised to handle hazardous waste on site;
- All hazardous liquid materials will be stored in a container of sufficient strength and structural integrity to ensure that it is unlikely to burst or leak in its ordinary use;
- Incompatible hazardous materials must be segregated and stored separately, e.g.: flammable liquids will be segregated from caustic / acidic materials, if relevant;
- Storage, handling and disposal of fuels, oils, lubricants and other potentially harmful chemicals (and their containers) will be undertaken under proper supervision in accordance with manufacturer’s instructions;
- Storage areas will be clearly marked and signed with regard to the quantity and hazardous characteristics of the materials stored (Material Safety Data Sheets);
- Containers will be stored, in designated areas that are isolated from surface water drains, open water and are bunded to contain any spillages;
- Emergency spillage kit will be located at strategic locations and in proximity of the main storage areas and the refuelling area;
- Leaking or empty oil drums will be removed to the hazardous waste storage area to be treated or disposed of via approved waste disposal contractors;
- Water used for dust damping should come from a source that will not risk causing contamination to soil or groundwater.

7.2.3.1.4.2. Bulk Storage

- The content of any tank will be clearly marked on the tank, and a notice displayed requiring that the valves and trigger guns be locked when not in use;
- All containers will be securely stored and labelled, so that appropriate remediation action will be taken; and
- All tanks will be located on a drip tray of sufficient size and bunded with a capacity of at least 110% of the tank capacity.

7.2.3.1.4.3. Handling and Refuelling

- Prior to commencing work involving handling materials, all personnel will be familiar with the relevant hazardous properties and instructed on the relevant emergency procedures;
- Appropriate Personnel Protective Equipment (PPE) will be issued to relevant personnel;
- Designated personnel will be trained in the use of Emergency Spill Kits;
- Any refuelling operation will be supervised and will take place over appropriately sized drip trays;
- All hoses and valves will be checked for wear and tear; and
- All hoses and valves will be securely locked and stowed away when not in use.

7.2.3.1.4.4. Transportation and Maintenance

- Contractors responsible for transporting waste materials to/from the site will be suitably qualified and possess a license from relevant Competent Environmental Authority;
- A transportation document will be created in order to establish a chain of custody using multiple signed copies to demonstrate that the material was transported and received by the final disposal facility in the correct manner;
- All hazardous materials will be labelled, and external signs will be provided on vehicles in accordance with the United Nations Transport Guidelines;
- Plant and vehicles will be well maintained to avoid leakages; and
- No vehicles will be serviced on-site.

7.2.3.1.5. Storage and disposal of hazardous wastes

- All hazardous wastes will be separated from general waste in a designated, well signed area to avoid cross contamination;
- All workers will be sufficiently trained to accurately identify and separate waste streams to prevent cross contamination of waste stores;
- Hazardous waste storage areas will be maintained and regularly inspected and audited to highlight any leaks or spills; and
- All hazardous wastewater should be collected and disposed of to a licensed facility by an appropriately licensed and EPC.

7.2.3.1.6. Generation of sanitary effluents

- No discharge or overflow of sanitary waste on site;
- Modular wastewater storage tanks will be introduced to the Project site to provide adequate containment facilities for the construction workforce;
- Regular checks will be carried out on sanitary facilities to ensure there are no leaks;
- All sanitary effluents will be stored in appropriate tanks and collected by a licensed waste contractor for treatment at a licensed facility; and
- All sanitary wastewater should be collected and disposed of to a licensed facility by an appropriately licensed and authorised contractor.

7.2.3.1.7. Disposal of dewatering effluents

With a potentially high groundwater table in parts of the Project site, it is expected that dewatering will be required, particularly at locations where deep excavation works will be required such as for bridge foundations.

Therefore, the EPC Contactor will have to apply for and receive dewatering permits from the relevant Competent Environmental Authority. Control measures shall be taken for testing effluent as per authority requirements/standards prior to discharge to ensure no impact to the environment occurs. Where exceedances of the standards are recorded, appropriate treatment measures must be implemented prior to discharge.

7.2.3.1.8. Disposal of washdown effluents

Contained areas for washing out and cleaning plant, concrete batching plant or ready-mix lorries will be established, and wash-waters will be collected for reuse or appropriately treated.

7.2.3.1.9. Importation of Fill Material

- Importation of fill material will be regularly screened and tested at the source site to ensure imported material is free from contaminants;
- Any imported material suspected to contains contaminants will not be accepted on site and will be subject to further analysis to confirm status and, if found to be contaminated, will be appropriately transported and disposed of as hazardous waste; and
- Workers to be trained to identify visual and odorous signs of contamination to allow the potential identification of contaminants to be raised to attention and thus to prevent the further contamination of areas of site.

7.2.3.1.10. Groundwater Contamination

All measures should be taken to ensure that groundwater is not adversely affected. This would include the implementation of best available techniques to reduce the risks of contamination from leaks, spills or accidental discharges of construction materials and effluents.

Procedures must be established to ensure that the risk of accidents and that the potential for spillages and hazardous substance release is minimised. This would also include the development of an emergency plan to ensure that in the event of a major incident there is an approved procedure to mitigate any environmental impacts.

The following will be implemented as part of the CESMP:

- Hazardous liquid materials will be stored in a container of sufficient strength and structural integrity to ensure that it is unlikely to burst or leak in its ordinary use;
- Containers will be stored, in designated areas that are isolated from surface water drains, open water and are bunded to contain any spillages;
- Storage, handling and disposal of fuels, oils, lubricants and other potentially harmful chemicals (and their containers) will be undertaken under proper supervision in accordance with manufacturer's instructions;
- Emergency spillage kit will be located at strategic locations and in proximity of the main storage areas and the refuelling area;
- Leaking or empty oil drums will be removed to the hazardous waste storage area to be treated or disposed of via an approved waste disposal contractor; and
- Water used for dust damping should come from a source that will not risk causing contamination to soil or groundwater.

7.2.3.1.11. Asbestos in Existing Buildings and Structures

There is the potential for asbestos to be present within existing buildings and structures which will require demolition in advance of the construction of the Project as well as the removal of visually confirmed asbestos cement sheeting located on site. In order to prevent impacts upon the workforce and residents of surrounding areas, the following control measures will be implemented prior to demolition works:

- A full asbestos survey of existing buildings will be required prior to the commencement of demolition works. The survey should conform to the survey methodology set out for Refurbishment and Demolition Surveys in HSG: 264 Asbestos: The survey guide;
- If asbestos is identified, this should be removed by a licensed Asbestos removal contractor, under the supervision of an Asbestos Supervising Consultant to provide independent verification that all Asbestos has been removed and that the demolition works can proceed; and
- The asbestos material should be disposed of, under the appropriate licence, to an authorised hazardous waste management facility.

7.2.3.2. Operational Phase

The key measures for preventing contamination during the operational phase will be designed into the Project. This includes appropriate designs in relation to the following:

- Appropriate containment systems around storage tanks (e.g. fuels, oils etc);
- Leak detection facilities;
- Fire prevention measures; and
- Appropriate storm water management systems.

An OESMP will also be developed which will contain the key operating procedures that are to be implemented for the Project to prevent contamination of the groundwater. The OESMP will include measures such as:

- Hazardous chemicals and materials to be appropriately stored on-site in secure, bunded, compounds and located on an impervious surface. The storage areas will need to be clearly labelled with material safety data sheets (MSDS) maintained as part of the on-site record keeping;
- All hazardous liquid materials will be stored in a container of sufficient strength and structural integrity to ensure that it is unlikely to burst or leak in its ordinary use;
- Incompatible hazardous materials must be segregated and stored separately, e.g.: flammable liquids will be segregated from caustic / acidic materials, if relevant;
- Storage, handling and disposal of fuels, oils, lubricants and other potentially harmful chemicals (and their containers) will be undertaken under proper supervision in accordance with manufacturer's instructions;
- Storage areas will be clearly marked and signed with regard to the quantity and hazardous characteristics of the materials stored (Material Safety Data Sheets);
- Containers will be stored, in designated areas that are isolated from surface water drains, open water and are bunded to contain any spillages;
- Emergency spillage kit will be located at strategic locations and in proximity of the main storage areas and the refuelling area;
- Ensure adequate maintenance of plant and infrastructure pipelines to reduce the risk of leaks and potential pollution of surface water bodies during operation;
- Relevant design guidelines for waste storage and collection strategy must be adhered to;
- The content of any tank will be clearly marked on the tank, and a notice displayed requiring that the valves and trigger guns be locked when not in use.
- Regular vehicle and equipment maintenance to be undertaken in hard-standing areas with isolated drainage and oil-interceptors;
- Vehicle and equipment refuelling to be undertaken in hard-standing areas with isolated drainage and oil-interceptors – where this is not possible drip-trays must be used;
- Emergency Response Procedure should be in place and all employees aware of their responsibilities;
- Spill clean-up kits to be readily available on site and staff trained in their appropriate use; and
- Spills to be cleaned up immediately and any waste materials generated, including excavated soils or aggregates, must be disposed of appropriately as hazardous waste.

The design and construction of the facility, as well as the adoption of best practice operations detailed within an OESMP should significantly limit the risk of pollution.

Other measures in relation to personnel safety, housekeeping and security, on-site awareness training and emergency preparedness policies are also essential. Such measures will form part of the OESMP with the overall aim of avoiding incidences which may lead to potential contamination issues. Such measures will include, inter alia:

- To protect and promote health and safety issues to all staff and personnel on-site;
- To minimise exposure to potential hazards and safety issues and reduction in risk from injury and health risk;

- To minimise impacts on the environment from the plant activities taking into account the necessary balance between economic efficiency, energy requirements and environmental protection;
- Promote good practice measures in terms of health and safety to comply, as a minimum, with law and policy requirements;
- Provide appropriate security measures to ensure that any potential issues that may result in contamination are avoided;
- Promote appropriate safety zoning to the hazards that may be present and to ensure that any spillages or incidents are avoided;
- Provide emergency response procedures to any potential incidents to ensure that contamination incidents are controlled if they occur;
- Provision of written standard operating procedures for all processes and appropriate document control;
- Provision of awareness training for all employees including management, office staff and technical staff on pollution prevention and control techniques and best practices;
- The establishment of daily checklists for plant and office areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found;
- Continuous monitoring and reporting of the plants' performance should be undertaken in order to establish baseline conditions and whether conditions are improving or deteriorating; and,
- Regular reviews of emergency response procedures should be undertaken, including a contingency plan for spills, leaks, weather extremes etc. Terrestrial Ecology

Due to fact that no natural habitats remain on the study area and the fact that the envisaged impact on flora and fauna is likely to negligible, no mitigation other than operational care, during the construction and operation phase, is required proposed.

Nevertheless, to meet with the requirements of PS6 it is recommended that e project opportunities to enhance habitat are undertaken, which could include the development of a landscaping scheme, which seeks to create areas of habitat.

7.2.4. Terrestrial Ecology

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Nevertheless, to meet with the requirements of PS6, it is recommended that project opportunities are undertaken to enhance the existing habitats. Opportunities could include the development of a landscaping scheme which seeks to create areas of habitat.

7.2.5. Marine Water & Sediment

7.2.5.1. Construction Phase

7.2.5.1.1. Sediment from construction activities

- Prior to construction, the Marine Works Contractor will be required to obtain additional permits for undertaking marine construction works;
- No activities shall take place outside of the pre-defined construction corridor;
- The type of equipment should be selected carefully to minimise the impact on the surrounding environment;
- The Marine Works Contractor's working practices should incorporate the following measures:
  - Prior to the start of any works in the marine environment, the Marine Works Contractor should install a double layer of low permeability silt screens to minimise the dispersion of marine sediments. Silt curtains should be placed between dredging / digging activities and the surrounding environment;
  - Best available techniques to reduce sedimentation and minimise water turbidity should be employed (based on a technical and environmental evaluation);
  - Consideration of natural variations within the coastal environment, including tidal and other sea level patterns, and the possibility of synchronising the activity with these changes to minimise environmental impacts;
  - Monitoring shall start prior to the commencement of the activity to provide baseline information for progress monitoring purposes; and
  - In the early phase of the activity, monitoring will be intensive enough in order to identify any problems or concerns. This may be reduced as confidence in the processes grows, but only with the approval of Fujairah Municipality.

7.2.5.1.2. Spill of hazardous material to the marine environment

Introduction of contaminants from accidental oil, fuel or chemical spills and inappropriate waste disposal would be mitigated through best practises and procedures including the following:

- Store hazardous materials at designated sites at least 50m away from the sea;
- Proper maintenance of construction vehicles and vessels;
- Provide appropriate (110% volume) secondary containment system at chemical and fuel storage areas;
- Containerising and labelling waste;
- Spill Response Plan to be developed;
- Appropriate spill kits and spill clean-up material available on marine vessels, at chemical, fuel and waste storage areas, and at re-fuelling and maintenance areas;
- No fuel stores within 50m of the sea, surface water bodies or drains leading to the sea; and
- Wastes and sewage to be collected regularly for disposal at appropriate facilities.

7.2.5.2. Operational Phase

7.2.5.2.1. Thermal discharge

The hydrodynamic study showed no exceedance (>3°C to ambient temperature) in the RMZ on the seabed. The area is already impacted from existing outfalls indicating the proposed outfall will have a very limited effect due to the use of a diffusor outfall.

7.2.5.2.2. Chlorine discharge

The hydrodynamic study showed no exceedance of residual chlorine (>0.01mg/l) in the RMZ on the surface water. The area is already impacted from existing outfalls indicating the proposed outfall will have very limited effect due to the use of a diffusor outfall. No further mitigation of the continuous dosing concentration or method is proposed; however, the shock dosing concentration of 2 mg/l should be limited to no more than 10 minutes per 24 hour period. In addition, monitoring should be undertaken to ensure no exceedances or residual impacts occur. Should exceedances be experienced then mitigation such as the use of alternative materials as a biocide e.g. chlorine dioxide (ClO_2) could be investigated.

7.2.5.2.3. Salinity

The hydrodynamic model showed salinity at the seabed (highest concentration in the water column) not to exceed the maximum allowable increase within the RMZ. The study area is already impacted from existing outfalls and the use of a diffuser outfall will not require further mitigation, but monitoring is suggested to ensure no exceedances or residual impacts occur during the operational phase.

7.2.6. Marine Ecology

7.2.6.1. Construction phase

7.2.6.1.1. Loss of habitat

Mitigation measures to be considered will involve the adoption of working methodologies and practices which reduce impacts to habitats. This would involve selecting working methods and equipment which are the least environmentally damaging, such as avoiding work during strong tides or during inclement wind conditions and the use of appropriate equipment in good working condition.

Limiting construction impacts to the pipeline corridor will prevent unnecessary impacts to surrounding habitats.

7.2.6.1.2. Collisions with marine mammals and reptiles

To reduce the potential impact of collision with marine fauna, members of the marine construction team should be familiar in the spotting of marine fauna. In the event that marine mammals or reptiles are spotted within 150 m of operations, then works should temporarily cease until the area is clear. Additional mitigation measures could include:

- Reduce marine vessel trip frequency;
- Reduce marine vessel speed;
- Limit marine vessel operations to dedicated navigation corridors; and
- Limit marine vessel trips to daylight hours.

7.2.6.1.3. Sedimentation from construction activities

Please refer to **Section 7.2.5.1.1**.

7.2.6.2. Operational Phase

7.2.6.2.1. Thermal discharge

The hydrodynamic study showed no exceedance (>3°C to ambient temperature) in the RMZ on the seabed. The area is already impacted from existing outfalls indicating the proposed outfall will have very limited effect due to the use of a diffusor outfall. Therefore, no further mitigation is required but monitoring should be undertaken to ensure no exceedances or residual impacts occur.

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The hydrodynamic model showed salinity at the seabed (highest concentration in the water column) not to exceed the maximum allowable increase within the RMZ. The study area is already impacted from existing outfalls and the use of a diffuser outfall will not require further mitigation, but monitoring is suggested to ensure no exceedances or residual impacts occur.

7.2.6.2.4. Habitat creation

The addition of some hard substrate habitat along the pipelines is a positive impact. As the dominant habitat type was unconsolidated sediments additional hard substrate could be provided along the pipeline corridors to compensate for any habitats lost during the construction phase. This hard substrate will act as artificial reef providing habitat for a number of sessile invertebrates and fish species. The presence of corals on the small patches of hard substrate observed in the study area indicate recruitment is occurring and additional hard substrate habitats should be colonised by these propagules.

7.2.6.2.5. Entrainment of faunal species

Mitigation measures to prevent the entrainment of marine species should be considered in the design phase and include measures such as:

- Installation of grills to prevent large species like turtles coming close to the intakes; and
- Mesh caging could reduce the entrainment of smaller species like fish and sea snakes.

7.2.7. Waste

7.2.7.1. Construction Phase

7.2.7.1.1. General Measures

During the construction phase of the Project, the EPC Contractor will be required to develop a CESMP which will include a site-specific Site Waste Management Plan (SWMP). This document shall be compiled in accordance with the requirements provided within UAE Legislation. The EPC Contractor must include the following requirements within the SWMP:

- The SWMP shall identify, at a minimum, measures for reducing waste streams generated during the construction phase and identify those streams suitable for recycling;
- For waste streams which are unavoidable and unrecyclable the SWMP will provide a waste management strategy for storage, collection and appropriate disposal of aforementioned construction waste streams. Additionally, the waste disposal routes will need to be clearly identified to ensure that potential impacts associated with the local and regional transport infrastructure are minimised as far as possible;
- The SWMP will particularly provide consideration of and control measures for wastes which may require to be transported via specific routes due to the quantity or nature of the waste stream e.g. contaminated soils identified during the site preparation phase. This will enable the closest possible disposal location to be identified for each particular waste stream; and
- The SWMP should also include the following provisions:
  - Identify who will be responsible for the management of construction waste;
  - What types of waste will be generated and in what volumes;
  - Targets for the diversion of waste from landfill;
  - How waste will be treated – with the adoption of a waste hierarchy with an order of priority as follows:
    1. Avoidance;
    2. Reduction;
    3. Reuse;
    4. Recycling; and
    5. Disposal as the final option only.
- Measures for testing of soils and fill material to identify contaminated materials, where relevant;
- Targets for the reuse of excavated spoil materials and prevent as far as practicable transport and disposal of these wastes;
- Training and toolbox talks should be provided to educate all construction workers regarding best practice waste management practices and recycling initiatives, and to encourage more sustainable working practices. Emphasis should be placed on the waste minimisation hierarchy: reduce, reuse, and recycle;
- Requirements for permits from authorities for storage, transport and treatment/disposal of wastes;
- Allocation and development of waste storage areas, with necessary provisions for segregation of waste types and appropriate means of avoiding contamination;
- The methods of transportation;
- The final destination of wastes for treatment or disposal;

- Identification of which licensed waste management contractors will be used; and
- How the types and quantities of waste generated by the project and the achievement of targets to avoid landfill will be measured and reported.

In addition, and in accordance with the IFC EHS Guidelines (Waste Management), waste minimisation should be encouraged among suppliers. This is likely to involve suppliers committing to reducing surplus packaging associated with any construction materials; particularly common packaging materials such as plastics (shrink wrap and bubble wrap), cardboard and wooden pallets. This may also involve improved procurement and consultation with selected suppliers regarding commitments to waste minimisation, recycling and the emphasis on continual improvements in environmental performance.

7.2.7.1.2. Dredged Waste

It is recommended that any dredged material is used as fill material on the site, if it is structurally suitable and uncontaminated. Prior to use of any source of material, sampling must be carried out to ensure the source material is not contaminated.

It is therefore recommended that 12 samples are collected from the first 4,000 m^3 used, with a single sample being collected for every 1,000 m^3 imported thereafter. Sampling should be tested for the following parameters:

- pH;
- Chlorides;
- Nitrates;
- Sulphates;
- Total Phosphates;
- Water Soluble Phosphates;
- Heavy Metals;
- VOCs;
- Total Petroleum Hydrocarbons (TPH) Diesel Range, Gasoline Range, Heavy Fractions;
- Sum of 10 Poly-aromatic Hydrocarbons (PAH); and
- PCBs.

The above parameters should be compared to the Dutch Intervention Value Standards (2009) for soil.

If the material is found to be contaminated, it should therefore be treated as hazardous waste and disposed of accordingly.

7.2.7.1.3. Liquid Waste (Effluent)-Storage and Treatment of Sanitary Wastewater

The EPC Contractor must include the following requirements within the SWMP:

- Wastewater storage tanks will be introduced to the site to provide adequate containment facilities for the construction workforce;
- Functional and well-maintained sanitary facilities must be available on site at all times;
- Sludge arising from temporary toilets should be disposed of by an appropriately licensed contractor in accordance with the appropriate Municipality Technical Guidelines and other pertinent Federal and Emirate level legislation and with an emphasis on preventing risk to public health and safety;

- Adequate removal of sanitary liquid waste from temporary toilets, in conjunction with inspections will avoid any overflow and create a zero-leakage site; and
- Removal of liquid sanitary waste from temporary toilets should be undertaken by a licensed waste management sub-contractor and transported to the nearest sewage treatment plant.

7.2.7.1.4. Impacts on Surrounding Receptors due to Improper Storage and Handling of Wastes

The EPC Contractor must include the following requirements within the SWMP:

- All hazardous materials will be stored in a container of sufficient strength and structural integrity to ensure that it is unlikely to burst or leak in its ordinary use;
- All hazardous liquid waste must be stored within a bunded area with a minimum volume if 110% of the largest container stored within;
- Incompatible hazardous materials must be segregated and stored separately, e.g.: flammable liquids will be segregated from caustic / acidic materials, if relevant;
- Storage, handling and disposal of fuels, oils, lubricants and other potentially harmful chemicals (and their containers) will be undertaken under proper supervision in accordance with manufacturer's instructions;
- Storage areas will be clearly marked and signed with regard to the quantity and hazardous characteristics of the materials stored (Material Safety Data Sheets);
- Containers will be stored, in designated areas that are isolated from surface water drains, open water and are bunded to contain any spillages;
- Emergency spillage kit will be located at strategic locations and in proximity of the main storage areas and the refuelling area;
- Leaking or empty oil drums will be removed to the hazardous waste storage area to be treated or disposed of via a Fujairah Municipality approved waste disposal contractor; and
- Emergency response procedures will be formulated and available to be implemented in the event of an incident and to minimise the impact of contamination incidents should they occur.

7.2.7.1.5. Health and Safety

7.2.7.1.5.1. Exposure to Harmful Substances

The EPC Contractor must include the following requirements within the SWMP:

- Training and toolbox talks should be provided;
- All workers will be provided with a comprehensive induction to demonstrate which wastes are segregated in adequately labelled containers; and
- Specific PPE and training will be provided, and PPE must be worn by employees at all times specific to the nature of their task.

