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Date: 06th January 2022

Engineer Mariam Mohammed Al Ansari
Head of Environmental Licencing Section
Supreme Council for Environment
Kingdom of Bahrain

Subject: **Aluminium Bahrain B.S.C: Power Station 5 Block 4 Expansion Project –Environmental and Social Impact Assessment (EIA) Report, Construction Environmental and Social Management Plan (CESMP) and Operational Environmental and Social Management Plan (OESMP)**

Dear Madam,

Further to the Notification (Ref. # EL-1917-20) dated 29th September 2020, Aluminium Bahrain B.S.C appointed Envirotech Consultancy W.L.L to prepare an Environmental and Social Impact Assessment Report, Construction Environmental and Social Management Plan and Operational Environmental and Social Management Plan for the proposed Power Station 5 Block 4 Expansion Project. We are pleased to submit the ESIA Report, CESMP and OESMP for your evaluation and comments.

Please find enclosed soft copy of the reports for your evaluation and comments.

Thank you,

Yours faithfully

Rajith Chandran
Managing Director

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CC:

1. Envirotech Consultancy W.L.L.
2. Aluminium Bahrain B.S.C.

ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT STUDY

PROJECT : ALBA POWER STATION 5 – BLOCK 4

CLIENT : ALUMINIUM BAHRAIN B.S.C

Prepared By:

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Table of Contents

List of Figures

List of Tables

ABBREVIATIONS

ACC	Air Cooled Condenser
ACGIH	American Conference of Governmental Industrial Hygienists
Alba	Aluminium Bahrain B.S.C
ARM	Ambient Ratio Method
BAT	Best Available Technique
BATNEEC	Best Available Technique Not Entailing Excessive Cost
BEGL	Below Existing Ground Level
BH	Borehole
DACH	Directorate of Archaeology and Cultural Heritage
CCGT	Combined Cycle Gas Turbine
CCP	Combined Cycle Power Plant
CESMP	Construction Environmental and Social Management Plan
CO	Carbon Monoxide
CPR	Cardiopulmonary Resuscitation
EC	Electrical Conductivity
ECP	Environmental Compensation Plan
EEC	European Economic Community
EIA	Environmental Impact Assessment
EMF	Electro-Magnetic Field
EMMP	Environmental Management & Monitoring Plan
EMP	Environmental Management Plan
EN	European Standards / European Norm
Envirotech	Envirotech Consultancy W.L.L.
EPC	Engineering, Procurement and Commissioning
ERP	Emergency Response Plan
ESIA	Environmental and Social Impact Assessment
ESR	Environmental Scoping Report
EU	European Union
EWA	Electricity and Water Authority

ESP	Electrostatic Precipitator
FGD	Flue Gas Desulphurization
GHG	Green House Gas
GIS	Geographical Information System
GL	Ground Level
GT	Gas Turbine
HF	Hydrogen Fluoride
HRSG	Heat Recovery Steam Generator
HSE	Health, Safety & Environment
ICNIRP	International Commission on Non-Ionizing Radiation Protection
ICSC	International Chemical Safety Cards
IEEE	Institute of Electrical and Electronics Engineers
IFC	International Finance Corporation
ISO	International Organization for Standardization
JAC	J-Air-Cooled
LEL	Lower Explosive Limit
LNTP	Limited Notice to Proceed
mmscfd	million standard cubic feet per day
MPW	Mitsubishi Power Ltd.
MSDS	Material Safety Data Sheet
MW	Mega Watts
NML	Noise Monitoring Location
NO_2	Nitrogen Dioxide
NOx	Oxides of Nitrogen
NSD	National Survey Datum
OEM	Original Equipment Manufacturer
OESMP	Operational Environmental and Social Management Plan
PM_{10}	Particulate Matter Less than 10 Microns
$PM_{2.5}$	Particulate Matter Less than 2.5 Microns
PPE	Personal Protective Equipment

PS	Power Station
RA	Risk Assessment
RH	Relative Humidity
RLNG	Regasified Liquefied Natural Gas
SCBA	Self-Contained Breathing Apparatus
SCE	Supreme Council for Environment
SCR	Selective Catalytic Reduction
SEPCO III	SEPCO III Electric Power Construction Co. Ltd.
SNCR	Selective Non-Catalytic Reduction
SO_2	Sulphur Dioxide
ST	Steam Turbine
TBC	To Be Confirmed
TLV	Threshold Limit Value
TWA	Time Weighted Averages
USEPA	United States Environmental Protection Agency
UTM	Universal Traverse Mercator
WDR	Waste Disposal Request
WHO	World Health Organization
WMP	Waste Management Plan
WRD	Water Resources Directorate

1 EXECUTIVE SUMMARY

1.1 Background

Aluminium Bahrain B.S.C. (Alba) consistently ranks as one of the largest and most modern aluminium smelters in the world. Known for its technological strength and innovative policies, Alba enforces strict environmental guidelines, maintains a high track record for safety, and is widely regarded as one of the top performers on a global scale.