7.2.7.1.5.2. Exposure to Hazardous Substances

The EPC Contractor must include the following requirements within the SWMP:

- All staff will be trained in appropriate hazardous material handling;
- All staff will be provided with appropriate PPE to ensure safe working; and
- An emergency response plan will be prepared and conveyed to all staff.

7.2.7.1.5.3. Asbestos in Existing Buildings and Structures

There is the potential for asbestos to be present within existing buildings and structures which will require demolition in advance of the construction of the Project, which has been confirmed with the presence of asbestos cement sheets on site. In order to prevent impacts upon the workforce and residents of surrounding areas, the EPC Contractor must include the following requirements within the SWMP:

- A full asbestos survey of existing buildings will be required prior to the commencement of demolition works. The survey should conform to the survey methodology set out for Refurbishment and Demolition Surveys in HSG: 264 Asbestos: The survey guide;
- If asbestos is identified, this should be removed by a licensed Asbestos removal contractor, under the supervision of an Asbestos Supervising Consultant to provide independent verification that all Asbestos has been removed and that the demolition works can proceed; and
- The asbestos material should be disposed of, under the appropriate licence, to an authorised hazardous waste management facility.

7.2.7.1.6. Waste Handling and Transport

The EPC Contractor must include the following requirements within the SWMP:

- Waste is suitably disposed of by a licenced operator and is not be transported to other Emirates unless the appropriate approvals from the respective Emirate Waste Authorities and the MOCCAE;
- All relevant consignments of waste (waste manifests) for disposal or recycling should be recorded indicating their type, destination and name of the carrier. This will indicate whether the waste is to be treated, recycled or disposed of to a landfill site and discharge liability from the waste producer by ensuring that disposal activities are in accordance with local regulations;
- Final disposal of wastes will be to respective Municipality approved waste treatment plants or respective Municipality approved landfill sites, as agreed by the relevant competent administrative authority;
- Waste manifests must be countersigned by the receiving facility;
- Where possible, conventional wastes (i.e. paper/cardboard, plastic) will be recycled by a Municipality approved company or removed from the Project Site by appropriate Municipality approved Contractors;
- Waste containers shall be checked prior to leaving the site to ensure:
- The waste containers are clean on the outside, sealed, and not leaking; and
- The required forms for wastes and other documents required for shipment are completed and correct.

7.2.7.2. Operation

The Operator will be required to develop an OESMP, which will include sustainable waste management practices commensurate with the activities which will be undertaken as part of this major industrial development. This will include the following as a minimum:

- Ensuring compliance with national and international best practice guidance;
- Encouraging opportunities to minimise waste, based upon the principle of the hierarchy of waste prevention and reduction through to reuse, recovery (energy and materials) and disposal via landfill as a final option;
- Providing suitable waste facilities, including the segregation of waste streams for recycling and general waste for disposal to landfill;
- Ensuring good on-site storage practices, including appropriately covered waste storage areas and dedicated hazardous waste storage facilities;
- Appointing dedicated personnel responsible for waste management issues;
- A clear process for the monitoring and recording waste, including a schedule of monitoring and periodic audits to inform the OESMP process;
- The financial resources necessary to implement and operate a suitable waste management system shall be specified, as well as those people responsible for making those resources available; and
- Capacity building and training needs shall be identified to ensure that waste can be properly managed and controlled.

Hazardous waste will be treated by a qualified and licensed contractor in Fujairah for the type of waste. If the hazardous waste cannot be treated in Fujairah Emirate, alternatives facilities should be used. For example, it is understood from Fujairah Municipality that certain waste types associated with ongoing maintenance of the RO facility cannot be effectively treated within Fujairah. This would include the following waste types:

- Lime waste;
- RO sludge; and
- Spent filters.

Fujairah Municipality has therefore recommended that these waste types are treated within waste management facilities within Abu Dhabi.

7.2.8. Socio-Economy

7.2.8.1. Construction Phase

A CESMP will be developed by the EPC to manage the construction activities in such a way as to minimise construction impacts.

7.2.8.1.1. Disruption to the local economy and population

7.2.8.1.1.1. Air Quality Impacts

Section 6.3.1: Ambient Air Quality sets out a series of measures which will be implemented during the construction phase to ensure that the generation of dust and emissions is minimised as far as possible.

7.2.8.1.1.2. Noise Impacts

Section 6.3.2: Ambient Noise sets out a series of controls to reduce the noise impacts during construction which will reduce the impacts of noise during construction.

7.2.8.1.2. Landscape and Visual Impacts

A range of mitigation measures as set out within the ESIA, NOC and Authority approved CESMP will be implemented by the D&B Contractor to minimise impacts relating to visual receptors and a reduction in landscape quality as a result of the construction activities and laydown areas required.

A summary is provided as follows:

- Strategic installation of hoarding of an appropriate height within areas along the alignment bordering onto residential areas and roads in order to shield the view of construction activities from the identified sensitive receptors;
- Establishment of a grievance mechanism for local residents;
- Ensure good housekeeping throughout the construction site and storage areas to minimise unsightly visual impacts; and
- Identify dedicated construction traffic routes, including use of appropriate signage to ensure that construction vehicles are routed away from residential areas where feasible.

7.2.8.1.3. Health and Safety

7.2.8.1.3.1. Construction Worker Welfare

- The development of a Health and Safety and Environmental Policy would provide detailed health and safety guidelines for staff, personnel and sub-contractors, including personal safety, site conduct, security, site safety zoning and emergency procedures;
- In common with Performance Standard 2, on site medical facilities must be made available throughout the construction phase for the use of workers. Trained health and safety and first aid personnel must be identified to workers as part of their training schedule;
- Suitably qualified personnel must be chosen for potentially hazardous activities such as for the installation and testing of specialist electrical equipment;

- Appropriate action must be taken for outbreaks of illnesses amongst workers, minimising the transmission as far as is possible;
- The Contractor must establish a Human Resources Policy which will be communicated to employees with information including, but not limited to, their rights under national labour and employment laws, salary, and other associated information, such as medical care and insurance. The Human Resources Policy will ensure an approach of non-discrimination is followed with equal opportunities for all. No child labour or forced labour will be used for the proposed facility;
- In common with Performance Standard 1 (Section 23), the establishment of a 'grievance mechanism' for workers will involve the identification of a local environmental co-ordinator, identified by the contractor within the management structure, to identify and log all concerns. This contact information will be provided via appropriate transparent measures and a placard left on the perimeter of the site with further details of contact arrangements. The resultant procedure to address these concerns will be made clear to the complainant and a set process followed, as identified within the CESMP, and within a suitably prompt period;
- Throughout the construction and operation of the proposed facility, a long-term training programme should be implemented to ensure adequate training and qualification of all staff employed within the RTR facility. The aim of this programme would be to ensure that personnel acquire and maintain the combination of knowledge and demonstrated skills as required to safely and adequately fulfil their responsibilities. The objective of the long-term training plan will be to ensure that the facility is operated safely and efficiently, while also guaranteeing the long term economic success of the Project; and
- In common with Performance Standard 4, all components of, and infrastructure associated with, the Project will be constructed in accordance with industry.

7.2.8.1.3.2. Exposure to Asbestos in Existing Buildings and Structures

A detailed Dust and Asbestos Control Plan for Workers Health and Safety should be established to ensure workers and nearby receptors safety, particularly during dust emitting activities such as demolition. These mitigation measures will be presented in the CESMP.

7.2.8.1.4. Impacts on Surrounding Receptors

Construction activities undertaken for the Project may result in an impact to construction worker accommodation, depending upon its eventual location, which is yet to be determined. It is important that this will be managed in such a way as to minimise construction impacts.

Firstly, the worker accommodation should be appropriately sited to avoid noise impacts from the construction activities. Where this is not possible appropriate noise attenuation measures should be provided.

Secondly, any on-going issues will be managed through the CESMP which will be implemented and monitored by the Contractor and any sub-contractors, to include an update of existing EHS documentation. The CESMP will be required to incorporate all the mitigation measures identified throughout this ESIA. This will ensure that the effects of construction works upon the local community is minimised.

In addition, a grievance procedure needs to be established for construction workers and local residents to ensure that any issues are resolved to the satisfaction of all parties. This will include the following:

- Clear contact numbers for key construction management staff who can be contacted in the case of complaints, which could be posted on signage near to the site access gates or in leaflets distributed to the local community; and

A clear grievance procedure which involves studying the basis of complaints, identifying corrective actions and communicating the response to the complainant.

7.2.8.2. Operation Phase

An OESMP will be developed by the EPC to manage the construction activities in such a way as to minimise construction impacts.

7.2.8.2.1. Air Quality Impacts

Section 6.3.1: Ambient Air Quality sets out a series of measures which will be implemented during the operations phase to ensure that the generation of dust and emissions is minimised as far as possible.

7.2.8.2.2. Noise Impacts

Section 6.3.2: Ambient Noise sets out a series of controls to reduce the noise impacts during operation which will reduce the impacts of noise during operation.

7.2.8.2.3. Impacts on Local Businesses and Social Issues

7.2.8.2.3.1. Impact on Local Businesses

As the impacts are considered to be **positive** there is no requirement for any mitigation measures to be implemented.

7.2.8.2.3.2. Impact on Local Services

As the impacts are considered to be **negligible** there is no requirement for any mitigation measures to be implemented.

7.2.8.2.4. Health and Safety

7.2.8.2.4.1. Operational Worker Welfare

- To provide the employees with a safe and risk-free environment, it is recommended that a comprehensive EHS plan is developed and implemented. This framework, in line with Performance Standard 2, will address measures for accident prevention, identification, mitigation and management of hazards (including physical, chemical, and radiological hazards), training of workers and reporting of accidents and incidents;
- An appropriate emergency procedure will be developed and implemented in the case of a hydrogen leak from the generators in the Project area. This emergency procedure will include the following mitigation measures and will be developed in accordance with Consortium Marubeni Corporation and Samsung C&T existing procedures within the site:
  - The employees will be informed on the serious risks of poisoning, fire and explosion hazards, especially on accidental exposure conditions, and on the measures to be taken in case of an accident. Special Procedures in the event of an accident will be subject to training exercises

- – Use of gas detectors which will warn the employees when alert thresholds are reached. These devices will be periodically checked using standard gases. Recalibration of sensors may be necessary depending on the test results;
  - – Location of windsocks in highly visible areas to provide staff with an indication of wind direction and therefore escape routes; and
  - – In case of leakage, every worker must have access to a mask breathing apparatus in his immediate vicinity.
- Occupational noise standards need to be maintained as part of the Health and Safety of the employees at the facility. It is therefore important that noise levels in working areas are limited to less than 85 dB(A) at 1m from any noise generating equipment. It is further recommended that a full occupational noise survey is undertaken in the interests of the health and safety of the site employees;
- In accordance with Performance Standard 2, the Project should develop and implement a human resource policy outlining the management approach towards working conditions, entitlement to wages and any benefits and terms of employment. This policy must be disseminated and accessible for all employees, clearly defining the employees' legal rights and the management's statement on child labour, forced labour and on non-discrimination and equal opportunities. This policy will also provide the mechanism through which employees can express and register their concerns and the system through which these grievances will be addressed;
- Expatriate staff must be provided with an induction course (as part of their training), which will highlight local customs, cultures and living conditions in the UAE. The objective of this course will be to familiarise the expatriate staff with knowledge of their host country and provide an understanding and respect for other cultures. The aim will be to reduce, prevent and mitigate against social and cultural tensions and potential hostility between workers and the residents of surrounding communities;
- The provision of facilities for workers, such as kitchen facilities, dining areas, washrooms, and a mosque, will minimise the placing of undue pressure on existing local services;
- Where feasible, staff will be of local origin where suitably qualified applicants are available. This will ensure a degree of balance between the use of expatriate workers and locally employed personnel during the operational phase, and limit the impact on the local economy;
- In common with Performance Standard 4, all components of and infrastructure associated with the Project will be operated in accordance with industry best practice by qualified staff; and

In line with IFC Performance Standard 1, it is also recommended that a grievance mechanism is established for local residents, giving them a platform to raise any concerns.

7.2.9. Archaeology and Cultural Heritage

7.2.9.1. Construction Phase

In order to ensure that archaeological impacts are minimised, it is recommended that the CESMP includes procedures to protect archaeological resources (if any are detected) which include:

- Toolbox talks concerning the potential for archaeological finds during earthworks, which will be provided to all construction workers involved in site works such as grading, excavations etc.;
- A chance finds procedure will be established which includes the following and is summarised within Figure 7-1 below:
  - Any chance finds or suspected evidence of archaeological and/or historical materials must be immediately reported by any of the construction workers, or other parties involved in the construction phase, to the HSE representative or Site Manager and all works in the area should be stopped immediately; and
  - Fujairah Tourism and Antiquities Authority (FTAA) should be contacted for advice on how to proceed and work should not recommence within that area until signed off by FTAA.

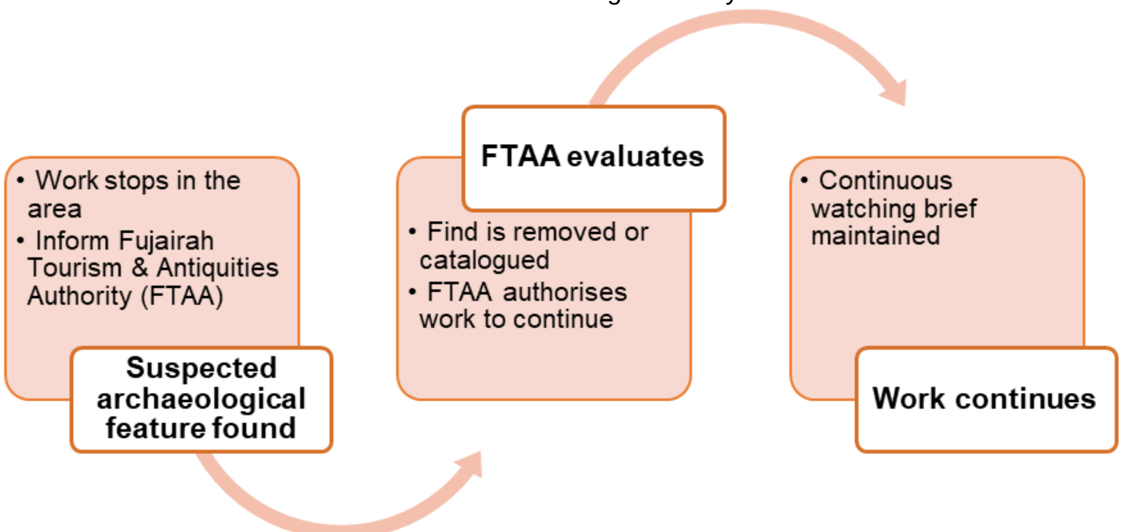

Figure 7-1: Summary of the archaeological watching brief and chance finds procedure

7.2.9.2. Operational Phase

No mitigation measures are required during the operation phase of the Project.

7.3. Residual Impacts

7.3.1. Summary Tables

7.3.1.1. Ambient Air Quality

7.3.1.1.1. Construction Phase

Additional mitigation measures have been identified, however the residual impacts are expected to be **"Minor Negative"** for construction related dust. Impacts to the F1 and F2 turbine air intakes should change from **"Minor Negative**" to **"Negligible"**.

Table 7-1: Construction air quality residual impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Dust	Construction dust impacting on Sensitive Receptors	Moderate Negative	– Implementation of the CESMP which promotes best practice management measures on site in order to manage construction related dust. – Consider paving / hard surfacing key site access routes	Minor Negative

Dust	Construction dust impacting on turbine air intakes at F1 and F2	Minor Negative	– Undertake dust suppression watering in the areas adjacent to the F1 and F2 during episodes of high winds or visible dust formation;
			– Install real time ambient air quality particulate monitors in vicinity of intakes prior to commencement of constriction to establish exiting PM concentrations;
			– Consult with F1 and F2 operators and explore management options at F1 and F2 during F3 construction including:
			  – Increasing filter inspection frequency at F1 and F2
			  – Where necessary optimising filter pulse system settings on filters at F1 and F2; and
			  – F1 and F2 operators to consider aligning filter maintenance (filter swaps) prior to F3 commencing construction.
				Negligible

Vehicle Emissions	Vehicle exhaust emissions from construction traffic	Negligible	– Implementation of a CESMP	Negligible

7.3.1.1.2. Operational Phase

The operations phase assessment considers two key aspects, namely the assessment of the Project in isolation as well as the assessment of cumulative impacts associated with the addition of the F1 and F2 plants, and measured background pollutant concentrations from nearby monitoring stations. The following provides a summary of the potential impacts on air quality based solely the Project contribution (when considering normal operations with SCR operational):

- The Project in isolation meets the IFC guideline which recommends that a project in isolation should not contribute more than 25% of the applicable standard or guideline (when considering the EU AAQS);
- The Project isolation will likely have an impact significance ranging from **minor negative** to **negligible**, when the turbines are operated in combined cycle with the SCR operational; and
- When the project is operated in open cycle, the impact significance ranges from **minor negative** to **negligible**.

However, when considering the cumulative impacts (modelled contributions from F1 and F2 with measured background added to the model results), even with the SCR operational, the significance of impact is expected to be **major negative**, when considering the comparison against the Federal 1 hour NO_2 Standard. If the Project can motivate for the adoption of the EU standard for assessment purposes, the residual impacts are expected to be **moderate negative**. In terms of open cycle operation, the impact significance is again expected to be **major negative** when comparing the cumulative results against the Federal 1 hour standard, however this lowers to **moderate negative** when considering the EU standards. All other impacts are expected to be of **minor negative** to **negligible significance**.

Appropriate mitigation measures will need to be discussed and agreed with the competent authorities, lenders and stakeholders, however the most discernible approach would be for the regulators / lenders to adopt a short term standard that allows for exceedances (e.g. EU AAQS), given the uncertainty and conservative nature associated with 100th percentile short term model results as per the Federal Standards.

Table 7-2: Operational air quality residual impacts

Scenario	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
2B	Cumulative increase in long term ambient concentrations of NO_2 at Sensitive Receptor locations	Moderate Negative	– Discuss with regulators/ lenders the option of comparing the 1 hour NO_2 values against the EU AAQS and not the Federal Standards. – The adoption of more stringent emission limits for the neighbouring F1 and F2 facilities, thereby lowering background pollutant concentrations in the vicinity of the three plants. – The approach with regards to the cumulative assessment was considered conservative in that F1 and F2 plants were modelled and background measured data was added to the model results. Potentially consider undertaking long term diffusion tube measurements at SR locations and update assessment accordingly to reduce degree of conservatism.	Minor Negative
2B	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project (Federal Standards).	Major Negative		Moderate Negative
2B	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project (EU Standards).	Moderate Negative		Minor Negative
2B	Breach of 1 hour NO_2 AAQS at location of highest model value as a result of Cumulative Impacts (Federal)	Moderate Negative		Minor Negative
3A	Increase in short term (1-hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project in Isolation (Federal Standards).	Major Negative	– Do not operate facility without SCR in operation. – Adopt EU AAQS for assessment purposes	Minor Negative
3A	Increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project in Isolation (EU Standards).	Moderate Negative	– Do not operate facility without SCR in operation.	Minor Negative
3B	Cumulative increase in long term ambient concentrations of NO_2 Sensitive Receptor locations	Moderate Negative	– Do not operate facility without SCR in operation.	Moderate Negative
3B	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project (Federal Standards).	Major Negative	– Do not operate facility without SCR in operation. – Adopt EU AAQS for assessment purposes	Moderate Negative
3B	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 Sensitive Receptor locations as a result of the Project (EU Standards).	Major Negative	– Do not operate facility without SCR in operation.	Moderate Negative
3B	Breach of 1 hour NO_2 AAQS at location of highest model value as a result of Cumulative Impacts (Federal)	Moderate Negative	– Do not operate facility without SCR in operation. – Adopt EU AAQS for assessment purposes	Negligible
3B	Breach of 1 hour NO_2 AAQS at location of highest model value as a result of Cumulative Impacts (EU Standard)	Moderate Negative	– Do not operate facility without SCR in operation.	Negligible
5A	Increase in short term (1-hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project in Isolation (Federal Standards).	Minor Negative	– Adopt EU AAQS for assessment purposes	Negligible
5B	Cumulative increase in long term ambient concentrations of NO_2 Sensitive Receptor locations	Moderate Negative	– The approach with regards to the cumulative assessment was considered conservative in that F1 and F2 plants were modelled AND background measured data was added to the model results. Potentially consider undertaking long term diffusion tube measurements at SR locations and update assessment accordingly to reduce degree of conservatism.	Moderate Negative
5B	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 at Sensitive Receptor locations as a result of the Project (Federal Standards).	Major Negative	– Adopt EU AAQS for assessment purposes	Minor Negative
5B	Cumulative increase in short term (1 hour) ambient concentrations of NO_2 Sensitive Receptor locations as a result of the Project (EU Standards).	Minor Negative	– No additional mitigation	Minor Negative
5B	Breach of 1 hour NO_2 AAQS at location of highest model value as a result of Cumulative Impacts (Federal)	Moderate Negative	– Adopt EU AAQS for assessment purposes	Negligible

7.3.1.2. Ambient Noise

7.3.1.2.1. Construction Phase

The predicted residual impacts following the implementation of the mitigation measures during construction are presented below and are all expected to be **moderate** for day time noise at SR3 and SR8, **major** for night time noise at SR3 and SR8, and **negligible** for all other SRs (both day and night).

Table 7-3: Construction noise residual impacts

Impact	Environmental Aspects	Impact Significance prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Noise increase at SR3 and SR8 during day-time	Increase in off-site noise levels due to construction noise.	Major	Noise and vibration from construction activities can be controlled through the Health, Safety and Environmental (HSE) Management Plans, such as the Construction Environmental Management Plan (CEMP). Due to the potential of exceedances at locations within close proximity to the project site the following general mitigation measures should be considered and commitments to good site practices should be incorporated into the CEMP: – Compliance monitoring at receptor locations; – Site inductions to cover the importance of noise control and available noise reduction measures; – Construction contractors should be required to use equipment that is in good working order, is properly maintained according to the equipment's manufacturer requirements and that meets current best practice noise emission levels. This should be achieved by making it a component of contractual agreements with the construction contractions; – As far as reasonably practicable, sources of significant noise should be enclosed. The extent to which this can be done depends on the nature of the machines to be enclosed and their ventilations requirements; – All mobile or fixed noise-producing equipment used on the project, which is regulated for noise output by a local, state, or federal agency, shall comply with such regulation while in the course of project activity; – Electrically powered equipment instead of pneumatic or internal combustion powered equipment shall be used, where feasible; – Construction site speed limits shall be established and enforced during the construction period; – A gradual start to noisy activities and as far as it is feasible, establish a schedule for noisy activities to reduce overlapping of works; – Community grievance mechanism and active information dissemination regarding the construction schedule and noisy activities; – The on-site construction supervisor shall have the responsibility and authority to receive and resolve noise complaints. A clear appeal process to the owner shall be established prior to construction commencement that will allow for resolution of noise problems that cannot be immediately solved by the site supervisor; – The Engineering, Procurement and Construction (EPC) contractor shall develop a project construction noise control plan, which shall be approved and implemented prior to commencement of any construction activity; – The EPC contractor shall limit the hours of operation for specific equipment or construction activities; and, – Contract incentives may be offered to the construction contractor to minimise or eliminate noise complaints resulting from project activities where project construction would result in significant noise impacts.	Moderate
Noise increase at other SRs during day-time	Increase in off-site noise levels due to construction noise.	Minor		Negligible
Noise increase at SR3 and SR8 during night-time	Increase in off-site noise levels due to construction noise.	Major		Major*
Noise increase at other SRs during night-time	Increase in off-site noise levels due to construction noise.	Moderate		Negligible

7.3.1.2.2. Operational Phase

The predicted residual impacts following the implementation of the mitigation measures during construction are presented below and are all predicted to be **negligible**.

Table 7-4: Operational noise residual impacts

Impact	Environmental Aspects	Impact Significance prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Exceedance of noise limit of Project boundary/industrial receptors surrounding Project site	Increase in noise levels at site boundary and off-site receptors	Negligible	N/A	Negligible
Impact upon all SRs	Increase in off-site noise levels due to operation of noisy equipment on-site.	Minor	– Update of all predictive noise models (Occupational and Environmental studies), based upon vendor equipment data during the EPC phase; – Application of various noise abatement measures (if required following the updated noise models); and – Developing a mechanism to record and respond to complaints.	Negligible

7.3.1.3. Soil, Surface Water and Groundwater

7.3.1.3.1. Construction Phase

The predicted residual impacts following the implementation of the mitigation measures during construction range from **negligible** to **moderate negative**.

Table 7-5: Construction soil, groundwater and surface water residual impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Soil Erosion	Loss of soil and aggregate reserves within the Project site	Moderate negative	Implementation a CESMP which includes the use of a soil/ aggregate Erosion Control Plan	Negligible
Mobilisation of Existing Contamination	Soil and groundwater contamination from improper storage and handling causing spills and leaks	Moderate negative	The CESMP will include an excavated materials management plan which will include hazardous soil remediation measures to be implemented to remove the suspected contaminated soil from site.	Minor negative
Storage, use and handling of hazardous materials		Moderate negative	Implementation of the CESMP which promotes best practice management measures on site in order to avoid and minimise spills, leaks etc.	Minor negative
Storage and disposal of hazardous wastes		Moderate negative	Implementation of the CESMP which promotes best practice waste management measures on site in order to avoid and minimise contamination of non-hazardous and hazardous wastes	Minor negative
Generation of sanitary effluents	Soil and groundwater contamination from improper storage and handling causing spills and leaks	Moderate negative	Regular checks will be carried out on sanitary facilities to ensure no leaks take place. All sanitary wastewater should be collected and disposed of to a licensed facility by an appropriately licensed and authorised contractor.	Minor negative
Disposal of washdown effluents		Moderate negative	All washdown effluents to be undertaken in a designated area on site with effluents captured for reuse or offsite processing	Negligible
Importation of Fill Material	Contamination of local groundwater levels	Major negative	Importation of fill material will be regularly screened and tested to ensure imported material is free from contaminants	Minor negative
Groundwater Contamination	Contamination of local groundwater levels	Major negative	Implementation of the CESMP which promotes best practice management measures on site in order to reduce risk or spillages or leaks. All liquids used during construction will be stored on in designated areas on site which is suitably bunded to protect in the event of leaks or drips	Minor negative
Release of Asbestos in Existing Buildings and Structures	Risk of the potential inhalation of asbestos fibres located within existing buildings and structures found within the Project site	Major negative	Develop and adopt an Asbestos Management Plan to appropriately and safely manage the presence and subsequent removal of existing asbestos containing material (ACM) found within existing buildings and structures.	Moderate negative

7.3.1.3.2. Operational Phase

The predicted residual impact following the implementation of the mitigation measures during operation construction is predicted to be **minor negative**.

Table 7-6: Construction soil, groundwater and surface water residual impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Operational Leakages and Accidental Discharges	potential leaks and spills associated with the plant operations and storage of hazardous materials on-site	Moderate negative	Implementation an OEMP which will contain the key design and operating procedures that are to be implemented for the Project to prevent contamination of the groundwater	Minor negative

7.3.1.4. Terrestrial Ecology

7.3.1.4.1. Construction Phase

The predicted residual impacts following the implementation of the mitigation measures during construction are all predicted to be **negligible**.

Table 7-7: Terrestrial ecology residual impacts during construction

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Impact 1: Vegetation clearing	Loss of Vegetation and Habitat	Negligible	No mitigation measures required	Negligible
Impact 2: Landscaping and construction				
Impact 3: Vibration and noise disturbance	Disturbance to Fauna			
Impact 4: Chemical pollution	Disturbance to Fauna and Flora			
Impact 5: Dust deposition	Disturbance to Fauna and Flora			

7.3.1.4.2. Operational Phase

The predicted residual impact following the implementation of the mitigation measures during operation is **negligible**.

Table 7-8: Terrestrial ecology residual impacts during operation

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Impacts to Flora and Fauna	N/A	Negligible	N/A	Negligible

7.3.1.5. Marine Water & Sediment

7.3.1.5.1. Construction Phase

The predicted residual impacts following the implementation of the mitigation measures during construction for marine water and sediment range from **negligible** to **minor negative**.

Table 7-9: Construction marine water and sediment residual impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Sedimentation from construction activities	Increased turbidity, metals and nutrients	Minor	Installation of silt curtains prior to construction activities to contain sediment plume	Minor
Spill of hazardous materials to marine environment	Pollution to marine water and sediments	Minor	Use of best practises and maintenance of facilities	Negligible

7.3.1.5.2. Operational Phase

The predicted residual impacts following the implementation of the mitigation measures during operation phase for marine water and sediment are predicted to be **minor negative**.

Table 7-10: Operation marine water and sediment residual impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Thermal discharge	Increase in temperature over ambient levels	Minor	No mitigation required, although monitoring should be implemented to ensure there are no ongoing impacts.	Minor
Chlorine discharge	Increase in chlorine over ambient levels	Minor		Minor
Salinity discharge	Increase in salinity above ambient levels	Minor		Minor

7.3.1.6. Marine Ecology

7.3.1.6.1. Construction phase

The predicted residual impacts following the implementation of the mitigation measures during construction for marine ecology are predicted to be **minor negative**.

Table 7-11: Construction Marine Ecology Residual Impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Loss of habitat	Loss of seagrass habitat	Minor	Implementation of best working practices, including selecting working methods and equipment which are the least environmentally damaging	Minor
Collisions with marine mammals and reptiles	Injury or death to marine fauna	Moderate	Have marine mammal observers stationed during activities and reduce/limit vessel activities where possible	Minor
Sedimentation	Loss of seagrass habitat	Minor	Installation of silt curtains prior to construction activities to contain sediment plume	Minor

7.3.1.6.2. Operational phase

The predicted residual impacts following the implementation of the mitigation measures during operation phase for marine ecology are predicted to range from **minor negative** to **minor positive**.

Table 7-12: Operation Marine Ecology Residual Impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Thermal discharge	Increase in temperature above ambient levels	Minor	No mitigation required	Minor
Chlorine discharge	Increase in residual chlorine above ambient levels	Minor	No mitigation required	Minor
Salinity	Increase in salinity above ambient levels	Minor	No mitigation required	Minor
Placement of intake and outfall pipelines	Provision of hard substrate habitat	Minor positive	Additional hard substrate added to create artificial reefs for colonising benthic invertebrates including corals	Minor positive
Pumping water from inlet pipeline	Entrainment of faunal species	Moderate	Design of barriers to prevent large (e.g. turtles) and small (e.g. fish/snakes) fauna from entering inlets	Minor

7.3.1.7. Waste

7.3.1.7.1. Construction Phase

The predicted residual impacts following the implementation of the mitigation measures during construction are predicted to range from **negligible** to **minor negative**.

Table 7-13: Construction waste residual impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Pressure on Waste Facilities	Generation of construction and demolition waste	Moderate negative	During the construction phase of the Project development, the EPC Contractor will be required to develop a SWMP which will include the implementation of best practice measures. It is recommended that any dredged material is used as fill material on the site, if it is structurally suitable and uncontaminated. Prior to use of any source of material, sampling must be carried out to ensure the source material is not contaminated.	Minor negative
	Generation of excavation waste	Moderate negative		Minor negative
	Generation of hazardous waste	Moderate negative		Minor negative
	Generation of wastewater	Minor negative	A range of additional measures for the storage, treatment and disposal of wastewater effluents will be included within the SWMP	Negligible
Impacts on Surrounding Receptors due to Improper Storage and Handling of Wastes	Improper storage and handling causing spills and leaks	Minor negative	The SWMP will also include waste storage controls to mimimise impacts upon surrounding receptors	Negligible
Health and Safety impacts on workers and surrounding human receptors	Workforce exposure to harmful substances	Major negative	All staff will be trained in appropriate hazardous material handling	Minor negative
	Workforce exposure to asbestos from demolition of structures containing asbestos	Major negative	Pre-demolition surveys of all structures and removal of asbestos where encountered prior to demolition.	Minor negative
	Fire hazard due to flammability of some waste material	Major negative	Appropriate waste management measures implemented to reduce fire risk.	Minor negative
Impact on terrestrial ecology	Improper storage and handling of waste	Negligible	During the construction phase of the Project development, the EPC Contractor will be required to develop a SWMP which will include the implementation of best practice measures	Negligible
Impact on Marine ecology	Improper storage and handling of waste	Minor negative		Negligible
Impact on aesthetics	Improper storage and handling of waste	Negligible		Negligible
Impact on odour	Improper storage and handling of waste	Negligible		Negligible
Transportation of construction waste	Direct / indirect impacts relating to air quality, dust and congestion resulting from waste transportation	Minor negative	All relevant best practice requirements for waste transportation and disposal by Fujairah Municipality licenced contractors will be implemented.	Negligible

7.3.1.7.2. Operational Phase

The predicted residual impacts following the implementation of the mitigation measures during operation are predicted to range from **negligible** to **minor negative**.

Table 7-14: Operational waste residual impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Pressure on Waste Facilities	Generation of wastewater	Negligible	The Operator will be required to develop an OESMP, which will include sustainable waste management practices commensurate with the activities which will be undertaken as part of this major industrial development. Hazardous waste will be treated by a qualified and licensed contractor in Fujairah for the type of waste. If the hazardous waste cannot be treated in Fujairah Emirate, alternatives such as Dubai, Sharjah, Ras Al Khaimah or Abu Dhabi licensed contractor should be used.	Negligible
	Generation of solid waste	Minor negative		Negligible
	Generation of hazardous waste	Moderate negative		Negligible
Impact on soil and groundwater	Improper storage and handling causing spills and leaks	Major negative		Minor negative
Impact on terrestrial ecology	Improper storage and handling of waste	Negligible		Negligible
Impact on marine ecology	Improper storage and handling of waste	Minor negative		Negligible
Impact on aesthetics	Improper storage and handling of waste	Negligible		Negligible
Impact on odour	Improper storage and handling of waste	Minor negative		Negligible
Health and Safety impacts on workers and surrounding human receptors	Fire hazard due to flammability of some waste material	Major negative		Minor negative
Transportation of operation waste	Direct / indirect impacts relating to air quality, dust and congestion resulting from waste transportation	Minor negative		Negligible

7.3.1.8. Socio-Economy

7.3.1.8.1. Construction Phase

The predicted residual impacts following the implementation of the mitigation measures during construction are presented below.

Table 7-15: Construction socio-economic residual impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Disruption to the local economy and population	Air Quality Impacts	Negligible to major negative	During the construction phase of the Project development, the EPC Contractor will be required to develop a CESMP which will include the implementation of best practice measures.	Minor negative to Negligible
	Noise Impacts	Negligible		Negligible
	Construction impacts on fishing activities	Negligible		Negligible
Landscape and Visual Impacts	Minimise impacts relating to visual receptors	Negligible	During the construction phase of the Project development, the EPC Contractor will be required to develop a CESMP which will include the implementation of best practice measures.	Negligible
Health and Safety impacts on workers and surrounding human receptors	Workforce health and safety at the workplace	Major negative	All staff will be trained in appropriate health and safety best practice	Minor negative
	Workforce conditions such as reasonable working hours	Moderate negative	Pre-demolition surveys of all structures and removal of asbestos where encountered prior to demolition.	Negligible
	Exposure to Asbestos in existing building and structures	Major negative	Pre-demolition surveys of all structures and removal of asbestos where encountered prior to demolition.	Minor negative

7.3.1.8.2. Operational Phase

The predicted residual impacts following the implementation of the mitigation measures during operation are presented below.

Table 7-16: Operational socio-economic residual impacts

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Disruption to the local economy and population	Air Quality Impacts	Negligible	During the construction phase of the Project development, the EPC Contractor will be required to develop an OESMP which will include the implementation of best practice measures	Negligible
	Noise and vibration Impacts	Negligible		Negligible
	Operational impacts on fishing activities	Negligible		Negligible
Landscape and Visual Impacts	Minimise impacts relating to visual receptors	Negligible	During the construction phase of the Project development, the EPC Contractor will be required to develop an OESMP which will include the implementation of best practice measures.	Negligible
Health and Safety impacts on workers and surrounding human receptors	Workforce health and safety at the workplace	Moderate negative	All staff will be trained in appropriate health and safety best practice	Minor negative

7.3.1.9. Archaeology and Cultural Heritage

7.3.1.9.1. Construction Phase

The predicted residual impacts following the implementation of the mitigation measures during construction are predicted to range from **minor** to **moderate negative**.

Table 7-17: Archaeology and cultural heritage residual impacts during construction

Environmental Impacts	Environmental Aspects	Impact Significance Prior to Mitigation Measures	Key Proposed Mitigation Measures	Residual Impact Significance
Construction impacts on unknown buried archaeological remains	Disturbance to archaeological finds	Negligible to Major	Development of a CESMP which will set specific mitigation measures in order to minimise the risk of impacts.	Minor to Moderate

7.3.1.9.2. Operational Phase

It is not expected that any impacts would be observed upon items of archaeological and/or historically relevant structures within the Project site during the operational phase.

7.4. Environmental Management Plans / Statement of Commitments

7.4.1. Framework Construction Environmental and Social Management Plan (F-CESMP)

7.4.1.1. Introduction

This Framework Construction Environmental and Social Management Plan (F-CESMP) has been prepared to provide a framework for the development of a Contractor's Construction Environmental and Social Management Plan (C-CESMP) by the EPC Contractor. The F-CESMP will ensure that best practice environmental control measures are adopted and implemented by the EPC Contractor and their sub-contractors during the construction phase of the Project in order to prevent, minimise or compensate for environmental and social impacts. This F-CESMP is applicable to the Project. As such, the C-CESMP developed by the EPC Contractor should discuss each project component, associated construction activities and Contractor's management and monitoring plans to mitigate environmental impacts.

This F-CESMP has integrated the findings of the impact assessments undertaken as part of the ESIA and includes all environmental control measures which shall be implemented as part of the construction phase in order to reduce the significance of identified impacts to acceptable levels.

In this way the C-CESMP should be seen as structured implementation of the ESIA to control environmental and social impacts during construction.

7.4.1.2. Purpose

The purpose of the F-CESMP is to provide a framework within which the EPC Contractor will be required to develop a C-CECMP, which includes:

- Demonstrate Contractor's commitment to protecting the environment through presenting Project specific Environmental Policy, objectives and targets;
- All statutory requirements to be adopted throughout the construction phase;
- Environmental requirements put forth in tender documents issued for the Project;
- Specific mitigation measures identified as part of the overall ESIA process to avoid or reduce construction related impacts to acceptable levels;
- General best-practice mitigation measures to be adopted; and
- Environmental monitoring to be carried out to ensure that impacts are within acceptable levels.

The EPC Contractor will be responsible for the development of a C-CESMP, in accordance with the framework established within this F-CESMP.

The EPC Contractor will be also responsible for issuing the C-CESMP to the relevant Environmental Regulator for approval prior to the commencement of construction activities and the issue of ongoing audit reports and environmental monitoring reports as required by the relevant Environmental Regulator.

7.4.1.3. Environmental Management System

One of the most widely used environmental management systems, developed by the International Standards Organization (ISO), is the ISO14001 standard for the environmental management of activities. The standard provides a logical framework within which to prepare and develop the CESMP of the Project.

The key element of ISO 14001 which has been embedded into the CESMP is one of continual feedback and improvement, whereby the identification of non-conformances together with the results of audits and environmental monitoring are continuously reviewed by the environmental management team and are fed back into the environmental management process. In this way, for example, where exceedances of standards are identified, a review of the environmental management actions being undertaken will be implemented and the CESMP updated with alternative or additional actions to work towards continued compliance. The EPC Contractor should ensure that construction objectives and activities are being undertaken to with continual improvement at its core. The structure of a typical EMS certified to ISO 14001, which demonstrates this cycle of continuous improvement, is shown in Figure 7-2 below.

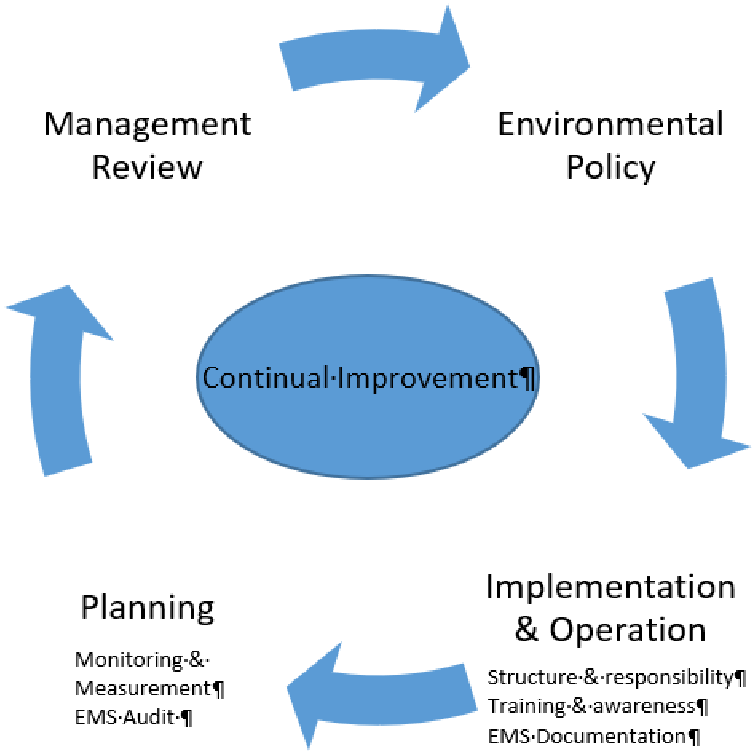

Figure 7-2: ISO 14001 Structure

7.4.1.4. Preparation of C-CEMP

The EPC Contractor shall submit the C-CESMP to the Project Proponent for review within 28 days after the Commencement Date. The EPC Contractor shall appoint a qualified and Authority's approved Environmental Consultant to develop the C-CESMP, who has the licence to legally operate within the relevant Emirates.

Subsequent to the Project Proponent's approval, the EPC Contractor (or the EPC Contractor's engaged environmental consultant) shall submit the EPC Contractor's CESMP to the relevant Competent Environmental Authority for issuance of a No Objection Certificate (NOC). Formal approval is a condition precedent to commencing construction.

The C-CESMP is considered to be a live document and the EPC Contractor shall prepare the required environmental documentation, to reflect any such modifications and/or changes to working practices and procedures that may have environmental implications during the contract period. At minimum, the C-CESMP shall be updated annually and issued to Project Proponent for their review and commentary.

In case, there are any major changes in the construction methodology or the Project design, the EPC Contractor shall issue a revised version of C-CESMP for Project Proponent's review and approval. Additionally, the EPC

Contractor shall seek Project Proponents' advice on if the major revision of the C-CESMP requires an updated approval from the relevant Competent Authority.

7.4.1.5. Permits and Approvals

The EPC shall be fully responsible for obtaining and maintaining all relevant permits and approvals for construction of the works including any changes which require modifications to these approvals. A permit compliance matrix and register shall be developed and maintained by the EPC Contractor. This should be a live document and shall be included in annual revision of the C-CESMP.

Additional permits and approvals which may be required (in addition to the NOC issued as part of the approval of the ESIA) includes, but is not limited to, the following:

- Any early works permit if required;
- Fencing;
- Site offices;
- Laydown areas;
- Vehicle and equipment maintenance areas;
- Concrete batching;
- Early works;
- Removal of trees and plantations;
- Translocation of protected species
- Use of local water resources;
- Demolition of existing structures and buildings;
- Use of explosives;
- Crushing, sorting, storage and transportation of spoil materials;
- Waste
  - Storage;
  - Transportation; and
  - Disposal;
- Hazardous materials
  - Storage;
  - Transportation; and
  - Disposal;
- Asbestos removal and disposal;
- Wastewater treatment, transport and disposal; and
- Dewatering.

7.4.1.6. Environmental Monitoring and Reporting

The EPC Contractor will be responsible for undertaking:

- Environmental monitoring;
- Weekly environmental reporting to the Project Proponent;

- Monthly Environmental Reporting to the Project Proponent; and
- Additional Environmental Reporting to the relevant Competent Authorities, as required.

7.4.1.7. Environmental Inspections and Audits

The EPC Contractor will be responsible for undertaking Environmental Inspections and ISO 14001:2015 compliant Environmental Audits to ensure compliance with all environmental and social requirements and standards. As part of this, an Environmental Inspection Checklist shall be developed to guide the process. Furthermore, the EPC Contractor shall describe inspections and auditing processes in an Environmental Monitoring and Auditing Plan.