Alba PS 5 Block 4 Combined Cycle Power Plant is an expansion of the existing Power Station 5, which was commissioned in 2019 – 2020 and consists of 3 x CCGT Blocks of 1:1:1 configuration, with H class gas turbine technology, GE A650 steam turbine, GE (Alstom legacy) heat recovery steam generator, GE Mark VIe distribute control system. PS5 power is exported to the Alba islanded grid through a recently completed (2019) Siemens 220kV indoor gas insulated switchgear Substation.

PS5 Block 4 Project is the addition of a fourth Block of similar 1:1:1 configuration with J-class gas turbine technology and with minimum nominal ISO rating of a 680.8 MW and it also includes tie into the existing 220kV Substation. A Consortium of Mitsubishi Power Ltd. (MPW) and SEPCO III Electric Power Construction Co. Ltd. (SEPCO III) will execute PS5 Block 4. PS5 capacity will increase from 1,800 MW to 2,481 MW. Block 4 Gas turbine unit will have the capability to operate on 100% Khuff gas, 100% Residual will also have the capability to operate on any proportionate mixture of Khuff-residual gas. Generally, concept for the new Block 4 is like the existing Blocks 1 to 3, and the services will be provided from the common facilities from the existing PS5 or other plants within the Alba complex.

Rationale behind the expansion of PS5 Block 4 is the efficiency of this combined cycle power plant is much higher than combined cycle power plants of PS 3 and PS 4. Power Station 3, which is operating on a low load, will be shut down and will be kept as emergency standby. Power station 4 will be running partially.

Key project information is provided in table below:

Table 1-1 Key Project Information

Project Details	
Project Name	Alba Power Station 5 – Block 4
Location	Aluminium Bahrain BSC
Type	Expansion of existing PS 5
OEM	Mitsubishi Power Ltd.
EPC Contractor	SEPCO III Bahrain Construction Company

Project Details		
Plot Size	20,000 m^2	
Number of Gas Turbines	1	
Number of Steam Turbines	1	
Number of HRSG's	1	
Number of Stacks	1 Main Stack and 1 Bypass Stack	
Capacity of CCP	681 MW	
Natural Gas Supply	117.059 mmscfd from existing natural gas supply	
Electricity Requirement	16,700 kW/h from PS 5	
Water Requirement	5,000 m^3/month from Alba facilities	
Chemical Requirement	Ammonia	150 litres / month
	Carbo Hydrazide	100 litres / month
	Tri-Sodium Phosphate	70 litres / month
Emissions	Carbon Monoxide, Oxides of Nitrogen and Sulphur Dioxide	

1.2 Regulatory Environmental Requirements

This development Project falls under the obligations of Ministerial Order No.1 of 1998, which sets the requirements for Assessing the Environmental Status of a Proposed Project or Expansion to facilitate informed decision-making in the permitting process. The anticipated environmental impacts will be addressed in the Environmental Impact Assessment Study (EIA), which will be considered by the Supreme Council for Environment (SCE). This process is being undertaken in three phases:

1. Environmental Screening,
2. Environmental Scoping, and
3. Environmental Impact Assessment.

An outline of the process flow is provided in Figure 1-1.