The EPC Contractor shall conduct periodic Internal Environmental Audits (quarterly or at a minimum bi-annual). The EPC Contractor will also be responsible for arranging an external audit to be conducted by the Engineer following ISO 14001:2015 (or latest ISO standard) requirements. The EPC Contractor will facilitate and assist with these Environmental Audits and provide the requested data and evidence.

7.4.1.8. Legal Compliance

The EPC Contractor shall ensure that all aspects of the Works comply with all applicable Laws, (including Environmental Laws), Environmental Guidelines, Environmental Standards, Environmental Permits/Environmental Clearances/No Objection Certificates (NOC)/license conditions and accepted good practice, and that measures to mitigate environmental impacts identified in the ESIA are implemented where applicable.

7.4.1.9. Environmental Awareness and Training

7.4.1.9.1. Overview

Environmental training is essential for executing construction work in an environmentally sound fashion during the construction phase of the Project. This Environmental Training Procedure covers all aspects of training. It will be developed and administered by the Environment Officer or authorised representatives and approved by the EPC Contractor's Environmental Manager.

7.4.1.9.2. Responsibilities

The Environment Officer will establish the Environmental training programme schedule, and will be responsible for:

- The development of training materials or the oversight of the preparation of such material by a competent person in order to effectively conduct environmental training;
- Development of an environmental training programme;
- The preparation and updating of the schedule for environmental training;
- Carrying out environmental training for site personnel in accordance with this procedure; and
- The collation and retention of training records.

All site personnel will be responsible for attending and participating in the scheduled training sessions, as applicable.

7.4.1.9.3. Environmental Induction Training for Site Personnel

Awareness and training is critical to the effective implementation of the CESMP and, therefore, all personnel including management, engineers, site workers, specialist contractors, drivers etc. shall attend an awareness induction prior to starting work in order to gain a better understanding of the environmental issues and associated main mitigation measures related to the construction phase of the Project.

It will be the responsibility of the Environmental Manager to ensure that all staff attend this mandatory awareness induction. Induction will include at least an overview of the environmental aspects related to the main activities of the project, emergency measures, incident reporting, and an overview of the main environmental controls set out within this CESMP.

The topics addressed in the induction training are set out in Table 7-18 below.

Table 7-18: Awareness Induction Content

Awareness Induction Content	
Environmental Management Overview	Duty of Care Concept
CESMP Overview	Hazardous Substances Management
Waste Management Procedures	Incident Reporting Procedure
Working Rules	Site Housekeeping
Emergency Plan	Disciplinary Action

7.4.1.9.4. Specialist Training

Specialist environmental training will be required based on specific requirements of each role and must be arranged by the Environment Officer where relevant. For example, emergency response training may be mandatory for staff involved in activities that have higher environmental risks, including the use of emergency response equipment.

7.4.1.9.5. Environmental Training for Managers

Environmental training, where required, will be provided by Environmental Managers and given to all the discipline Managers and authorized representatives. In addition to the contents of the standard Environmental Induction Training, the environmental items set out in Table 7-19 below will be specifically highlighted at the Environmental Training for the Environmental Managers and authorized representatives. Additionally, where it is felt required, general management staff and supervisors should receive suitable Environmental Training if it is considered relevant to the needs of their role or to improve the general environmental performance of their place of work or operational duties.

Table 7-19: Training Content for Environmental Managers, Team Leaders or authorized representative

Training Content	
Details of Policies (if applicable)	Format and availability of CESMP
Organisation and Responsibilities	Necessity of expanding Environmental awareness
Environmental Incident Procedure	CESMP Compliance Procedure
Management Procedures	Complaints Management Procedure

7.4.1.9.6. HSE Training for Workers Working with Hazardous Materials

Specialist training will be given to all personnel assigned to working with hazardous materials. Such training will be delivered by the Environment Officer before commencing works, and on a periodic basis, and will encompass the topics set out in Table 7-20 below.

Table 7-20: Training Content for Hazardous Materials

Training Content	
Chemical and Fuel Handling	Handling and storage of waste materials
Handling and storage of liquids	Emergency response procedures
Refuelling procedures	

7.4.1.9.7. Toolbox Talks

Toolbox talks will be provided for all members of the work force during the construction phase of the project on a weekly or fortnightly basis to reinforce the culture of environmental protection as part of the work ethic and will include any materials referenced within this F-CESMP including noise, air, terrestrial ecology awareness, soil and water pollution, waste minimisation and segregation, spillage containment, management of contaminated land and groundwater, chance find procedures and other environmental issues specific to the work activity, as highlighted in Table 7-21.

Table 7-21: Toolbox Talks Topics

Training Content	
Review of working methods	Review of HSE procedures
Identification of specific hazards at site and control measures	Specific environmental concerns and management actions
General terrestrial ecology identification and awareness	General environmental performance requirements

Toolbox talks will be normally given by the Environment Officer; however, other personnel with site HSE team can also provide assistance as required.

Toolbox talk training is a cost-effective way to provide targeted information on an environmental issue, for example, in relation to a change in procedures, results of an environmental incident investigation, or changes to environmental conditions on site.

7.4.1.9.8. Training Register

A Training Register will be maintained by the Environment Officer in order to record the training attendance by employees. The Training Register will be developed in order to allow the training history of any employee to be checked.

7.4.1.9.9. Training Record

A training attendance sheet will be developed, and must be completed for all training sessions, which includes:

- Training module name;
- Date;
- Location;
- Presenter's name (and company if the presenter is not employed by the contractor); and
- Trainee's details: name, company, position and signature.

7.4.1.10. C-CESMP Review and Updates

The C-CESMP and associated documentation will be regularly reviewed and updated by EPC Contractor's Environmental Manager. In case a major update is required where C-CESMP would need to be submitted to Competent Authority for approval, the revision should be carried out by a qualified Environmental Consultant. The periodic review of the CESMP shall include, but not limited to:

- Review the C-CESMP for continued suitability with the evolving project and its progress, adequacy and effectiveness, by assessing the need for changes to policies, objectives and other elements of the C-CESMP and other procedures in light of compliance audits, system audits, changing circumstances and commitment to continual improvement;
- Establish whether suitable progress has been made towards achieving objectives, targets and programmes within stated timescales;
- Obtain commitments and identify necessary resources for new initiatives and improvements;
- Update C-CESMP on at least an annual basis, taking into consideration how much ongoing construction activity and intensity has changed since previous review. Also taking into consideration the adoption of continuous improvement techniques to raise the overall quality, working conditions and working practice on site and during the remainder of the construction phase.

7.4.1.11. Coordination with External Entities Addressing Complaints

7.4.1.11.1. Scope

This section defines how complaints relating to the Project will be handled.

7.4.1.11.2. Responsibility

The EPC Contractor's Environment Officer will be ultimately responsible for handling complaints from local communities relating to the environmental performance of the site and for ensuring appropriate communication with interested parties, including the complainant and the relevant Competent Environmental Authority in relation to all complaints.

7.4.1.11.3. Complaints Management

Members of the public or other interested parties may make complaints or enquiries relating to the aspects of the environment and a particular contractor's work directly to the EPC Contractor's Environment Officer.

A mechanism for addressing complaints will be implemented, as follows:

- All complaints will be acknowledged within 48 hours of receipt;
- The EPC Contractor's Environment Officer will have the responsibility to check whether the complaint is valid, and will assign and dispatch an investigation team;
- The Complainant shall be contacted by the EPC Contractor's stakeholder team within 48-hours from receiving the complaint;
- The investigation tasks will be agreed, delegated by the investigation team;
- Remedial actions recommended by the investigation team will be implemented and finalised; and

- Complainant will be contacted by the EPC Contractor's stakeholder team and advised of the outcome on the investigation within one week, unless additional information or clarifications are needed.

All complaints will be recorded using a Non-Conformance Recording Form.

7.4.1.12. Framework Construction Environmental Control Plans

7.4.1.12.1. Overview

This section provides Framework Environmental and Social Control Plans (ESCP) for each environmental and social aspect, which will be included as a minimum within the EPC Contractor's detailed CESMP.

7.4.1.12.2. Ambient Air Quality

7.4.1.12.2.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the C-CESMP to control impacts upon Air Quality.

7.4.1.12.2.2. Permits

Prior to construction, the EPC Contractor will be required to obtain additional permits, in addition to the relevant Environmental Authority NOC, which would include, but not be limited to:

- Permits for establishment of laydown areas, site offices;
- Permits for demolition;
- Permits for removal and disposal of Asbestos materials, where relevant; and
- Permits for storage, transport and disposal of spoil materials.

7.4.1.12.2.3. Environmental Control Measures

Mitigation measures are an integral part of minimising impacts to air quality and a summary of key measures associated with construction is outlined below:

- The EPC Contractor will produce a C-CESMP including the mitigation measures set out within this EIA;
- The C-CESMP will set specific mitigation and monitoring measures to follow during the Project construction in order to reduce the sources of PM_{10} and dust;
- Ensure the C-CESMP mitigation and monitoring measures are implemented on-site;
- It is recommended that fugitive dust is monitored (visual assessment) and further mitigation measures are implemented in the event of dust episodes;
- Adoption of best working practices to reduce the emissions of dust;
- Careful management of construction activities located within close proximity to existing residential receptors;
- Ensuring the proper use and maintenance of construction equipment.

With regards to the potential impacts to the turbine air intakes at the existing F1 and F2 plants, the following is recommended in consultation with the F1 and F2 operators / owners:

- Undertake dust suppression watering in the areas adjacent to the F1 and F2 during episodes of high winds or visible dust formation;

- Install real time ambient air quality particulate monitors in vicinity of intakes prior to commencement of constriction to establish exiting PM concentrations;
- Consult with F1 and F2 operators, and potentially explore management options at F1 and F2 during F3 construction including:
  - Increasing filter inspection frequency
  - Where necessary optimising filter pulse system settings on filters; and
  - F1 and F2 operators to consider aligning filter maintenance (filter swaps) prior to F3 commencing construction.

7.4.1.12.2.4. Monitoring Requirements

There are no specific monitoring requirements other than those prescribed within the C-CESMP.

7.4.1.12.3. Ambient Noise

7.4.1.12.3.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the C-CESMP to control impacts upon Noise and Vibration.

7.4.1.12.3.2. Permits

Prior to construction, the EPC Contractor will be required to obtain additional permits, in addition to the relevant Environmental Authority NOC, which would include, but not be limited to:

- Permits for establishment of laydown areas, site offices; and
- Permits for demolition.

7.4.1.12.3.3. Environmental Control Measures

Noise and vibration from construction activities can be controlled through the Health, Safety and Environmental (HSE) Management Plans, such as the Construction Environmental Management Plan (CESMP). Due to the potential of exceedances at locations within close proximity to the project site, the following general mitigation measures should be considered and commitments to good site practices should be incorporated into the CESMP:

- Compliance monitoring at receptor locations;
- Site inductions to cover the importance of noise control and available noise reduction measures;
- Construction contractors should be required to use equipment that is in good working order, is properly maintained according to the equipment's manufacturer requirements and that meets current best practice noise emission levels. This should be achieved by making it a component of contractual agreements with the construction contractions;
- As far as reasonably practicable, sources of significant noise should be enclosed. The extent to which this can be done depends on the nature of the machines to be enclosed and their ventilations requirements;
- All mobile or fixed noise-producing equipment used on the project, which is regulated for noise output by a local, state, or federal agency, shall comply with such regulation while in the course of project activity;
- Electrically powered equipment instead of pneumatic or internal combustion powered equipment shall be used, where feasible;

- Construction site speed limits shall be established and enforced during the construction period;
- A gradual start to noisy activities and as far as it is feasible, establish a schedule for noisy activities to reduce overlapping of works;
- Community grievance mechanism and active information dissemination regarding the construction schedule and noisy activities;
- The on-site construction supervisor shall have the responsibility and authority to receive and resolve noise complaints. A clear appeal process to the Owner shall be established prior to construction commencement that will allow for resolution of noise problems that cannot be immediately solved by the site supervisor;
- The Engineering, Procurement and Construction (EPC) Contractor shall develop a project construction noise control plan, which shall be approved and implemented prior to commencement of any construction activity;
- The EPC Contractor shall limit the hours of operation for specific equipment or construction activities; and,

Contract incentives may be offered to the construction contractor to minimise or eliminate noise complaints resulting from project activities where project construction would result in significant noise impacts.

7.4.1.12.3.4. Monitoring Requirements

Due to the temporary/short-term and transient nature of construction noise, as opposed to operational noise levels or conditions that are long-term, no cumulative impacts are anticipated during construction and therefore monitoring is not considered necessary.

7.4.1.12.4. Soil, Surface Water and Groundwater

7.4.1.12.4.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the C-CESMP to control impacts upon Soil, Surface Water and Groundwater.

7.4.1.12.4.2. Permits

Prior to construction, the EPC Contractor will be required to obtain additional permits, in addition to the relevant Environmental Authority NOC, which would include, but not be limited to:

- Permits for establishment of laydown areas, site offices;
- Permits for establishment of haul routes;
- Permits for demolition;
- Permits for removal and disposal of asbestos materials, where relevant;
- Permits for storage, transport and disposal of spoil materials; and
- Dewatering permits.

7.4.1.12.4.3. Environmental Control Measures

7.4.1.12.4.3.1. Soil Erosion

Prior to construction, an Erosion Control Plan along with best practice management measures on-site shall be implemented as part of the CESMP which will include the following measures:

- Avoidance of activities that will mobilise soils before or during the wet season;

- Minimisation of clearance of existing vegetation and removal of existing topsoil;
- Stabilisation of bare soils/aggregates on the site damping down or covering with gravel;
- Implementation of wheel cleaning for construction traffic leaving the site;
- Identification of natural drainage channels and implement control measures, such as screens or sedimentation basins to reduce sediments leaving the site; and
- Appropriate stormwater management procedures to be implemented.

7.4.1.12.4.3.2. Mobilisation of Existing Contaminants

As far as practically possible, the Project will avoid contaminated areas, both known and suspected. In the event of suspected contaminated soils being located within the Project site, depending on significance of contamination, hazardous soil remediation measures will be implemented by the EPC Contractor to remove the suspected contaminated soil and aggregates from site, which will reduce the risk of mobilisation during construction.

The CESMP will include an excavated materials management plan. This will describe how uncontaminated and contaminated materials will be dealt with (excavated, temporarily stockpiled and stored and disposed) during construction.

7.4.1.12.4.3.3. Contamination from Construction Activities

In order to avoid and minimise the risk and likelihood of contamination on-site, the following measures shall be implemented and incorporated within the CESMP prepared for the Project, which promotes on-site environmental good practice:

- Adequate hazardous waste and hazardous material management facilities and practices, which is to be clearly labelled and segregated to avoid contamination;
- Potentially hazardous material to be used away, as far as practical, from high risk areas;
- Any hazardous substances to be substituted with safer alternatives;
- No discharge or overflow of sanitary waste on site. Modular wastewater storage tanks will be introduced to the Project site to provide adequate containment facilities for the construction workforce;
- Fuel storage tanks to be located above ground and be fully bunded with an impermeable barrier of at least 110% of the tank capacity;
- Regular vehicle and equipment maintenance to be undertaken in hard-standing areas with isolated drainage and oil-interceptors;
- Vehicle and equipment refuelling to be undertaken in hard-standing areas with isolated drainage and oil-interceptors – where this is not possible drip-trays must be used;
- Spill clean-up kits to be readily available on site and staff trained in their appropriate use;
- Spills to be cleaned up immediately and any waste materials generated, including excavated soils or aggregates, must be disposed of appropriately as hazardous waste;
- Environmental incident reports to be prepared for any spills on site;
- Appropriate housekeeping precautions to be implemented to prevent construction workers from having contact with potentially contaminated soils/aggregates;

- Construction workers to be required to wear appropriate personal protective equipment (PPE) and to have undertaken adequate training / awareness;
- Appropriate stormwater management procedures to be implemented to ensure that contaminants are not mobilised into the wider environment; and
- Washout from concrete mixing plant or from cleaning ready-mix concrete lorries is contaminated with cement and therefore is highly alkaline. This should not be allowed to enter the aquatic environment and should be re-used on site where possible or disposed of appropriately.

7.4.1.12.4.3.4. Storage, use and handling of Hazardous Materials

General

- Training material on proper management of hazardous waste to be kept on record, along with signatures of workers who have been trained. Only these workers are authorised to handle hazardous waste on site;
- All hazardous liquid materials will be stored in a container of sufficient strength and structural integrity to ensure that it is unlikely to burst or leak in its ordinary use;
- Incompatible hazardous materials must be segregated and stored separately, e.g.: flammable liquids will be segregated from caustic / acidic materials, if relevant;
- Storage, handling and disposal of fuels, oils, lubricants and other potentially harmful chemicals (and their containers) will be undertaken under proper supervision in accordance with manufacturer's instructions;
- Storage areas will be clearly marked and signed with regard to the quantity and hazardous characteristics of the materials stored (Material Safety Data Sheets);
- Containers will be stored, in designated areas that are isolated from surface water drains, open water and are bunded to contain any spillages;
- Emergency spillage kit will be located at strategic locations and in proximity of the main storage areas and the refuelling area;
- Leaking or empty oil drums will be removed to the hazardous waste storage area to be treated or disposed of via approved waste disposal contractors;
- Water used for dust damping should come from a source that will not risk causing contamination to soil or groundwater.

Bulk Storage

- The content of any tank will be clearly marked on the tank, and a notice displayed requiring that the valves and trigger guns be locked when not in use;
- All containers will be securely stored and labelled, so that appropriate remediation action will be taken; and
- All tanks will be located on a drip tray of sufficient size and bunded with a capacity of at least 110% of the tank capacity.

Handling and Refuelling

- Prior to commencing work involving handling materials, all personnel will be familiar with the relevant hazardous properties and instructed on the relevant emergency procedures;
- Appropriate Personnel Protective Equipment (PPE) will be issued to relevant personnel;
- Designated personnel will be trained in the use of Emergency Spill Kits;
- Any refuelling operation will be supervised and will take place over appropriately sized drip trays;
- All hoses and valves will be checked for wear and tear; and
- All hoses and valves will be securely locked and stowed away when not in use.

Transportation and Maintenance

- Contractors responsible for transporting waste materials to/from the site will be suitably qualified and possess a license from relevant Competent Environmental Authority;
- A transportation document will be created in order to establish a chain of custody using multiple signed copies to demonstrate that the material was transported and received by the final disposal facility in the correct manner;
- All hazardous materials will be labelled, and external signs will be provided on vehicles in accordance with the United Nations Transport Guidelines;
- Plant and vehicles will be well maintained to avoid leakages; and
- No vehicles will be serviced on-site.

7.4.1.12.4.3.5. Storage and disposal of hazardous wastes

- All hazardous wastes will be separated from general waste in a designated, well signed area to avoid cross contamination;
- All workers will be sufficiently trained to accurately identify and separate waste streams to prevent cross contamination of waste stores;
- Hazardous waste storage areas will be maintained and regularly inspected and audited to highlight any leaks or spills; and
- All hazardous wastewater should be collected and disposed of to a licensed facility by an appropriately licensed and EPC.

7.4.1.12.4.3.6. Generation of sanitary effluents

- No discharge or overflow of sanitary waste on site;
- Modular wastewater storage tanks will be introduced to the Project site to provide adequate containment facilities for the construction workforce;
- Regular checks will be carried out on sanitary facilities to ensure there are no leaks;
- All sanitary effluents will be stored in appropriate tanks and collected by a licensed waste contractor for treatment at a licensed facility; and

- All sanitary wastewater should be collected and disposed of to a licensed facility by an appropriately licensed and authorised contractor.

7.4.1.12.4.3.7. Disposal of dewatering effluents

With a potentially high groundwater table in parts of the Project site, it is expected that dewatering will be required, particularly at locations where deep excavation works will be required such as for bridge foundations.

Therefore, the EPC Contactor will have to apply for and receive dewatering permits from the relevant Competent Environmental Authority. Control measures shall be taken for testing effluent as per authority requirements/standards prior to discharge to ensure no impact to the environment occurs. Where exceedances of the standards are recorded, appropriate treatment measures must be implemented prior to discharge.

7.4.1.12.4.3.8. Disposal of washdown effluents

Contained areas for washing out and cleaning plant, concrete batching plant or ready-mix lorries will be established, and wash-waters will be collected for reuse or appropriately treated.

7.4.1.12.4.3.9. Importation of Fill Material

- Importation of fill material will be regularly screened and tested at the source site to ensure imported material is free from contaminants;
- Any imported material suspected to contains contaminants will not be accepted on site and will be subject to further analysis to confirm status and, if found to be contaminated, will be appropriately transported and disposed of as hazardous waste; and
- Workers to be trained to identify visual and odorous signs of contamination to allow the potential identification of contaminants to be raised to attention and thus to prevent the further contamination of areas of site.

7.4.1.12.4.3.10. Groundwater Contamination

All measures should be taken to ensure that groundwater is not adversely affected. This would include the implementation of best available techniques to reduce the risks of contamination from leaks, spills or accidental discharges of construction materials and effluents.

Procedures must be established to ensure that the risk of accidents and that the potential for spillages and hazardous substance release is minimised. This would also include the development of an emergency plan to ensure that in the event of a major incident there is an approved procedure to mitigate any environmental impacts.

The following will be implemented as part of the CESMP:

- Hazardous liquid materials will be stored in a container of sufficient strength and structural integrity to ensure that it is unlikely to burst or leak in its ordinary use;
- Containers will be stored, in designated areas that are isolated from surface water drains, open water and are bunded to contain any spillages;
- Storage, handling and disposal of fuels, oils, lubricants and other potentially harmful chemicals (and their containers) will be undertaken under proper supervision in accordance with manufacturer's instructions;
- Emergency spillage kit will be located at strategic locations and in proximity of the main storage areas and the refuelling area;

- Leaking or empty oil drums will be removed to the hazardous waste storage area to be treated or disposed of via an approved waste disposal contractor; and
- Water used for dust damping should come from a source that will not risk causing contamination to soil or groundwater.

7.4.1.12.4.3.11. Asbestos in Existing Buildings and Structures

There is the potential for asbestos to be present within existing buildings and structures which will require demolition in advance of the construction of the Project as well as the removal of visually confirmed asbestos cement sheeting located on site. In order to prevent impacts upon the workforce and residents of surrounding areas, the following control measures will be implemented prior to demolition works:

- A full asbestos survey of existing buildings will be required prior to the commencement of demolition works. The survey should conform to the survey methodology set out for Refurbishment and Demolition Surveys in HSG: 264 Asbestos: The survey guide;
- If asbestos is identified, this should be removed by a licensed Asbestos removal contractor, under the supervision of an Asbestos Supervising Consultant to provide independent verification that all Asbestos has been removed and that the demolition works can proceed; and

The asbestos material should be disposed of, under the appropriate licence, to an authorised hazardous waste management facility.

7.4.1.12.4.4. Monitoring Requirements

No further soil and groundwater monitoring is expected. However, it is required that during construction, the construction contractor will be required to develop a comprehensive CESMP, with all measures fully implemented and audited. This will ensure that both are being effectively and appropriately implemented.

7.4.1.12.5. Terrestrial Ecology

7.4.1.12.5.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the C-CESMP to control impacts upon Terrestrial Ecology.

7.4.1.12.5.2. Permits

Prior to construction, the EPC Contractor will be required to obtain additional permits, in addition to the NOC, which would include, but not be limited to:

- Permits for establishment of laydown areas, site offices;
- Permits for transportation or disposal of waste;
- Permits for translocation or removal trees; and
- Permits for the translocation of protected species, where found to be present within the construction footprint.

If required, construction NOC will also be submitted to each relevant authority (after approval of CESMP).

7.4.1.12.5.3. Environmental Control Measures

Due to the fact that no natural habitats remain on the study area and that the envisaged impact on flora and fauna is negligible, no mitigation other than operational care, during the construction and operation phase, is proposed.

Nevertheless, to meet with the requirements of PS6, it is recommended that project opportunities are undertaken to enhance the existing habitats. Opportunities could include the development of a landscaping scheme which seeks to create areas of habitat.

7.4.1.12.5.4. Monitoring Requirements

Due to the fact that the area will be completely transformed, and no natural ecosystems or flora and fauna species will remain, no monitoring of terrestrial ecosystems is possible or required.

7.4.1.12.6. Marine Ecology

7.4.1.12.6.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the C-CESMP to control marine ecology impacts.

7.4.1.12.6.2. Environmental Control Measures

7.4.1.12.6.2.1. Loss of habitat

Mitigation measures to be considered will involve the adoption of working methodologies and practices which reduce impacts to habitats. This would involve selecting working methods and equipment which are the least environmentally damaging, such as avoiding work during strong tides or during inclement wind conditions and the use of appropriate equipment of good working condition.

Limiting construction impacts to the pipeline corridor will prevent unnecessary impacts to surrounding habitats.

7.4.1.12.6.2.2. Collisions with marine mammals and reptiles

To reduce the potential impact of collision with marine fauna, members of the marine construction team should be familiar in the spotting of marine fauna. In the event that marine mammals or reptiles are spotted within 150 m of operations, then works should temporarily cease until the area is clear. Additional mitigation measures could include:

- Reduce marine vessel trip frequency;
- Reduce marine vessel speed;
- Limit marine vessel operations to dedicated navigation corridors; and
- Limit marine vessel trips to daylight hours.

7.4.1.12.6.2.3. Sedimentation from construction activities

- Prior to construction, the Marine Works Contractor will be required to obtain additional permits for undertaking marine construction works;
- No activities shall take place outside of the pre-defined construction corridor;
- The type of equipment should be selected carefully to minimise the impact on the surrounding environment;
- The Marine Works Contractor’s working practices should incorporate the following measures:

- Prior to the start of any works in the marine environment, the Marine Works Contractor should install a double layer of low permeability silt screens to minimise the dispersion of marine sediments. Silt curtains should be placed between dredging / digging activities and the surrounding environment;
- Best available techniques to reduce sedimentation and minimise water turbidity should be employed (based on a technical and environmental evaluation);
- Consideration of natural variations within the coastal environment, including tidal and other sea level patterns, and the possibility of synchronising the activity with these changes to minimise environmental impacts;
- Monitoring shall start prior to the commencement of the activity to provide baseline information for progress monitoring purposes; and
- In the early phase of the activity, monitoring will be intensive enough in order to identify any problems or concerns. This may be reduced as confidence in the processes grows, but only with the approval of Fujairah Municipality.

7.4.1.12.6.3. Monitoring Requirements

The following monitoring measures should be implemented by the contractor during the construction phase to ensure any impacts to marine ecology are minimised and mitigated as far as possible:

- Permanent seagrass transects should be established in the vicinity but not directly within the footprint of the pipeline corridors and changes over time recorded. 4 permanent (50m) transects one either side of each pipeline (north and south) in suitable areas containing seagrass habitats, between 5-10m depth, should be established and marked. These transects should be monitored quarterly to asses impacts during the construction phase; and
- Permanent coral quadrats should be established in suitable habitat in the vicinity of the pipeline corridors. 10 permanent quadrats at two sites should be monitored quarterly to assess impacts to coral species during the construction phase.

7.4.1.12.7. Marine Water & Sediment

7.4.1.12.7.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the C-CESMP to control marine water and sediment impacts.

7.4.1.12.7.2. Environmental Control Measures

7.4.1.12.7.2.1. Sediment from construction activities

- Prior to construction, the Marine Works Contractor will be required to obtain additional permits for undertaking marine construction works;
- No activities shall take place outside of the pre-defined construction corridor;
- The type of equipment should be selected carefully to minimise the impact on the surrounding environment;
- The Marine Works Contractor’s working practices should incorporate the following measures:

- Prior to the start of any works in the marine environment, the Marine Works Contractor should install a double layer of low permeability silt screens to minimise the dispersion of marine sediments. Silt curtains should be placed between dredging / digging activities and the surrounding environment;
- Best available techniques to reduce sedimentation and minimise water turbidity should be employed (based on a technical and environmental evaluation);
- Consideration of natural variations within the coastal environment, including tidal and other sea level patterns, and the possibility of synchronising the activity with these changes to minimise environmental impacts;
- Monitoring shall start prior to the commencement of the activity to provide baseline information for progress monitoring purposes; and
- In the early phase of the activity, monitoring will be intensive enough in order to identify any problems or concerns. This may be reduced as confidence in the processes grows, but only with the approval of Fujairah Municipality.

7.4.1.12.7.2.2. Spill of hazardous material to the marine environment

Introduction of contaminants from accidental oil, fuel or chemical spills and inappropriate waste disposal would be mitigated through best practises and procedures including the following:

- Store hazardous materials at designated sites at least 50m away from the sea;
- Proper maintenance of construction vehicles and vessels;
- Provide appropriate (110% volume) secondary containment system at chemical and fuel storage areas;
- Containerising and labelling waste;
- Spill Response Plan to be developed;
- Appropriate spill kits and spill clean-up material available on marine vessels, at chemical, fuel and waste storage areas, and at re-fuelling and maintenance areas;
- No fuel stores within 50m of the sea, surface water bodies or drains leading to the sea; and
- Wastes and sewage to be collected regularly for disposal at appropriate facilities.

7.4.1.12.7.3. Monitoring Requirements

The following monitoring measures should be implemented by the contractor during the construction phase to ensure any impacts to marine water and sediment quality are minimised and mitigated as far as possible:

- Water quality monitoring (both In Situ and Ex Situ) should be undertaken at four locations, one at the outfall area, one north, one south and lastly inland between outfall and shoreline. Water quality monitoring should commence before construction starts and be conducted bi-monthly (every 2-months) until marine construction activities have ceased;
- Sediment quality monitoring should be conducted bi-monthly at four sites concomitant with the water quality sampling to ensure mitigation measures are preventing any exceedances in contaminants or parameters; and
- TSS monitoring on the outside of the silt curtains should be conducted daily during active digging/ dredging activities to ensure adequate mitigation is in place and the sediment plume is being contained. Should levels

reach exceedances of values shown in Table 6-54 then additional mitigation measures would need to be implemented.

7.4.1.12.8. Waste

7.4.1.12.8.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the C-CESMP to control waste impacts.

7.4.1.12.8.2. Permits

Prior to construction, the EPC Contractor will be required to obtain additional permits, in addition to the relevant Competent Environmental Authority NOC, which would include, but not be limited to:

- Permits for storage, transport and disposal of all waste materials, including:
  - Hazardous wastes;
  - Non-hazardous wastes;
  - Demolition wastes; and
  - Spoil materials.
- Permits for removal and disposal of Asbestos materials, where relevant.

7.4.1.12.8.3. Environmental Control Measures

7.4.1.12.8.3.1. General Measures

During the construction phase of the Project, the EPC Contractor will be required to develop a CESMP which will include a site-specific Site Waste Management Plan (SWMP). This document shall be compiled in accordance with the requirements provided within UAE Legislation. The EPC Contractor must include the following requirements within the SWMP:

- The SWMP shall identify, at a minimum, measures for reducing waste streams generated during the construction phase and identify those streams suitable for recycling;
- For waste streams which are unavoidable and unrecyclable the SWMP will provide a waste management strategy for storage, collection and appropriate disposal of aforementioned construction waste streams. Additionally, the waste disposal routes will need to be clearly identified to ensure that potential impacts associated with the local and regional transport infrastructure are minimised as far as possible;
- The SWMP will particularly provide consideration of and control measures for wastes which may require to be transported via specific routes due to the quantity or nature of the waste stream e.g. contaminated soils identified during the site preparation phase. This will enable the closest possible disposal location to be identified for each particular waste stream; and
- The SWMP should also include the following provisions:
  - Identify who will be responsible for the management of construction waste;
  - What types of waste will be generated and in what volumes;
  - Targets for the diversion of waste from landfill;
  - How waste will be treated – with the adoption of a waste hierarchy with an order of priority as follows:
    1. Avoidance;

2. Reduction;
3. Reuse;
4. Recycling; and
5. Disposal as the final option only.

- Measures for testing of soils and fill material to identify contaminated materials, where relevant;
- Targets for the reuse of excavated spoil materials and prevent as far as practicable transport and disposal of these wastes;
- Training and toolbox talks should be provided to educate all construction workers regarding best practice waste management practices and recycling initiatives, and to encourage more sustainable working practices. Emphasis should be placed on the waste minimisation hierarchy: reduce, reuse, and recycle;
- Requirements for permits from authorities for storage, transport and treatment/disposal of wastes;
- Allocation and development of waste storage areas, with necessary provisions for segregation of waste types and appropriate means of avoiding contamination;
- The methods of transportation;
- The final destination of wastes for treatment or disposal;
- Identification of which licensed waste management contractors will be used; and
- How the types and quantities of waste generated by the project and the achievement of targets to avoid landfill will be measured and reported.

In addition, and in accordance with the IFC EHS Guidelines (Waste Management), waste minimisation should be encouraged among suppliers. This is likely to involve suppliers committing to reducing surplus packaging associated with any construction materials; particularly common packaging materials such as plastics (shrink wrap and bubble wrap), cardboard and wooden pallets. This may also involve improved procurement and consultation with selected suppliers regarding commitments to waste minimisation, recycling and the emphasis on continual improvements in environmental performance.

7.4.1.12.8.3.2. Liquid Waste (Effluent)-Storage and Treatment of Sanitary Wastewater

The EPC Contractor must include the following requirements within the SWMP:

- Wastewater storage tanks will be introduced to the site to provide adequate containment facilities for the construction workforce;
- Functional and well-maintained sanitary facilities must be available on site at all times;
- Sludge arising from temporary toilets should be disposed of by an appropriately licensed contractor in accordance with the appropriate Municipality Technical Guidelines and other pertinent Federal and Emirate level legislation and with an emphasis on preventing risk to public health and safety;
- Adequate removal of sanitary liquid waste from temporary toilets, in conjunction with inspections will avoid any overflow and create a zero-leakage site; and
- Removal of liquid sanitary waste from temporary toilets should be undertaken by a licensed waste management sub-contractor and transported to the nearest sewage treatment plant.

7.4.1.12.8.3.3. Impacts on Surrounding Receptors due to Improper Storage and Handling of Wastes

The EPC Contractor must include the following requirements within the SWMP:

- All hazardous materials will be stored in a container of sufficient strength and structural integrity to ensure that it is unlikely to burst or leak in its ordinary use;
- All hazardous liquid waste must be stored within a bunded area with a minimum volume if 110% of the largest container stored within;
- Incompatible hazardous materials must be segregated and stored separately, e.g.: flammable liquids will be segregated from caustic / acidic materials, if relevant;
- Storage, handling and disposal of fuels, oils, lubricants and other potentially harmful chemicals (and their containers) will be undertaken under proper supervision in accordance with manufacturer's instructions;
- Storage areas will be clearly marked and signed with regard to the quantity and hazardous characteristics of the materials stored (Material Safety Data Sheets);
- Containers will be stored, in designated areas that are isolated from surface water drains, open water and are bunded to contain any spillages;
- Emergency spillage kit will be located at strategic locations and in proximity of the main storage areas and the refuelling area;
- Leaking or empty oil drums will be removed to the hazardous waste storage area to be treated or disposed of via a Fujairah Municipality approved waste disposal contractor; and
- Emergency response procedures will be formulated and available to be implemented in the event of an incident and to minimise the impact of contamination incidents should they occur.

7.4.1.12.8.3.4. Health and Safety

Exposure to Harmful Substances

The EPC Contractor must include the following requirements within the SWMP:

- Training and toolbox talks should be provided;
- All workers will be provided with a comprehensive induction to demonstrate which wastes are segregated in adequately labelled containers; and
- Specific PPE and training will be provided, and PPE must be worn by employees at all times specific to the nature of their task.

Exposure to Hazardous Substances

The EPC Contractor must include the following requirements within the SWMP:

- All staff will be trained in appropriate hazardous material handling;
- All staff will be provided with appropriate PPE to ensure safe working; and
- An emergency response plan will be prepared and conveyed to all staff.

Asbestos in Existing Buildings and Structures

There is the potential for asbestos to be present within existing buildings and structures which will require demolition in advance of the construction of the Project, which has been confirmed with the presence of asbestos cement sheets on site. In order to prevent impacts upon the workforce and residents of surrounding areas, the EPC Contractor must include the following requirements within the SWMP:

- A full asbestos survey of existing buildings will be required prior to the commencement of demolition works. The survey should conform to the survey methodology set out for Refurbishment and Demolition Surveys in HSG: 264 Asbestos: The survey guide;
- If asbestos is identified, this should be removed by a licensed Asbestos removal contractor, under the supervision of an Asbestos Supervising Consultant to provide independent verification that all Asbestos has been removed and that the demolition works can proceed; and
- The asbestos material should be disposed of, under the appropriate licence, to an authorised hazardous waste management facility.

Waste Handling and Transport

The EPC Contractor must include the following requirements within the SWMP:

- Waste is suitably disposed of by a licenced operator and is not be transported to other Emirates unless the appropriate approvals from the respective Emirate Waste Authorities and the MOCCAE;
- All relevant consignments of waste (waste manifests) for disposal or recycling should be recorded indicating their type, destination and name of the carrier. This will indicate whether the waste is to be treated, recycled or disposed of to a landfill site and discharge liability from the waste producer by ensuring that disposal activities are in accordance with local regulations;
- Final disposal of wastes will be to respective Municipality approved waste treatment plants or respective Municipality approved landfill sites, as agreed by the relevant competent administrative authority;
- Waste manifests must be countersigned by the receiving facility;
- Where possible, conventional wastes (i.e. paper/cardboard, plastic) will be recycled by a Municipality approved company or removed from the Project Site by appropriate Municipality approved Contractors;
- Waste containers shall be checked prior to leaving the site to ensure:
- The waste containers are clean on the outside, sealed, and not leaking; and

The required forms for wastes and other documents required for shipment are completed and correct.

7.4.1.12.8.4. Monitoring Requirements

The following monitoring and auditing measures should be implemented throughout the construction phase by the EPC Contractor to ensure that any potential impacts relating to waste generated by the Project are minimised and mitigated as far as possible:

- Records of raw material wastage;
- Quantitative records for the generation of each waste stream;
- Methods by which the waste streams are being handled and stored;
- Quantifying the wastes diverted from landfill, with records for each treatment method;

- Monthly collation of waste consignment data and receipt at waste treatment/disposal facilities;
- Review of all waste permits;
- Records of any waste complaints or incidents; and
- Review of effectiveness of waste management programme procedures and update as necessary.

7.4.1.12.9. Socio-Economy

7.4.1.12.9.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the C-CESMP to control impacts on local socio-economics.

7.4.1.12.9.2. Environmental Control Measures

7.4.1.12.9.2.1. Air Quality Impacts

Section 7.4.1.12.2: Ambient Air Quality sets out a series of measures which will be implemented during the construction phase to ensure that the generation of dust and emissions is minimised as far as possible.

7.4.1.12.9.2.2. Noise Impacts

Section 7.4.1.12.3: Ambient Noise sets out a series of controls to reduce the noise impacts during construction which will reduce the impacts of noise during construction.

7.4.1.12.9.2.3. Landscape and Visual Impacts

A range of mitigation measures as set out within the ESIA, NOC and Authority approved CESMP will be implemented by the EPC Contractor to minimise impacts relating to visual receptors and a reduction in landscape quality as a result of the construction activities and laydown areas required.

A summary is provided as follows:

- Strategic installation of hoarding of an appropriate height within areas along the alignment bordering onto residential areas and roads in order to shield the view of construction activities from the identified sensitive receptors;
- Establishment of a grievance mechanism for local residents;
- Ensure good housekeeping throughout the construction site and storage areas to minimise unsightly visual impacts; and
- Identify dedicated construction traffic routes, including use of appropriate signage to ensure that construction vehicles are routed away from residential areas where feasible.

7.4.1.12.9.2.4. Health and Safety

Construction Worker Welfare

- The development of a Health and Safety and Environmental Policy would provide detailed health and safety guidelines for staff, personnel and sub-contractors, including personal safety, site conduct, security, site safety zoning and emergency procedures;

- In common with Performance Standard 2, on site medical facilities must be made available throughout the construction phase for the use of workers. Trained health and safety and first aid personnel must be identified to workers as part of their training schedule;
- Suitably qualified personnel must be chosen for potentially hazardous activities such as for the installation and testing of specialist electrical equipment;
- Appropriate action must be taken for outbreaks of illnesses amongst workers, minimising the transmission as far as is possible;
- The EPC Contractor must establish a Human Resources Policy which will be communicated to employees with information including, but not limited to, their rights under national labour and employment laws, salary, and other associated information, such as medical care and insurance. The Human Resources Policy will ensure an approach of non-discrimination is followed with equal opportunities for all. No child labour or forced labour will be used for the proposed facility;
- In common with Performance Standard 1 (Section 23), the establishment of a 'grievance mechanism' for workers will involve the identification of a local environmental co-ordinator, identified by the contractor within the management structure, to identify and log all concerns. This contact information will be provided via appropriate transparent measures and a placard left on the perimeter of the site with further details of contact arrangements. The resultant procedure to address these concerns will be made clear to the complainant and a set process followed, as identified within the CESMP, and within a suitably prompt period;
- Throughout the construction and operation of the proposed facility, a long-term training programme should be implemented to ensure adequate training and qualification of all staff employed within the RTR facility. The aim of this programme would be to ensure that personnel acquire and maintain the combination of knowledge and demonstrated skills as required to safely and adequately fulfil their responsibilities. The objective of the long-term training plan will be to ensure that the facility is operated safely and efficiently, while also guaranteeing the long term economic success of the Project; and
- In common with Performance Standard 4, all components of, and infrastructure associated with, the Project will be constructed in accordance with industry.

Exposure to Asbestos in Existing Buildings and Structures

A detailed Dust and Asbestos Control Plan for Workers Health and Safety should be established to ensure workers and nearby receptors safety, particularly during dust emitting activities such as demolition. These mitigation measures will be presented in the CESMP.

7.4.1.12.9.2.5. Impacts on Surrounding Receptors

Construction activities undertaken for the Project may result in an impact to surrounding communities. It is important that this will be managed in such a way as to minimise construction impacts.

Any on-going issues will be managed through the CESMP which will be implemented and monitored by the Contractor and any sub-contractors, to include an update of existing EHS documentation. The CESMP will be required to incorporate all the mitigation measures identified throughout this ESIA. This will ensure that the effects of construction work upon the local community is minimised.

In addition, a grievance procedure needs to be established for local residents to ensure that any issues are resolved to the satisfaction of all parties. This will include the following:

- Clear contact numbers for key construction management staff who can be contacted in the case of complaints, which could be posted on signage near to the site access gates or in leaflets distributed to the local community; and
- A clear grievance procedure which involves studying the basis of complaints, identifying corrective actions and communicating the response to the complainant.

7.4.1.12.9.3. Monitoring Requirements

The following monitoring measures should be implemented throughout the construction phase by the EPC contractor to ensure that any potential impacts relating to waste generated by the Project are minimised and mitigated as far as possible:

- Grievance mechanism for workers will involve the identification of a local environmental co-ordinator, identified by the contractor within the management structure, to identify and log all concerns; and
- A grievance procedure needs to be established for local residents to ensure that any issues are resolved to the satisfaction of all parties.

Both procedures must be in line with Performance Standard 1 (Section 23).

7.4.1.12.10. Archaeology and Cultural Heritage

7.4.1.12.10.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the C-CESMP to control impacts upon Cultural Heritage and Archaeology.

7.4.1.12.10.2. Permits

Prior to construction, the EPC Contractor may be required to obtain additional permits, in addition to the relevant Competent Environmental Authority NOC, which would include, but not be limited to:

- Permits from relevant Cultural Heritage Authority;
- Permits for establishment of laydown areas, site offices; and
- Permits for demolition.

7.4.1.12.10.3. Environmental Control Measures

In order to ensure that archaeological impacts are minimised, it is recommended that the CESMP includes procedures to protect archaeological resources (if any are detected) which include:

- Toolbox talks concerning the potential for archaeological finds during earthworks, which will be provided to all construction workers involved in site works such as grading, excavations etc.;
- A chance finds procedure will be established which includes the following and is summarised within Figure 7-1 below:

- Any chance finds or suspected evidence of archaeological and/or historical materials must be immediately reported by any of the construction workers, or other parties involved in the construction phase, to the HSE representative or Site Manager and all works in the area should be stopped immediately; and
- Fujairah Tourism and Antiquities Authority (FTAA) should be contacted for advice on how to proceed and work should not recommence within that area until signed off by FTAA.