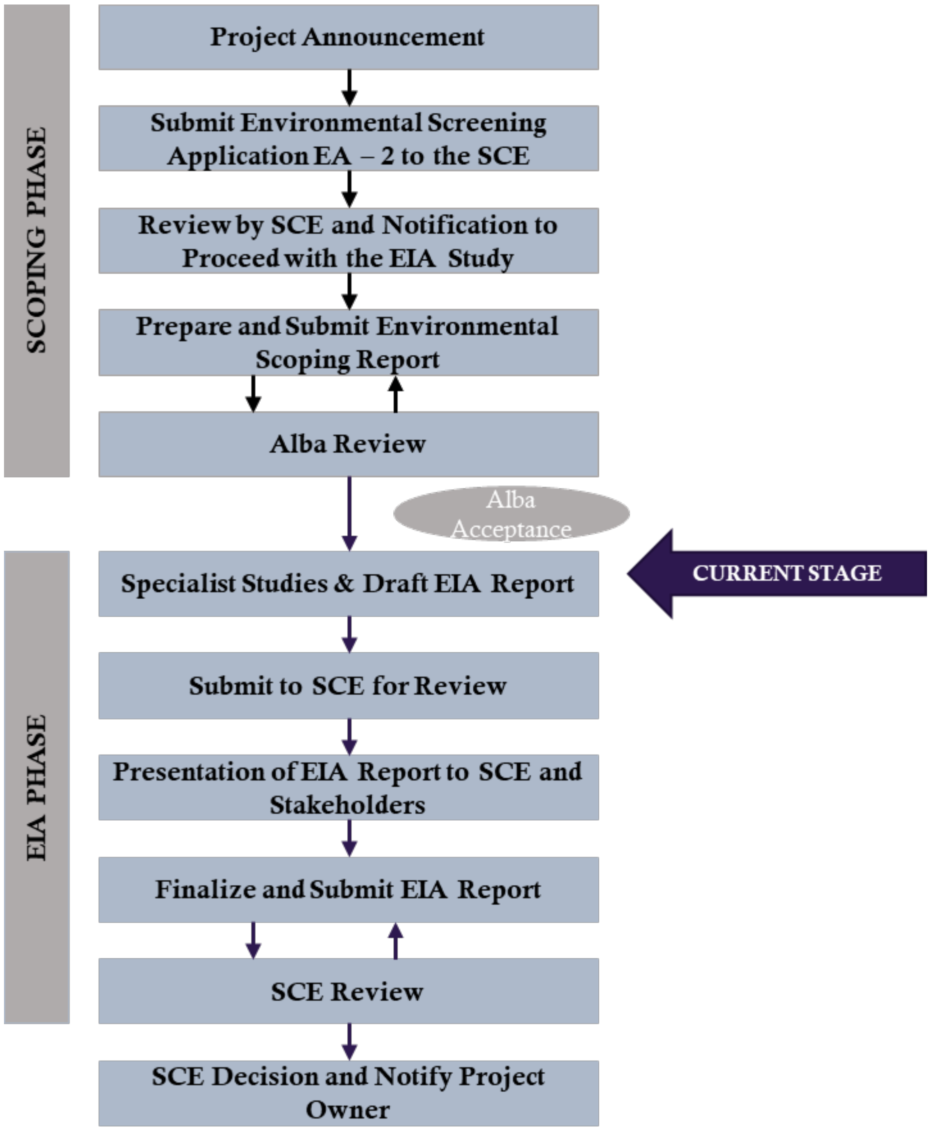

Figure 1-1 Outline of EIA Process

Environmental Screening Application – EA 2 for Industrial Projects – was submitted by Aluminium Bahrain on 12th August 2020. The Supreme Council for Environment issued an official notification (Reference No. EL-1917-20) to the screening application on 05th October 2020.

Through the notification, the SCE indicated that the project is subject to pass through Environmental Impact Assessment Process in an attempt to address and mitigate its likely environmental impacts on the environmental resources and surroundings. The scope of EIA Study with key areas of focus were specified in the notification.

Though the SCE does not require a detailed Environmental and Social Impact Assessment Study for the proposed expansion Project, this ESIA report is prepared as the project is subject to the approval from International Finance Corporation (IFC).

To ensure uniformity throughout the report and to ensure alignment with IFC's requirements, the term ESIA is being utilized. It is understood that there are differences in the scope of EIA and ESIA. However, this ESIA include the elements in the scope of EIA specified by the Supreme Council for Environment.

Alba commissioned M/s Envirotech Consultancy W.L.L as environmental consultant to perform the ESIA Study.

1.3 Process Description

In combined cycle plant, Natural gas is fired in the combustor, then the hot gas from the combustor passes through the Gas turbine and the electricity is generated. Waste exhaust hot gas leaving the Gas turbine passes through the Heat Recovery Steam Generator (HRSG) and steam is generated. Steam generated in the HRSG is admitted into the steam turbine and the electricity is generated. Steam leaving the steam turbine is cooled in the Air-Cooled Condenser (ACC) and the condensate water is send to the HRSG and returned as steam again as water steam cycle as a closed circuit.

1.4 Profile of Baseline Environment

Climate

A five (5) year meteorological data was obtained from Lakes Environmental Canada and reviewed during the baseline studies. The maximum temperature reaches up to the high 45°C during daytime in summer while the minimum night temperature ranges from low 30's°C in summer to a low of 9°C in winter. The mean relative humidity ranges between 38.7% and 69.4%.

Based on the evaluation of the meteorological data, the predominant wind direction is for the area under review occurs mainly from North Eastern and North Western regions. Secondary winds were noted from the South Eastern Quadrant. 39.1% of the total wind speeds experienced fell within the 3.6 – 5.7 m/s wind class, while 29.9 % of the total wind speeds fell within the 2.1 – 3.6 m/s wind class. Calm winds were 0.5% during this period.

Ambient Air Quality

Background concentrations of CO, NOx and SO_2 were determined using passive sampler monitoring. The passive samplers were placed at six (6) monitoring locations labelled AQ 1 to AQ 6 from 08^{th} November 2020 to 6^{th} December 2020. Following completion of the monitoring survey, the passive samplers were capped, and placed in a protective container and sent to the passam laboratory for analysis.