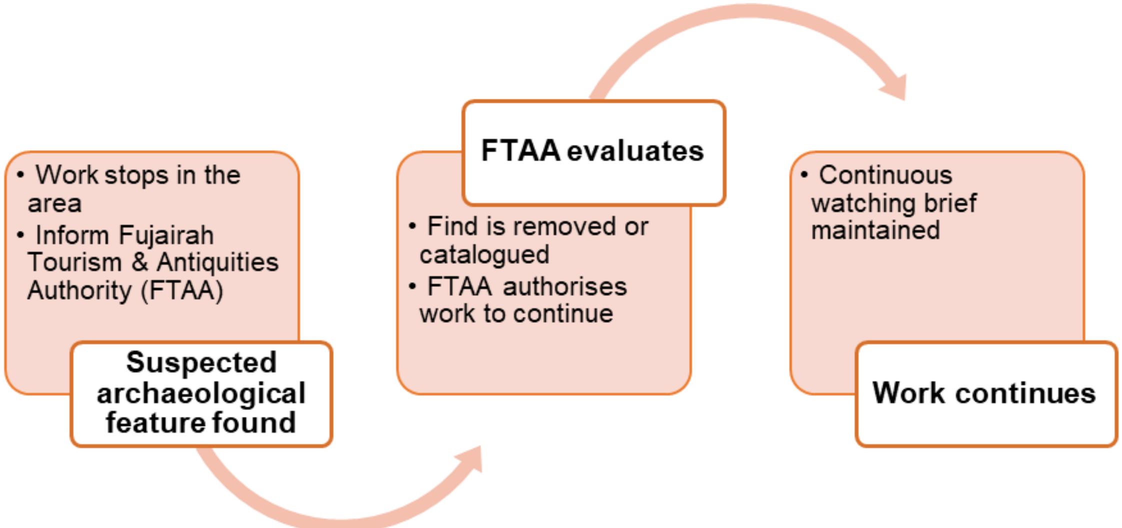

Figure 7-3: Summary of the archaeological watching brief and chance finds procedure

7.4.1.12.10.4. Monitoring Requirements

No monitoring is proposed as necessary during the construction phase of the Project. In the event of archaeological finds being discovered on site, FTAA will be notified, and a removal and monitoring plan will be implemented and adopted until safely removed from the Project site.

7.4.1.12.11. Decommissioning

Upon the completion of the construction phase, the EPC Contractor will fully decommission all facilities and work sites. The following activities will be undertaken:

- Removal of all construction related plant, machinery, vehicles and equipment;
- Removal of construction site offices;
- Removal of all waste generated during the construction stage;
- Removal of all hazardous materials and clean-up of any contamination (if relevant); and
- Restoration of sites to former condition.

8.1.14 Reporting Requirements

7.4.1.13. Environmental Performance Reporting

The ECP Contractor will be responsible for the provision of Environmental Performance Reports (EPR) to the relevant Competent Environmental Authority, which are usually required on a six-monthly basis, although this may require more frequent reporting given the sensitivity of the Project site.

7.4.1.14. Incident reporting

The ECP Contractor will notify the relevant Competent Authority (e.g. Civil Defence) as soon as practicable about any environmental incident with actual or potential significance for impacts on the environment. Should an incident occur, the contractor must inform the relevant municipality within 48-hours and provide an incident report to the relevant municipality outlining the details of the incident, which would include:

- Fuel or chemical spills;
- System failures or malfunctions;
- Control failures or malfunctions;
- Other emergencies (e.g., natural disasters); and
- Other events that led to non-compliance with environmental standards or requirements.

All incidents should be recorded on a Non-Conformance Recording Form.

7.4.1.15. Monitoring Compliance

7.4.1.15.1. Non-Compliance Procedures

7.4.1.15.1.1. Scope

Non-conformances are a deviation from the agreed process which could lead to a significant environmental impact. Alternatively, environmental issues with no significant impacts but repeatedly observed for two consecutive days will also be considered a non-conformance.

This procedure defines the level of severity of non-conformances and the methodology to be adopted in order to rectify the issue and prevent re-occurrence.

7.4.1.15.1.2. Responsibilities

Depending on the severity of the non-conformance, it will be the responsibility of the EPC Contractor's Environmental Manager or authorized representative to investigate non-conformities in order to determine its cause and the appropriate corrective action to be taken in order to prevent re-occurrence.

Specific actions will be assigned to appropriate individuals, who are responsible for completing the corrective action within a timescale that reflects the urgency of the situation.

All non-conformances will be recorded using a Non-Conformance Report Form.

There are several levels at which corrective action can be implemented. These are listed and described below.

7.4.1.15.1.3. Observations

Observations are likely to be the most frequently used form of corrective action and will be given in response to minor transgressions that are evident during routine inspections. Verbal instructions will also be used to create further awareness amongst workers of the contractor as often transgressions are a function of a lack of awareness. The contractor must obey instructions through formally recording the actions taken to resolve the matter so that the instructions can be successfully closed out and recorded.

7.4.1.15.1.4. Non-conformances

Written instructions issued by the Environmental Manager or authorized representative will be given following repeated non-conformances or transgressions which may have a significant adverse health, safety and environmental impacts. The written instruction will indicate the source of the issue and proposed corrective action supported by a preventive action to resolve those problems. The implementation of these solutions will be assessed in a follow up audit and further written instructions issued if required.

7.4.1.15.1.5. Contract Notice

A contract notice reflects the transgression as a potential breach of contract. If there is not an adequate response to a contract notice, the next step will be the issue of a penalty fine, or to have the contractor removed from the site and the contract cancelled.

7.4.1.15.1.6. Non-conformances and Root Cause

Following the discovery of a non-conformance, immediate actions will be taken in order to determine the root cause of the non-conformance. The actions will aim to efficiently mitigate the environmental impact and to reduce the likelihood of escalation. Such actions will be taken when there is an immediate threat of a serious impact on the environment.

7.4.1.15.1.7. Non-conformances and Corrective Action Plans

Following the determination of the root cause of the non-conformance, it will either be the responsibility of the Environmental Manager or authorized representative to develop a Corrective Action Plan, for approval by the PMC or Lead Consultant. This will identify the non-conformance, the location of the non-conformance and the actions to be implemented.

Corrective Action Plans will need to be:

- Specific;
- Measurable;
- Achievable;
- Relevant; and
- Time-based.

7.4.1.15.1.8. Non-conformances and Records

All non-conformances investigated will be recorded and recorded on a Non-conformance Report form which includes the following information:

- Location, date, time that the incident occurred, or when incident was first reported to the contractor;
- Who observed the incident;
- Description of the incident and description of the activities that were taking place when the incident occurred;
- Name and company details of those involved in the incident;
- Likely receivers;
- Immediate actions taken in response to the incident;
- Corrective action and preventative actions proposed, and the due date and responsibility for these actions; and
- Incident close-out date and sign off by the Environmental Manager or authorized representative.

7.4.1.16. Documentation

A copy of the EPC Contractor's C-CESMP must be kept on-site at all times for inspection, together with the following as a minimum:

- A copy of all relevant NOC;
- A copy of this EIA;
- Training register;
- Training records;
- Non-conformance reports; and
- Weekly inspection records.

7.4.2. Framework Operational Environmental and Social Management Plan (F-OESMP)

7.4.2.1. Introduction

This Framework Operational Environmental and Social Management Plan (F-OESMP) has been prepared to provide a framework for the development of an Operational Environmental and Social Management Plan (OESMP) by the Operator, which will ensure that best practice environmental control measures are adopted and implemented by the Operators and their sub-contractors during the operational phase of the Project in order to avoid, minimise or compensate for environmental and social impacts.

This F-OESMP has integrated the findings of the impact assessments undertaken as part of the ESIA and includes recommendations made within the OESMP.

All environmental control measures which shall be implemented as part of the operational phase in order to reduce the significance of identified impacts to acceptable levels. The F-OESMP and its requirements are applicable to the operations and maintenance of the Project.

The F-OESMP should be seen as an extension of the ESIA and provides a framework for the implementation of environmental controls during operation.

7.4.2.2. Purpose

The purpose of the F-OESMP is to provide a framework within which the Operator will be required to develop an OESMP, which includes:

- All statutory requirements to be adopted throughout the operational phase;
- Identification and commitment to obtain and maintain all applicable and relevant consent to operate permits;
- Specific mitigation measures identified as part of the overall ESIA process to avoid or reduce operational related impacts to acceptable levels and those put forth in the consent to operate permits issued by the relevant Competent Authorities;
- General best-practice mitigation measures to be adopted; and
- Environmental monitoring to be carried out to ensure that impacts are within acceptable levels.

The operator will be responsible for the development of an OESMP, in accordance with the framework established within this F-OESMP.

The Operator will also be responsible for issuing the OESMP to the relevant Environmental Regulator for approval prior to the commencement of operational activities and the issue of ongoing audit reports and environmental monitoring reports as required by the relevant Environmental Regulator.

7.4.2.3. Environmental Management System

One of the most widely used environmental management systems, developed by the International Standards Organization (ISO), is the ISO14001 standard for the environmental management of activities. The standard provides a logical framework within which to prepare and develop the OESMP of the Project.

The key element of ISO 14001 which has been embedded into the OESMP is one of continual feedback and improvement, whereby the identification of non-conformances together with the results of audits and environmental monitoring are continuously reviewed by the environmental management team and are fed back into the environmental management process. In this way, for example, where exceedances of standards are identified, a review of the environmental management actions being undertaken will be implemented and the OESMP updated with alternative or additional actions to work towards continued compliance. The Operator should ensure that Operational objectives and activities are being undertaken with continual improvement at its core. If the Operator is not currently ISO 14001 accredited, efforts should be made to achieve ISO 14001, an equivalent or better accreditation for the operation of the Project. The structure of a typical ESMS certified to ISO 14001, which demonstrates this cycle of continuous improvement, is shown in Figure 7-4 below.

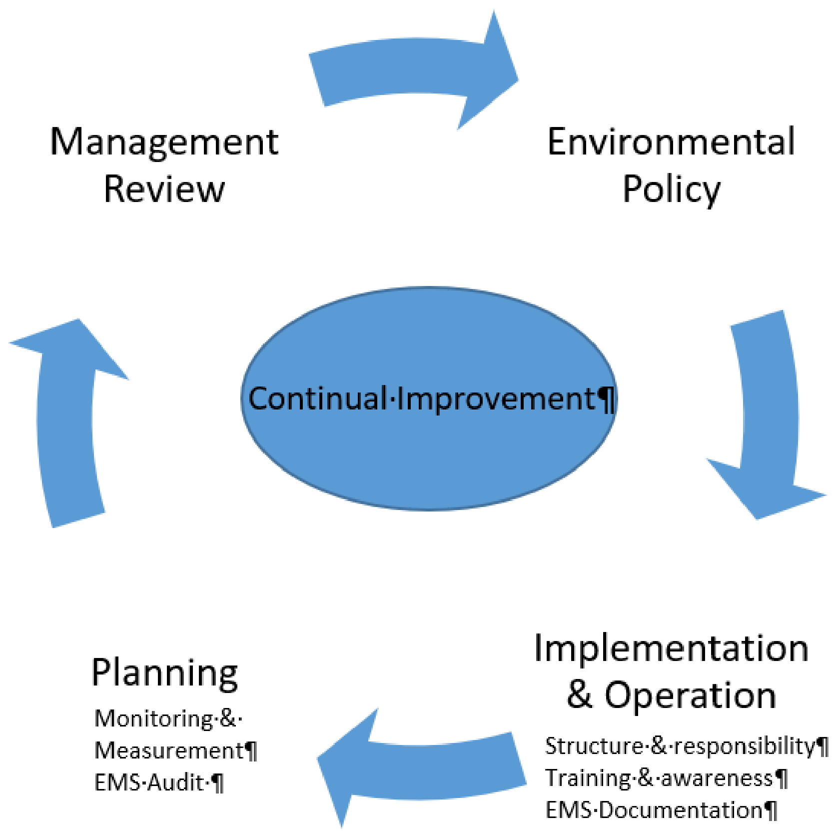

Figure 7-4: ISO 14001 Structure

7.4.2.4. Preparation of OESMP

The Operator shall submit the OESMP to the relevant Competent Environmental Authority for issuance of a No Objection Certificate (NOC). Formal approval is a condition precedent to commencing operation.

The OESMP is considered to be a live document and the Operator shall prepare the required environmental documentation, to reflect any such modifications and/or changes to working practices and procedures that may have environmental implications during the operational period.

The OESMP will be prepared by relevant Competent Environmental Authority approved and registered consultant who legally operates within the emirate of Fujairah.

7.4.2.5. Permits and Approvals

The Operator shall be fully responsible for obtaining and maintaining all relevant permits and approvals for the operation of the Project and associated facilities including any changes which require modifications to these approvals.

Additional permits and approvals which may be required (in addition to the NOC issued as part of the approval of the ESIA) includes, but is not limited to, the following:

- Site offices;
- Operations and maintenance facilities and offices;
- Vehicle and equipment maintenance areas;
- Storage and movement of potentially hazardous and non-hazardous intermodal freight;
- Waste storage, transportation, and disposal;
- Hazardous materials storage, transportation, and disposal; and
- Wastewater treatment, transport and disposal;

7.4.2.6. Environmental Monitoring and Reporting

The Operator will be responsible for undertaking:

- Environmental monitoring during the commissioning stage and subsequently during operations, as required; and
- Additional Environmental reporting to the relevant Competent Authorities, as required.

7.4.2.7. Environmental Inspections and Audits

The Operator will be responsible for undertaking Environmental Inspections and Audits to ensure compliance with all environmental and social requirements and standards. As part of this, an Environmental Inspection Checklist will be developed and adopted to guide the process. Furthermore, the Operator will describe inspections and auditing processes in an Environmental Monitoring and Auditing Plan.

The Operator will conduct periodic Environmental Audits, providing the requested data and evidence and submit to the relevant Competent Environmental Authority (on an at least quarterly frequency). In addition, the Operator shall arrange and facilitate periodic audits by relevant authority (if any).

7.4.2.8. Legal Compliance

The Operator shall ensure that all aspects of the Works comply with all applicable Laws, (including Environmental Laws), Environmental Guidelines, Environmental Standards, Environmental Permits/Environmental Clearances/No Objection Certificates (NOC)/license conditions and accepted good practice, and that measures to mitigate environmental impacts identified in the ESIA are implemented where applicable.

7.4.2.9. Environmental Awareness and Training

7.4.2.9.1. Overview

Environmental training is essential for carrying out day to day operations in an environmentally sound fashion during the operational phase of the Project. Final training material will be created as per the requirement of the Operator to allow for operations to be completed in the required manner and level of competency. It will be created, authorised and distributed by the Operator's in-house environmental team or authorised representatives.

7.4.2.9.2. Responsibilities

The Operator (or authorised representative(s)) will establish the Environmental training programme schedule, and will be responsible for the below as a minimum:

- The development of training materials or the oversight of the preparation of such material by a competent person in order to effectively conduct environmental training;
- Development of an environmental training programme;
- The preparation and updating of the schedule for environmental training;
- Carrying out environmental training for site personnel in accordance with this procedure; and
- The collation and retention of training records.

The operator will be responsible for ensuring all workers attend and participate in the scheduled training sessions, as applicable.

7.4.2.9.3. Environmental Induction Training for Site Personnel

Awareness and training is critical to the effective implementation of the OESMP and, therefore, all operational personnel and specialist contractors shall attend an awareness induction prior to starting work in order to gain a better understanding of the environmental issues and associated main mitigation measures related to the operational phase of the Project.

Induction will include at least an overview of the environmental aspects related to the main activities of the project, emergency measures, incident reporting, and an overview of the main environmental controls set out within this F-OESMP.

The topics addressed in the induction training, as a minimum, are set out in Table 7-22 below with any additional material deemed necessary by the relevant Competent Environmental Authority to be added as required.

Table 7-22: Awareness Induction Content

Awareness Induction Content	
Environmental Management Overview	Duty of Care Concept
Waste Management Procedures	Hazardous Substances Management
Working Rules	Incident Reporting Procedure
Emergency Plan	Site Housekeeping
Disciplinary Action	

7.4.2.9.4. Specialist Training

Specialist environmental training will be required based on specific requirements of each role.

7.4.2.9.5. Environmental Training for Managers

Environmental training, where required, will be provided by Environmental Managers and given to discipline managers, senior level staff and authorized representatives. In addition to the contents of the standard Environmental Induction Training, the environmental items set out in Table 7-23 below will be specifically highlighted at the Environmental Training for the Environmental Officers and authorized representatives. Additionally, where it is felt required, general management staff and supervisors should receive suitable Environmental Training if it is considered relevant to the needs of their role or to improve the general environmental performance of their place of work or operational duties.

Table 7-23: Training Content for Environmental Managers, Team Leaders and authorized representative

Training Content	
Details of Policies (if applicable)	Format and availability of OEMP
Organisation and Responsibilities	Necessity of expanding Environmental awareness
Environmental Incident Procedure	OEMP Compliance Procedure
Management Procedures	Complaints Management Procedure

7.4.2.9.6. HSE Training for Workers Working with Hazardous Materials

Specialist training will be given to all personnel assigned to working with hazardous materials. Such training will be delivered by the Operator's authorised representative before commencing works, and on a periodic basis, and will encompass the topics set out in Table 7-24 below.

Table 7-24: Training Content for Hazardous Materials

Training Content	
Chemical and Fuel Handling	Handling and storage of waste materials
Handling and storage of liquids	Emergency response procedures
Refuelling procedures	

7.4.2.9.7. Toolbox Talks

Toolbox talks will be provided for all members of the maintenance and repair work force and operations support staff during the operational phase of the project on a weekly or fortnightly basis (or more frequent, if deemed necessary by the Operator) to reinforce the culture of environmental protection as part of the work ethic and will include any materials referenced within this F-OESMP, including noise, air, terrestrial ecology awareness, soil and water pollution, waste minimisation and segregation, spillage containment, management of contaminated land and groundwater and other environmental issues specific to the work activity.

Toolbox talks will be normally given by the Environment Officer; however, other personnel with site HSE responsibility can also provide assistance as required.

Toolbox talk training is a cost-effective way to provide targeted information on an environmental issue, for example, in relation to a change in procedures, results of an environmental incident investigation, or changes to environmental conditions on site.

7.4.2.9.8. Training Register

A Training Register will be maintained in order to record the training attendance by employees. The Training Register will be developed in order to allow the training history of any employee to be checked.

7.4.2.9.9. Training Record

A training attendance sheet will be developed, and must be completed for all training sessions, which includes:

- Training module name;
- Date;
- Location;
- Presenter’s name (and company if the presenter is not employed by the contractor); and
- Trainee’s details: name, company, position and signature.

7.4.2.10. OESMP Review and Updates

The OESMP and associated documentation will be regularly reviewed and updated by an approved Environmental Consultant as required based on consultation with the Operator, with the following main objectives:

- Review the OESMP for continued suitability, adequacy and effectiveness, by assessing the need for changes to policies, objectives and other elements of the OESMP and other procedures in light of compliance audits, system audits, changing circumstances and commitment to continual improvement;
- Establish whether suitable progress has been made towards achieving objectives, targets and programmes within stated timescales; and
- Obtain commitments and identify necessary resources for new initiatives and improvements; and
- Update OESMP on at least an annual basis, taking into consideration how much ongoing operation activity and intensity has changed since previous review. Also taking into consideration the adoption of continuous improvement techniques to raise the overall quality, working conditions and working practice on site.

7.4.2.11. Coordination with External Entities Addressing Complaints

7.4.2.11.1. Scope

This section defines how complaints relating to the Project will be handled.

7.4.2.11.2. Responsibility

The Operator will be ultimately responsible for handling complaints from local communities relating to the environmental performance of the site and for ensuring appropriate communication with interested parties, including the complainant and the relevant Competent Environmental Authority in relation to all complaints.

7.4.2.11.3. Complaints Management

Members of the public or other interested parties may make complaints or enquiries relating to the aspects of the environment and a particular operational activity directly to an Operator representative.

A mechanism for addressing complaints will be implemented, as follows:

- All complaints will be acknowledged within 48 hours of receipt;
- The Operator will have the responsibility to check whether the complaint is valid, and will assign and dispatch an investigation team;
- The investigation tasks will be agreed, delegated by the investigation team;
- Remedial actions recommended by the investigation team will be implemented and finalised; and
- Complainant will be contacted by the Operator and advised of the outcome on the investigation within one week, unless additional information or clarifications are needed.

All complaints will be recorded using a Non-Conformance Recording Form.

7.4.2.11.4. Stakeholder management Plan

The Operator should develop and keep updated a Stakeholder Management Plan. During the commissioning stage of the Project, the Operator should reach out to nearby stakeholders to present the Project operations scheme, as well as detailing the high-level operation of the Project. At this stage, the Operator should also provide contact details on how to maintain smooth communication channels with local stakeholders.

Additionally, through the Stakeholder Management Plan, the Operator should periodically investigate current or future development projects close to the network to enable the initiation of communication channels between the Operator and current or future stakeholder to avoid and mitigate potential issues where possible.

7.4.2.12. Framework Operational Environmental and Social Management Plan

7.4.2.12.1. Overview

This section provides Framework Environmental and Social Control Plans (ESCP) for each environmental and social aspect, which will be included as a minimum within a detailed OESMP.

7.4.2.12.2. Ambient Air Quality

7.4.2.12.2.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the OESMP to control impacts upon Air Quality.

7.4.2.12.2.2. Environmental Control Measures

The project design basis includes the use of combined cycle gas turbines with low NOx technology operating on natural gas as a main fuel. In addition, SCR systems are included in all HRSGs, including ammonia injection and storage systems with a five-day storage capacity, to guarantee the NOx emission limit of 20 mg/Nm3 at 15% O2. The IFC recommended secondary mitigation measures to prevent, minimise, and control NOx emissions include the use of SCR for combustion turbines burning gaseous or liquid fuels.

Based on the results of the dispersion model, no additional end of pipe control measures are deemed necessary outside of the SCR, and it is envisaged that when the new Federal Emission Limits for Stationary combustion sources are introduced (date to be determined), the nearby facilities will be required to reduce their NOx emissions in accordance with the regulatory requirements, thereby lowering background pollutant concentrations in the vicinity of the three plants.

Operation on fuel oil (diesel) for short periods during maintenance and emergency conditions is not likely to lead to significant breaches of air quality standards. In addition, the project has committed to using low sulphur (10ppm) fuel oil, which will minimise potential SO_2 emissions.

7.4.2.12.2.3. Monitoring Requirements

Mitigation measures to minimise emissions of NOx, SO_2, CO and PM to air are included within the Project design. In addition, ambient air quality monitoring and emissions monitoring will be undertaken, as described below (in accordance with the IFC general EHS Guidelines for Thermal Plants). These monitoring requirements include:

- In stack continuous monitoring for NOx:
  - To further ensure conformity with the Project standards, a Continuous Emission Monitoring System (CEMS) will be included in the power plant. This will provide continuous assessment of the stack emissions to verify if the NOx concentration (measured as NO_2) meet the project commitment not to exceed 20 mg/Nm^3 at 15% O_2 at the HRSG stacks. Appropriate maintenance and/or operating changes will be implemented, if necessary, to maintain design parameters.
- Ambient air quality monitoring including:
  - Implement an air quality monitoring programme for the first year of the F3 operations phase that measures the actual ground level concentrations of NO_2. The survey should include the placement of diffusion tubes at the sensitive receptor locations assessed in the survey (to be established in consultation with the local regulators); and
  - Individual tubes should be in place for no more than one month in duration and a minimum of 6 months of data should be collected.

7.4.2.12.3. Ambient Noise

7.4.2.12.3.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the OESMP to control noise and vibration impacts.

7.4.2.12.3.2. Environmental Control Measures

As exceedances of the most stringent standards are predicted to be exceeded at a number of SRs as a result of the Project noise contribution, clear measures to resolve any exceedances need to be in place. This will be undertaken through the adoption of the following:

- An update of all predictive noise models (Occupational and Environmental studies), based upon vendor equipment data during the EPC phase, and also refer to recommendations set in the Front-End Engineering Design (FEED) Contractor Noise Studies (individual units and global Occupational models);
- Application of various noise abatement measures as follows:
  - Apply acoustic lagging to the connecting suction and discharge piping;
  - Application of inlet and outlet noise silencers;
  - Apply an acoustic enclosure to the compressor(s) where operationally feasible;
  - Partial screening between the compressor and site boundary;
  - Installing silencers for fans;
  - Installing suitable mufflers on engine exhausts and compressor components;
  - Installing acoustic enclosures for equipment casing radiating noise;
  - Improving the acoustic performance of constructed buildings, apply sound insulation;
  - Installing acoustic barriers without gaps and with a continuous minimum surface density of 10 kg/m2 in order to minimize the transmission of sound through the barrier. Barriers should be located as close to the source or to the receptor location to be effective;
  - Installing vibration isolation for mechanical equipment;
  - Limiting the hours of operation for specific pieces of equipment or operations;
- Measure the baseline noise at the most impacted sensitive receptors during EPC and model it along with the noisy equipment with the final vendor data; and,
- Developing a mechanism to record and respond to complaints.

7.4.2.12.3.3. Monitoring Requirements

It is recommended that noise monitoring be undertaken at site boundaries and sensitive environmental receptors during the commissioning phase of the Project as well as annually throughout the project lifetime for the purposes of verifying operational phase noise levels. Additionally, in the event of complaints being received from local sensitive receptors, abatement measures should be implemented to reduce operational noise emissions and, in this event, noise monitoring would be required at the locations listed above to verify the implementation of the abatement measures.

Monitoring requirements should comply with IFC general EHS guidelines which recommend the following (71):

- Noise monitoring programs should be designed and conducted by trained specialists;
- Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate; and,
- Monitors should be located approximately 1.5 m above the ground and no closer than 3 m to any reflecting surface.

In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise sources under investigation.

7.4.2.12.4. Soil, Surface Water and Groundwater

7.4.2.12.4.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the OESMP to control impacts upon soil and groundwater.

7.4.2.12.4.2. Environmental Control Measures

The key measures for preventing contamination during the operational phase will be designed into the Project. This includes appropriate designs in relation to the following:

- Appropriate containment systems around storage tanks (e.g. fuels, oils etc);
- Leak detection facilities;
- Fire prevention measures; and
- Appropriate storm water management systems.

An OESMP will also be developed which will contain the key operating procedures that are to be implemented for the Project to prevent contamination of the groundwater. The OESMP will include measures such as:

- Hazardous chemicals and materials to be appropriately stored on-site in secure, bunded, compounds and located on an impervious surface. The storage areas will need to be clearly labelled with material safety data sheets (MSDS) maintained as part of the on-site record keeping;
- All hazardous liquid materials will be stored in a container of sufficient strength and structural integrity to ensure that it is unlikely to burst or leak in its ordinary use;
- Incompatible hazardous materials must be segregated and stored separately, e.g.: flammable liquids will be segregated from caustic / acidic materials, if relevant;
- Storage, handling and disposal of fuels, oils, lubricants and other potentially harmful chemicals (and their containers) will be undertaken under proper supervision in accordance with manufacturer's instructions;
- Storage areas will be clearly marked and signed with regard to the quantity and hazardous characteristics of the materials stored (Material Safety Data Sheets);
- Containers will be stored, in designated areas that are isolated from surface water drains, open water and are bunded to contain any spillages;
- Emergency spillage kit will be located at strategic locations and in proximity of the main storage areas and the refuelling area;
- Ensure adequate maintenance of plant and infrastructure pipelines to reduce the risk of leaks and potential pollution of surface water bodies during operation;
- Relevant design guidelines for waste storage and collection strategy must be adhered to;
- The content of any tank will be clearly marked on the tank, and a notice displayed requiring that the valves and trigger guns be locked when not in use.
- Regular vehicle and equipment maintenance to be undertaken in hard-standing areas with isolated drainage and oil-interceptors;
- Vehicle and equipment refuelling to be undertaken in hard-standing areas with isolated drainage and oil-interceptors – where this is not possible drip-trays must be used;

- Emergency Response Procedure should be in place and all employees aware of their responsibilities;
- Spill clean-up kits to be readily available on site and staff trained in their appropriate use; and
- Spills to be cleaned up immediately and any waste materials generated, including excavated soils or aggregates, must be disposed of appropriately as hazardous waste.

The design and construction of the facility, as well as the adoption of best practice operations detailed within an OESMP should significantly limit the risk of pollution.

Other measures in relation to personnel safety, housekeeping and security, on-site awareness training and emergency preparedness policies are also essential. Such measures will form part of the OESMP with the overall aim of avoiding incidences which may lead to potential contamination issues. Such measures will include, inter alia:

- To protect and promote health and safety issues to all staff and personnel on-site;
- To minimise exposure to potential hazards and safety issues and reduction in risk from injury and health risk;
- To minimise impacts on the environment from the plant activities taking into account the necessary balance between economic efficiency, energy requirements and environmental protection;
- Promote good practice measures in terms of health and safety to comply, as a minimum, with law and policy requirements;
- Provide appropriate security measures to ensure that any potential issues that may result in contamination are avoided;
- Promote appropriate safety zoning to the hazards that may be present and to ensure that any spillages or incidents are avoided;
- Provide emergency response procedures to any potential incidents to ensure that contamination incidents are controlled if they occur;
- Provision of written standard operating procedures for all processes and appropriate document control;
- Provision of awareness training for all employees including management, office staff and technical staff on pollution prevention and control techniques and best practices;
- The establishment of daily checklists for plant and office areas to confirm cleanliness and adherence to proper storage and security. Specific employees should be assigned specific inspection responsibilities and given the authority to remedy any problems found;
- Continuous monitoring and reporting of the plants' performance should be undertaken in order to establish baseline conditions and whether conditions are improving or deteriorating; and,
- Regular reviews of emergency response procedures should be undertaken, including a contingency plan for spills, leaks, weather extremes etc.

7.4.2.12.5. Terrestrial Ecology

7.4.2.12.5.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the OESMP to control impacts upon Terrestrial Ecology.

7.4.2.12.5.2. Environmental Control Measures

Due to the fact that no natural habitats remain on the study area and that the envisaged impact on flora and fauna is negligible, no mitigation other than operational care, during the construction and operation phase, is proposed.

Nevertheless, to meet with the requirements of PS6, it is recommended that project opportunities are undertaken to enhance the existing habitats. Opportunities could include the development of a landscaping scheme which seeks to create areas of habitat.

7.4.2.12.5.3. Monitoring Requirements

Due to the fact that the area will be completely transformed, and no natural ecosystems or flora and fauna species will remain, no monitoring of terrestrial ecosystems is possible or required.

7.4.2.12.6. Marine Ecology

7.4.2.12.6.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the OESMP to control impacts upon Marine Ecology.

7.4.2.12.6.2. Environmental Control Measures

7.4.2.12.6.2.1. Thermal discharge

The hydrodynamic study showed no exceedance (>3°C to ambient temperature) in the RMZ on the seabed. The area is already impacted from existing outfalls indicating the proposed outfall will have very limited effect due to the use of a diffusor outfall. Therefore, no further mitigation is required but monitoring should be undertaken to ensure no exceedances or residual impacts occur.

7.4.2.12.6.2.2. Chlorine discharge

The hydrodynamic study showed no exceedance of residual chlorine (>0.01mg/l) in the RMZ on the surface water. The area is already impacted from existing outfalls indicating the proposed outfall will have very limited effect due to the use of a diffusor outfall. No further mitigation of the continuous dosing concentration or method is proposed; however, the shock dosing concentration of 2 mg/l be limited to no more than 10 minutes per 24 hour period to minimise impacts to marine ecology.

7.4.2.12.6.2.3. Salinity

The hydrodynamic model showed salinity at the seabed (highest concentration in the water column) not to exceed the maximum allowable increase within the RMZ. The study area is already impacted from existing outfalls and the use of a diffuser outfall will not require further mitigation, but monitoring is suggested to ensure no exceedances or residual impacts occur.

7.4.2.12.6.3. Monitoring Requirements

The following monitoring measures should be implemented by the operator during the operational phase to ensure any impacts to marine ecology are minimised and mitigated as far as possible:

- The permanent seagrass transects, and coral quadrats should be monitored seasonally (twice per year – winter and summer). This will allow the recovery post construction to be monitored; and
- Monitoring of artificial habitats established as part of mitigation along the pipeline corridors should be sampled seasonally with transects to monitor the recruitment of benthic invertebrates especially corals.

7.4.2.12.7. Marine Water & Sediment

7.4.2.12.7.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the OESMP to control impacts upon Marine Water & Sediment.

7.4.2.12.7.2. Permits

Prior to the operational phase, the operator will be required to obtain additional permits, in addition to the relevant Environmental Authority NOC, which would include, but not be limited to:

- Discharge of effluent into the marine water environment.

7.4.2.12.7.3. Environmental Control Measures

7.4.2.12.7.3.1. Thermal discharge

The hydrodynamic study showed no exceedance (>3°C to ambient temperature) in the RMZ on the seabed. The area is already impacted from existing outfalls indicating the proposed outfall will have a very limited effect due to the use of a diffusor outfall. A minor risk of re-circulation was however identified due to influence from the existing Fujairah 1 and Fujairah 2 IPP and the Fujairah 3 intake location. It is therefore proposed that the Fujairah 3 intake be moved further offshore, and monitoring be conducted to determine the optimal height of the intake structure. Note however that this is proposed from an operational perspective and not as a results of environmental requirements (which are fully met).

7.4.2.12.7.3.2. Chlorine discharge

The hydrodynamic study showed no exceedance of residual chlorine (>0.01mg/l) in the RMZ on the surface water. The area is already impacted from existing outfalls indicating the proposed outfall will have very limited effect due to the use of a diffusor outfall. No further mitigation of the continuous dosing concentration or method is proposed; however, the shock dosing concentration of 2 mg/l should be limited to no more than 10 minutes per 24 hour period. In addition, monitoring should be undertaken to ensure no exceedances or residual impacts occur. Should exceedances be experienced then mitigation such as the use of alternative materials as a biocide e.g. chlorine dioxide (ClO2) could be investigated.

7.4.2.12.7.3.3. Salinity

The hydrodynamic model showed salinity at the seabed (highest concentration in the water column) not to exceed the maximum allowable increase within the RMZ. The study area is already impacted from existing outfalls and the use of a diffuser outfall will not require further mitigation, but monitoring is suggested to ensure no exceedances or residual impacts occur during the operational phase

7.4.2.12.7.4. Monitoring Requirements

The following monitoring measures should be implemented by the operator during the operational phase to ensure any impacts to marine water and sediment quality are minimised and mitigated as far as possible:

- Marine water and sediment quality sampling should be continued at the same four locations mentioned in **Section 7.4.1.12.7.3**. Monitoring should be conducted quarterly to ensure water and sediment quality parameters and contaminants do not reach levels in exceedance of regulatory guidelines; and
- Continuous monitoring should be undertaken of discharge water to ensure chemical parameters, salinity and temperature remain within the allowable discharge limits.

7.4.2.12.8. Waste

7.4.2.12.8.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the OESMP to control impacts upon waste management.

7.4.2.12.8.2. Environmental Control Measures

The Operator will be required to develop an OESMP, which will include sustainable waste management practices commensurate with the activities which will be undertaken as part of this major industrial development. This will include the following as a minimum:

- Ensuring compliance with national and international best practice guidance;
- Encouraging opportunities to minimise waste, based upon the principle of the hierarchy of waste prevention and reduction through to reuse, recovery (energy and materials) and disposal via landfill as a final option;
- Providing suitable waste facilities, including the segregation of waste streams for recycling and general waste for disposal to landfill;
- Ensuring good on-site storage practices, including appropriately covered waste storage areas and dedicated hazardous waste storage facilities;
- Appointing dedicated personnel responsible for waste management issues;
- A clear process for the monitoring and recording waste, including a schedule of monitoring and periodic audits to inform the OESMP process;
- The financial resources necessary to implement and operate a suitable waste management system shall be specified, as well as those people responsible for making those resources available; and

Capacity building and training needs shall be identified to ensure that waste can be properly managed and controlled.

7.4.2.12.8.3. Monitoring Requirements

The following monitoring and auditing measures should also be implemented throughout the operation phase by the Operator to ensure that any potential impacts relating to waste generated by the Project are minimised and mitigated as far as possible:

- Records of raw material wastage;
- Quantitative records for the generation of each waste stream;
- Methods by which the waste streams are being handled and stored;
- Quantifying the wastes diverted from landfill, with records for each treatment method;
- Monthly collation of waste consignment data and receipt at waste treatment/disposal facilities;
- Review of all waste permits;
- Records of any waste complaints or incidents; and

Review of effectiveness of waste management programme procedures and update as necessary.

7.4.2.12.9. Socio-Economy

7.4.2.12.9.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the OESMP to control impacts upon socio-economic.

7.4.2.12.9.2. Environmental Control Measures

An OESMP will be developed by the operator to manage the construction activities in such a way as to minimise construction impacts.

7.4.2.12.9.2.1. Air Quality Impacts

Section 7.4.2.12.2: Ambient Air Quality sets out a series of measures which will be implemented during the operations phase to ensure that the generation of dust and emissions is minimised as far as possible.

7.4.2.12.9.2.2. Noise Impacts

Section 7.4.2.12.3: Ambient Noise sets out a series of controls to reduce the noise impacts during operation which will reduce the impacts of noise during operation.

7.4.2.12.9.2.3. Impacts on Local Businesses and Social Issues

Impact on Local Businesses

As the impacts are considered to be positive there is no requirement for any mitigation measures to be implemented.

Impact on Local Services

As the impacts are considered to be negligible there is no requirement for any mitigation measures to be implemented.

Health and Safety

Operational Worker Welfare

- To provide the employees with a safe and risk free environment, it is recommended that a comprehensive EHS plan is developed and implemented. This framework, in line with Performance Standard 2, will address measures for accident prevention, identification, mitigation and management of hazards (including physical, chemical, and radiological hazards), training of workers and reporting of accidents and incidents;
- An appropriate emergency procedure will be developed and implemented in the case of a hydrogen leak from the generators in the Project area. This emergency procedure will include the following mitigation measures and will be developed in accordance with Consortium Marubeni Corporation and Samsung C&T existing procedures within the site:
  - The employees will be informed on the serious risks of poisoning, fire and explosion hazards, especially on accidental exposure conditions, and on the measures to be taken in case of an accident. Special Procedures in the event of an accident will be subject to training exercises
  - Use of gas detectors which will warn the employees when alert thresholds are reached. These devices will be periodically checked using standard gases. Recalibration of sensors may be necessary depending on the test results;
  - Location of windsocks in highly visible areas to provide staff with an indication of wind direction and therefore escape routes; and
  - In case of leakage, every worker must have access to a mask breathing apparatus in his immediate vicinity.
- Occupational noise standards need to be maintained as part of the Health and Safety of the employees at the facility. It is therefore important that noise levels in working areas are limited to less than 85 dB(A) at 1m from any noise generating equipment. It is further recommended that a full occupational noise survey is undertaken in the interests of the health and safety of the site employees;
- In accordance with Performance Standard 2, the Project should develop and implement a human resource policy outlining the management approach towards working conditions, entitlement to wages and any benefits and terms of employment. This policy must be disseminated and accessible for all employees, clearly defining the employees' legal rights and the management's statement on child labour, forced labour and on non-discrimination and equal opportunities. This policy will also provide the mechanism through which employees can express and register their concerns and the system through which these grievances will be addressed;
- Expatriate staff must be provided with an induction course (as part of their training), which will highlight local customs, cultures and living conditions in the UAE. The objective of this course will be to familiarise the expatriate staff with knowledge of their host country and provide an understanding and respect for other cultures. The aim will be to reduce, prevent and mitigate against social and cultural tensions and potential hostility between workers and the residents of surrounding communities;
- The provision of facilities for workers, such as kitchen facilities, dining areas, washrooms, and a mosque, will minimise the placing of undue pressure on existing local services;
- Where feasible, staff will be of local origin where suitably qualified applicants are available. This will ensure a degree of balance between the use of expatriate workers and locally employed personnel during the operational phase, and limit the impact on the local economy;

- In common with Performance Standard 4, all components of and infrastructure associated with the Project will be operated in accordance with industry best practice by qualified staff; and
- In line with IFC Performance Standard 1, it is also recommended that a grievance mechanism is established for local residents, giving them a platform to raise any concerns.

7.4.2.12.9.3. Monitoring Requirements

The following monitoring and auditing measures should also be implemented throughout the operation phase by the Operator to ensure that any potential impacts relating to waste generated by the Project are minimised and mitigated as far as possible:

- In line with Performance Standard 1 (Section 23), a grievance procedure needs to be established for local residents to ensure that any issues are resolved to the satisfaction of all parties.

7.4.2.12.10. Archaeology and Cultural Heritage

7.4.2.12.10.1. Introduction

This section provides a framework for key control measures which will be implemented as part of the OESMP to control impacts upon archaeology and cultural heritage.

7.4.2.12.10.2. Environmental Control Measures

No mitigation measures are required during the operation phase of the Project.

7.4.2.12.10.3. Monitoring Requirements

No monitoring is proposed as necessary during the operational phase of the Project.

7.4.2.12.11. Decommissioning and Abandonment

The operational phase of the Project is expected to last approximately 25 years. Due to this, no decommissioning or abandonment procedures are considered to be currently required. However, in the event of the Project lasting significantly shorter than the expected 25-year life expectancy, the Operator will be required to create and implement suitable decommissioning and abandonment procedures.

7.4.2.12.12. Emergency Procedures

7.4.2.12.12.1. Overview

It is the nature of major incidents that they are unpredictable, and each will present a unique set of challenges. In formulating a major incident plan, the task is to have a set of expertise available and to have developed a set of core processes to handle the uncertainty and unpredictability of whatever happens. Co-operation between local regulatory bodies is a necessity and must be addressed when formulating the plan.

Table 7-25 below provides an overview of the possible environmental incidents that could be associated with the Project.

Table 7-25: Potential environmental incidents

Potential environmental incidents			
1.	Oils / fuel spills	2.	Chemical Spill or Leak
3.	Fires & Explosions	4.	Uncontrolled release of effluents

7.4.2.12.12.2. Responsibilities

The Operator will develop and maintain a Site Emergency Response Plan.

The Operator's QHSE Manager is responsible for ensuring that local authorities, including Civil Defence and relevant Competent Environmental Authority, are contacted in the event of a major incident. Upon notification of an incident, all response procedures should be implemented in accordance with this procedure and as directed by relevant Competent Environmental Authority.

The QHSE Manager is responsible for ensuring the incident response for minor incidents are implemented and that the Incident Response Form is completed, and Corrective Action Plan prepared, signed off and implemented.

In the event of an incident of medium, severity, the QHSE Manager is responsible for ensuring that the incident responses are implemented, and the Incident Response Form is completed, and Corrective Action Plan prepared, signed off and implemented.

It is the responsibility of all site personnel to notify the QHSE Manager of all incidents.

7.4.2.12.12.2.1. Emergency Management Plan

Incident Classification

The incidents should be classified and categorised using the definitions in the Table 7-26 below.

Table 7-26: Categorisation of Environmental Incidents

Tier	Definition	Example	Responsibility
Tier A	Minor Incident One that is easily brought under control and prevented from re-occurring	Small, containable spills within the site boundary. Minor nuisance but controllable and preventable from reoccurrence. Minimal environmental damage but controllable and preventable from re-occurrence.	Following the incident response, the Safety officer will be responsible for notifying the Project proponent.
Tier B	Medium Incident One that will need to be brought under control and prevented from reoccurrences in consultation with the HSE Manager	Un-containable or uncontrollable spills within site boundary Excessive uncontrollable incidents which are likely to cause nuisance or when a complaint is received	Following the incident response, the Safety officer will be responsible for notifying the Project proponent.

Tier	Definition	Example	Responsibility
		Un-rectifiable environmental damage and likely to occur	
Tier C	Major Incident One which cannot be controlled by the Project or that effects local authorities or independent parties	Un-containable or uncontrollable spills outside the site boundary or which affect local authorities Massive loss of biodiversity at the site which will re-occur to cause impacts to biodiversity.	Following the incident response, the Safety officer will be responsible for notifying the Project proponent and statutory authorities.

General Incident Response

Figure 7-5 below provides an overview of the procedures to be implemented with each category of incident.

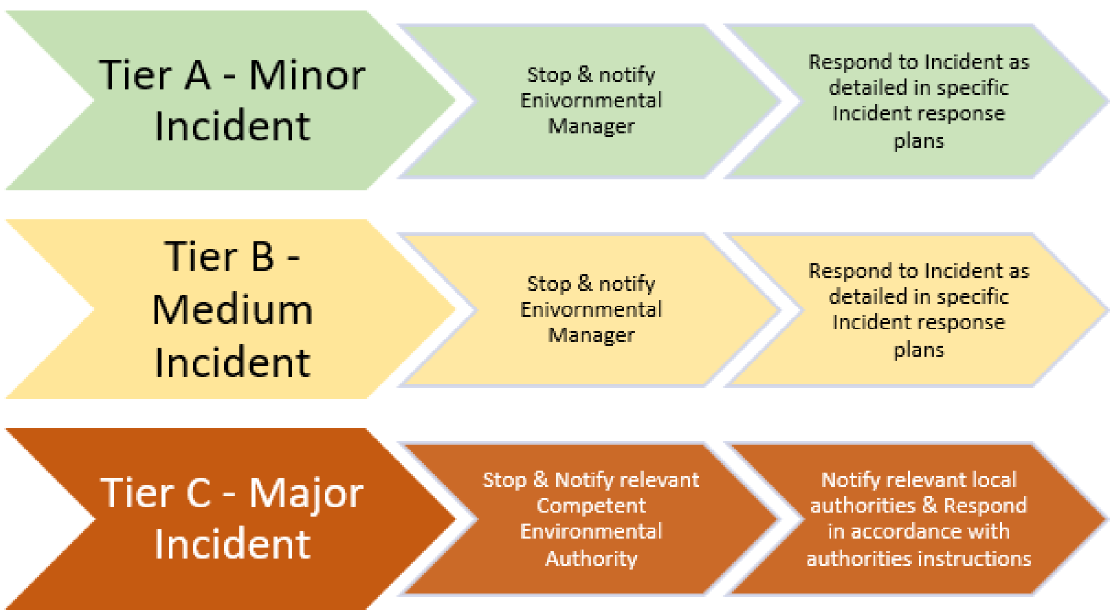

Figure 7-5: General Incident Procedure

Specific Incident Response

Major incidents must be dealt with in accordance with the relevant Competent Environmental Authority requirements, while responses to minor incidents will be under the responsibility of the QHSE Manager. To determine these requirements for major incidents the authority must be notified immediately, and their requirements implemented.

The incident response procedure is presented in detail in Table 7-27 to Table 7-30.

7.4.2.12.12.2.2. Oil and Fuel Spill

Table 7-27: Incident Response Procedure - Oil and Fuel Spill

INITIAL RESPONSE	Wear protective clothing Prevent further release at source Remove sources of ignition Prevent access to the site
ANALYSIS & NOTIFICATION	Categorise Incident and notify responsible part Tier A: Refer to Notification Process Tier B: Refer to Notification Process Tier C: Refer to Emergency contacts
REMEDIATION & RECOVERY	Implement measures described within the relevant Material Safety Data Sheet (MSDS) Use absorbent materials for clean-up, e.g.: sand or pads to absorb excessive materials and dispose of within plastic bucket so not to transfer spill Do not rinse away spills If spills migrate, create temporary bunds using soil, sandbags or spill kit materials Any contaminated materials will be considered as Hazardous Waste

7.4.2.12.12.2.3. Chemical Spill or Leak

Table 7-28: Incident Response Procedure - Chemical Spill or Leak

INITIAL RESPONSE	Wear protective clothing Identify the source Prevent further release at source Prevent access to the site Wear protective clothing Prevent further release at source Remove sources of ignition Prevent access to the site
ANALYSIS & NOTIFICATION	Categorise Incident and notify responsible part Tier A: Refer to Notification Process Tier B: Refer to Notification Process Tier C: Refer to Emergency contacts
REMEDIATION & RECOVERY	Implement measures described within the relevant Material Safety Data Sheet (MSDS) Use absorbent materials for clean-up, e.g.: sand or pads to absorb excessive materials and dispose of within plastic bucket so not to transfer spill Do not rinse away spills If spills migrate, create temporary bunds using soil, sandbags or spill kit materials Any contaminated materials will be considered as Hazardous Waste and should be appropriately treated as Hazardous Waste If drains are located nearby, install drain seals

7.4.2.12.12.2.4. Fires & Explosions

Table 7-29: Incident Response Procedure - Fires & Explosions

INITIAL RESPONSE	Ensure personal safety; and Rescue and evacuate all personnel & visitors from the affected area
ANALYSIS & NOTIFICATION	Categorise Incident and notify responsible part Tier A: Refer to Notification Process Tier B: Refer to Notification Process Tier C: Refer to Emergency contacts
REMEDIATION & RECOVERY	Close all doors to the hazard or fire area; Extinguish using the closest fire extinguisher if the fire impedes your evacuation; and Evacuate to the designated meeting location

7.4.2.12.12.2.5. Uncontrolled release of effluents

Table 7-30: Incident Response Procedure – Uncontrolled release of Effluents

INITIAL RESPONSE	Identify the source Assess the situation and associated areas affected Make a judgement of what can be done, if anything, to stop or minimise release
ANALYSIS & NOTIFICATION	Categorise Incident and notify responsible part Tier A: Refer to Notification Process Tier B: Refer to Notification Process Tier C: Refer to Emergency contacts
REMEDIATION & RECOVERY	Implement measures described within the relevant Material Safety Data Sheet (MSDS) Use absorbent materials for clean-up, e.g.: sand or pads to absorb excessive materials and dispose of within plastic bucket so not to transfer spill Do not rinse away spills If spills migrate, create temporary bunds using soil, sandbags or spill kit materials Any contaminated materials will be considered as Hazardous Waste

Environmental Incident Record

In the event of Tier, A, B or C environmental incident, a Non-Conformance Recording Form will be completed. The Environmental Incident Form includes details on the following:

- Details of the witness responsible for reporting the incident;
- Date of the incident;
- Condition on site during the incident;
- Description of location of the incident;
- Cause of the incident;
- Scale of the incident;
- Potential impacts of the incident;
- Confirmation environmental control measures have been implemented;
- Describe non-compliance with reference to the CESMP;

- Proposed corrective actions to correct the incident and prevent re-occurrence;
- Person responsible for corrective action;
- Date the corrective action is to be completed; and
- Signature upon completion.

This information will be provided to the relevant Competent Environmental Authority within 48-hours of the incident occurring.

Security Plan

The Operator will implement the following measures to ensure that the site is secured:

- Security barrier at site entrance;
- Security guards employed 24 hours per day;
- Identification cards for employees and subcontractors; and
- Visitor's pass system.

All visitors must report to security at the gate to the site office and will be required to supply the following details:

- Date and time of arrival;
- Vehicle registration;
- Company and contact details;
- Reason for visiting the site and site contact; and
- Time of departure.

7.4.2.13. Project Specific Commitments

Table 7-31 overleaf sets out the Project specific commitments which will be implemented, based upon the conclusions of this ESIA to minimise environmental impacts. This sets out a clear list of requirements together with responsibilities for implementation.

Table 7-31: Project Specific Commitments

No.	Project Stage	Commitment	Responsible Party
1.	Detailed Engineering Design	Implement design measures to prevent dust impacts from stockpiles at construction site	EPC
2.		Design of noise mitigation measures, including design of noise barriers and emissions stack	EPC
3.		Appropriate design of waste management and hazardous materials storage areas	EPC
4.		Hydrological marine modelling to inform appropriate design of discharges and outflows	EPC
5.	Pre-Construction	Obtain required permits from all Authorities prior to commencement of construction activities	EPC
6.		Asbestos surveys of existing buildings prior to demolition	EPC
7.		Development of a Construction Environmental and Social Management Plan which will include the following Environmental Control Plans: – Ambient Air Quality; – Ambient Noise; – Soil, Surface Water and Groundwater; – Terrestrial Ecology; – Marine Ecology; – Marines Water & Sediment; – Site Waste Management Plan; – Archaeology and Cultural Heritage; – Health and Safety; and – Emergency Procedures. Submission of CESMP to relevant Authority for approval prior to the commencement of construction	EPC
8.	Construction	Implementation of all measures as set out within the approved CESMP	EPC
9.		Environmental monitoring which will include: – Daily inspections; – Weekly inspections; – Asbestos airborne fibre monitoring where asbestos is being removed from existing buildings prior to demolition; – Monitoring of dewatering effluent discharges; – Monitoring of discharges to the marine environment;	EPC

No.	Project Stage	Commitment	Responsible Party
		– Monitoring of all waste streams, including records of types and volumes of wastes produced, transported and sent for treatment/disposal; – Visual inspections of hazardous waste management storage areas – Site accident register; and – Community complaints register	
10.		Undertake appropriate decommissioning of construction facilities and restoration of areas to former condition	EPC
11.	Operation	Development of an Operational Environmental and Social Management Plan, which will include the following Environmental Control Plans: – Ambient Air Quality; – Ambient Noise; – Soil, Surface Water and Groundwater; – Terrestrial Ecology; – Marine Ecology; – Marines Water & Sediment; – Site Waste Management Plan; – Archaeology and Cultural Heritage; – Community Relations; – Health and Safety; and – Emergency Procedures	Operator
12.		Operational monitoring, which shall include: – Ongoing monitoring of stack emissions during operation; – Ambient air quality monitoring for first year at ground level to ensure ongoing compliance; – Monitoring of discharges to the marine environment; – Noise monitoring will be undertaken during commissioning, annually during operation and additionally in the event of noise complaints leading to noise abatement measures; – Chemicals and Hazardous Materials Visual Inspections; – Chemicals and Hazardous Materials Inventory; – Waste generation and disposal; – Hazardous Waste generation, storage and disposal; – Worker Welfare; and – Community Complaints	Operator
13.	Decommissioning	Develop Decommissioning Environmental Management Plan in future where relevant	Operator

8. ALTERNATIVES

8.1. Overview

The chapter presents an overview of the potential alternatives which could be considered with respect to the Project.

8.2. No-Development Option

The Project is planned to act as a complement to both existing and future renewable energy generation in the UAE.

One of the main challenges of renewable energy is that electricity demand does not always coincide with the production of energy. For example, during summer time in the UAE, the peak load hours of electricity are from 12pm to 6pm (1). While the peak load hours seem to match with the sunlight hours, the production of energy will not be always sufficient to respond to the energy demand. In addition, during the night-time or days where there is insufficient sun, the solar facility will not be able to generate energy.

Therefore, the Project will be required to cope with the ramping up and down of solar photovoltaic generation during sunrise and sunset. During winter nights, efficient gas plants, including the Project, will compensate for the lack of solar photovoltaic generation, while in the summer such efficient gas plants will satisfy night-time demand which is primarily driven by air conditioning.

Therefore, the Project, along with other thermal plants, will therefore support the following UAE Plans and Strategies:

- **Ministry of Energy Strategic Plan 2017 – 2021:** The Strategic Plan focus on organising and developing general policies and legislations under the consultation of the stakeholders involved in order to fit the energy sector as per the international standards and following up its implementation. Three of the five strategic goals comprise sustainability targets as follows:
  - Achieving security and sustainability of the energy sector, water and mining;
  - Regulation of the energy, water and mining sector, and buried gases emission to support economic development; and
  - Sustainable development and integrated management of water resources.
- **UAE Energy Strategy 2050:** the UAE has set direct targets to reduce carbon emission and increase the use of clean energy such as wind power, solar power, hydropower etc. With the reduction of fossil fuels, use of cleaner fossil fuels such as clean coal and gas and the increase of clean energy, the UAE Energy Strategy targets re reduce 70% carbon emission from the power generating process.

8.3. Alternative Location Option

The Project will be located adjacent to the existing F1 IWPP and F2 IWPP plants and is located on a site that was previously developed as a power and water plant by the Federal Electricity and Water Authority (FEWA).

Building the power plant in this location will allow the plant to share some of the existing facilities including gas pipelines, transmission lines, back-up fuel storage and loading facilities, roads and other site infrastructure. This will reduce costs, increase efficiencies and reduce the overall impacts associated with the development of the Project

Given the industrial nature of the adjacent facilities and historical use of the proposed site, the selected site is considered appropriate for the development of the Project.

8.4. Alternative Technology Options

As discussed in **Section 8.2: No-Development Option** above, the Project is required to meet the UAE Plans and Strategies for future power generation through:

Complementing existing and planned renewable energy generation, which does not provide consistent generation or does not coincide with peak demand;

Enduring that complementary conventional power generation is as clean and efficient as possible, which is one of the key elements of the Project, whereby combined cycle gas generation is generally less polluting and more carbon efficient than other means of conventional energy generation; and

Demonstrated cost efficiencies.

In addition to the above, the Project has adopted best practice environmental control measures to further reduce impacts upon the immediate surrounding areas and local communities, which includes:

- The adoption of Selective Catalytic Reduction (SCR) which can reduce emissions of nitrogen oxides in the range of 80 to 95%;
- The installation of Continuous Emissions Monitoring Systems (CEMS) to ensure that emissions to air are known at all times and any issues rectified immediately;
- Use of gas as the primary fuel which is a lower carbon containing fuel per unit of calorific value; and
- Higher energy conversion efficiency technology to ensure lower CO_2 emissions;
- Appropriate design of seawater outfall pipelines, which extend approximately 1.4km offshore, with diffuser sections which will be staggered to distribute the cooling water across the main direction of ambient flow to ensure that the mixing zone is minimised as far as practicable;
- Monitoring of effluent discharges during operation to ensure that ambient marine water quality is not adversely affected as a result of operation.

9. MONITORING PROGRAM

9.1. Monitoring Program for Compliance of Mitigation Measures

9.1.1. Ambient Air Quality

9.1.1.1. Construction Phase

Monitor and supervise the EPC contractor during construction to verify that dust control measures are being implemented in-line with the Project's requirements. In addition, it is recommended that fugitive dust is monitored through daily visual assessment, with further mitigation measures implemented in case of dust episodes, or visible impacts to nearby communities. In particular, damping and screening should be considered during activities such as earthworks for which dust raising may be high. Site constraints, such as water availability for spraying, should be considered prior to selecting mitigation measures. Finally, with regard to emissions linked to road traffic, delivery vehicles will be the object of regular maintenance and will be inspected by the company responsible for supplies.

9.1.1.2. Operational Phase

Mitigation measures to minimise emissions of NO_x , SO_2, CO and PM to air are included within the Project design. In addition, ambient air quality monitoring and emissions monitoring will be undertaken, as described below (in accordance with the IFC general EHS Guidelines for Thermal Plants). These monitoring requirements include:

- In stack continuous monitoring for NOx:
  - To further ensure conformity with the Project standards, a Continuous Emission Monitoring System (CEMS) will be included in the power plant. This will provide continuous assessment of the stack emissions to verify if the NOx concentration (measured as NO_2) meet the project commitment not to exceed 20 mg/Nm3 at 15% O_2 at the HRSG stacks. Appropriate maintenance and/or operating changes will be implemented, if necessary, to maintain design parameters.
- Ambient air quality monitoring including:
  - Implement an air quality monitoring programme for the first year of the F3 operations phase that measures the actual ground level concentrations of NO2. The survey should include the placement of diffusion tubes at the sensitive receptor locations assessed in the survey (to be established in consultation with the local regulators).
  - Individual tubes should be in place for no more than one month in duration and a minimum of 6 months of data should be collected.

9.1.2. Ambient Noise

9.1.2.1. Construction Phase

Due to the proximity of the Project to nearby residences, day and night time noise monitoring is considered necessary throughout the duration of the construction phase. EPC contractor to develop construction noise monitoring plan in accordance with the IFC general EHS guidelines and in consultation with the Fujairah Municipality.

9.1.2.2. Operational Phase

It is recommended that noise monitoring be undertaken at site boundaries and sensitive environmental receptors throughout the project lifetime for the purposes of verifying operational phase noise levels. Monitoring requirements should comply with IFC general EHS guidelines which recommend the following (71):

- Noise monitoring programs should be designed and conducted by trained specialists;
- Typical monitoring periods should be sufficient for statistical analysis and may last 48 hours with the use of noise monitors that should be capable of logging data continuously over this time period, or hourly, or more frequently, as appropriate; and,
- Monitors should be located approximately 1.5m above the ground and no closer than 3m to any reflecting surface.

In general, the noise level limit is represented by the background or ambient noise levels that would be present in the absence of the facility or noise sources under investigation.

9.1.3. Soil, Surface Water and Groundwater

9.1.3.1. Construction Phase

No further soil and groundwater monitoring is expected. However, it is required that during construction, the construction contractor will be required to develop a comprehensive CESMP, with all measures fully implemented and audited. This will ensure that both are being effectively and appropriately implemented.

9.1.3.2. Operational Phase

No cumulative impacts are anticipated once the Project becomes operational and so monitoring is not considered necessary.

9.1.4. Terrestrial Ecology

Due to the fact that the area will be completely transformed, and no natural ecosystems or flora and fauna species will remain, no monitoring of terrestrial ecosystems is possible or required.

9.1.5. Marine Water & Sediment

9.1.5.1. Construction phase

The following monitoring measures should be implemented by the contractor during the construction phase to ensure any impacts to marine water and sediment quality are minimised and mitigated as far as possible:

- Water quality monitoring (both In Situ and Ex Situ) should be undertaken at four locations, one at the outfall area, one north, one south and lastly inland between outfall and shoreline. Water quality monitoring should commence before construction starts and be conducted bi-monthly (every 2-months) until marine construction activities have ceased;
- Sediment quality monitoring should be conducted bi-monthly at four sites concomitant with the water quality sampling to ensure mitigation measures are preventing any exceedances in contaminants or parameters; and

- TSS monitoring on the outside of the silt curtains should be conducted daily during active digging / dredging activities to ensure adequate mitigation is in place and the sediment plume is being contained. Should levels reach exceedances of values shown in Table 6-54, then additional mitigation measures would need to be implemented.

9.1.5.2. Operational phase

The following monitoring measures should be implemented by the operator during the operational phase to ensure any impacts to marine water and sediment quality are minimised and mitigated as far as possible:

- Marine water and sediment quality sampling should be continued at the same four locations mentioned in **Section 9.1.5.1**. Monitoring should be conducted quarterly to ensure water and sediment quality parameters and contaminants do not reach levels in exceedance of regulatory guidelines.

9.1.6. Marine Ecology

9.1.6.1. Construction phase

The following monitoring measures should be implemented by the contractor during the construction phase to ensure any impacts to marine ecology are minimised and mitigated as far as possible:

- Permanent seagrass transects should be established in the vicinity but not directly within the footprint of the pipeline corridors and changes over time recorded. 4 permanent (50m) transects one either side of each pipeline (north and south) in suitable areas containing seagrass habitats, between 5-10m depth, should be established and marked. These transects should be monitored quarterly to asses impacts during the construction phase; and
- Permanent coral quadrats should be established in suitable habitat in the vicinity of the pipeline corridors. 10 permanent quadrats at two sites should be monitored quarterly to assess impacts to coral species during the construction phase.

9.1.6.2. Operational phase

The following monitoring measures should be implemented by the operator during the operational phase to ensure any impacts to marine ecology are minimised and mitigated as far as possible:

- The permanent seagrass transects and coral quadrats should be monitored seasonally (twice per year – winter and summer). This will allow the recovery post construction to be monitored; and
- Monitoring of artificial habitats established as part of mitigation along the pipeline corridors should be sampled seasonally with transects to monitor the recruitment of benthic invertebrates especially corals.

9.1.7. Waste

9.1.7.1. Construction Phase

The following monitoring and auditing measures should be implemented throughout the construction phase by the EPC Contractor to ensure that any potential impacts relating to waste generated by the Project are minimised and mitigated as far as possible:

- Records of raw material wastage;
- Quantitative records for the generation of each waste stream;
- Methods by which the waste streams are being handled and stored;
- Quantifying the wastes diverted from landfill, with records for each treatment method;
- Monthly collation of waste consignment data and receipt at waste treatment/disposal facilities;
- Review of all waste permits;
- Records of any waste complaints or incidents; and
- Review of effectiveness of waste management programme procedures and update as necessary.

9.1.7.2. Operation Phase

The following monitoring and auditing measures should also be implemented throughout the operation phase by the Operator to ensure that any potential impacts relating to waste generated by the Project are minimised and mitigated as far as possible:

- Records of raw material wastage;
- Quantitative records for the generation of each waste stream;
- Methods by which the waste streams are being handled and stored;
- Quantifying the wastes diverted from landfill, with records for each treatment method;
- Monthly collation of waste consignment data and receipt at waste treatment/disposal facilities;
- Review of all waste permits;
- Records of any waste complaints or incidents; and
- Review of effectiveness of waste management programme procedures and update as necessary.

9.1.8. Socio-Economy

The following monitoring measures should be implemented throughout the construction phase by the EPC contractor to ensure that any potential impacts relating to waste generated by the Project are minimised and mitigated as far as possible:

- Grievance mechanism for workers will involve the identification of a local environmental co-ordinator, identified by the contractor within the management structure, to identify and log all concerns; and
- A grievance procedure needs to be established for local residents to ensure that any issues are resolved to the satisfaction of all parties.

Both procedures must be in line with Performance Standard 1 (Section 23).

9.1.9. Archaeology and Cultural Heritage

9.1.9.1. Construction Phase

No monitoring is proposed as necessary during the construction phase of the Project. In the event of archaeological finds being discovered on site, FTAA will be notified, and a removal and monitoring plan will be implemented and adopted until safely removed from the Project site.

9.1.9.2. Operation Phase

No monitoring is proposed as necessary during the operational phase of the Project.

9.2. Monitoring Program for Residual Impacts

9.2.1. Ambient Air Quality

No additional monitoring is deemed necessary in terms of residual impacts.

9.2.2. Ambient Noise

9.2.2.1. Construction Phase

Due to the transient nature of construction noise, it is advised that 'best practice' measures be implemented in respect of noise control, wherever possible. A variety of possible noise management measures have been suggested, which if implemented effectively, could lead to reduction in impacts for the off-site receptors which are affected by construction noise and therefore should be implemented through HSE management plans (Noise Control Plan during Construction).

9.2.2.2. Operational Phase

There are expected to be no residual impacts associated with noise generated by the operational facility in terms of exceedances of the applicable boundary noise limits.

9.2.3. Soil, Surface Water and Groundwater

9.2.3.1. Construction Phase

No monitoring for residual impacts is considered necessary during the construction phase of the Project.

9.2.3.2. Operational Phase

No monitoring for residual impacts is considered necessary once the Project becomes operational.

9.2.4. Terrestrial Ecology

9.2.4.1. Construction Phase

No monitoring for residual impacts is considered necessary during the construction phase of the Project due to the lack of terrestrial ecology present within the Project site.

9.2.4.2. Operational Phase

No monitoring for residual impacts is considered necessary once the Project becomes operational due to the lack of ecology within the Project site.

9.2.5. Marine Water & Sediment

9.2.5.1. Construction phase

The monitoring program outlined in **Section 9.1.5.1** will be sufficient to detect any residual impacts during construction and no further monitoring is required.

9.2.5.2. Operational phase

The monitoring program outlined in **Section 9.1.5.2** will be able assess any residual effects from operational activities particularly related to the outfall and build-up of any residual effects. No additional monitoring is required.

9.2.6. Marine Ecology

9.2.6.1. Construction phase

The monitoring program outlined in **Section 9.1.6.1** will be able to determine any residual effects from construction to the marine ecology and no further monitoring is required.

9.2.6.2. Operational phase

The monitoring measures proposed in **Section 9.1.6.2** will be able to monitor the residual impacts both positive and negative during the operational phase of this Project.