NOx concentrations were exceeding annual mean guideline values at locations near West Point Home, Princess Sabeeka Oasis and BSPCA Animal Kennel. Sulphur Dioxide Concentrations were exceeding the annual mean limit values at all locations except BSCPCA animal kennel and Askar Village.

In addition to the passive sampler monitoring, Ambient air quality monitoring was conducted at PS 5 Block 4 site from 22nd August to 11th September 2021 using Scentroid SL50 ambient air quality monitoring station. The results can be summarized as follows:

- During the monitoring period the temperature and relative humidity at Alba ranged from 30.1°C to 50.4°C and 17.5% to 74.0% respectively.
- Hourly average concentration of nitrogen dioxide was 56.6 ppb and Daily average concentration of nitrogen dioxide was 57.2 ppb. The recorded maximum hourly concentration was 155.6 ppb, and the recorded maximum daily concentration was 85.74 ppb. 10 exceedances were recorded as compared to SCE and IFC Standard of 106 ppb (hourly average).and 1 exceedance was recorded as compared to SCE standard of 80 ppb (daily average).
- Hourly average concentration of Sulphur dioxide was 61.7 ppb and Daily average concentration of Sulphur dioxide was 62.6 ppb. The recorded maximum hourly concentration was 151.8 ppb, and the recorded maximum daily concentration was 97.21 ppb. In comparison with SCE guideline value of 115 ppb, 17 exceedances was recorded (hourly average) and 15 exceedances were recorded as compared to SCE standard of 48 ppb (daily average).
- Hourly average concentration of Ozone was 55.1 ppb and 8-hours average concentration of Ozone was 55.51 ppb. There were 63 exceedances when compared to SCE standard of 100 ppb (Hourly Average). There were 15 and 26 exceedances when compared with SCE standard of 76 ppb (8-hours average) and IFC standard of 50 ppb (8-hours average) respectively. Meteorological conditions conductive to ozone formation, coupled with other precursor pollutant concentrations (Nitrogen Dioxide and Volatile Organic Compounds) August lead to elevated ozone concentrations at monitoring sites.
- Hourly average concentration of Carbon Monoxide was 0.43 ppm and 8-hours average concentration of Carbon Monoxide was 0.44 ppm Maximum hourly concentration was 2.5 ppm and the maximum 8-hours average concentration was 1.38 ppm. In comparison with SCE Standard of 17 ppm (1-hour average) and 9 ppb (8-hours average), no exceedances were recorded.
- Daily average concentration of particulate matter (PM_{10}) was 48.43 µg/m^3. Maximum daily concentration observed was 68.16.71 µg/m^3. In comparison with SCE standard of 340 µg/m^3 (daily average), no exceedances were recorded and with IFC standard of 50 µg/m^3 (daily average), 6 exceedances were recorded.
- Daily average concentration of particulate matter ($PM_{2.5}$) was 45.71 µg/m^3. Maximum daily concentration observed was 65.43.91 µg/m^3. When compared with SCE standard of 50 µg/m^3 (daily average), 5 exceedances were recorded and with IFC standard of 25 µg/m^3 (daily average), 21 exceedances were recorded.

Local Emission Influences

Nearest point sources of emissions are the stacks of adjacent PS 5 Block 1 to Block 3. PS 4 is located approximately 520 meters and PS 3 is located approximately 650 meters in the North East quadrant of Block 5. Alba Potlines 1 to 6 are in the East, South-East, and Southern Quadrants of the proposed plot. Industrial facilities such as Bahrain Atomisers, West point Home, and Middle East Recycling Co. are falling in the North-West and West Quadrant. Bapco refinery is located at approximately 3 Kms and Riffa Power Station is located at 3.5 Kms away from the proposed plot in the North East.

Emissions due to the combustions processes in these facilities will result in increased ambient air concentrations of Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), Carbon Monoxide (CO), etc. It is expected that the emissions from these sources are well mixed in the local air shed.

Noise

Noise monitoring was carried out on 19th and 20th November 2020 covering a weekday day, night, and weekend day times. Noise measurement results can be summarized as:

1. Weekday - Day Time Monitoring - The mean LAeq noise levels ranged from 61.8 dB (A) at NML 4 to 74.0 dB (A) at NML 3. LAeq noise levels at other monitoring stations falls within this range.
2. Weekday - Night Time Monitoring - The mean LAeq noise levels ranged from 60.6 dB (A) at NML 5 to 73.2 dB (A) at NML 3. LAeq noise levels at other monitoring stations falls within this range.
3. Weekend – Day Time Monitoring - The mean LAeq noise levels ranged from 58.4 dB (A) at NML 4 to 72.5 dB (A) at NML 3. LAeq noise levels at other monitoring stations falls within this range.

From the monitoring results it is evident that the mean LAeq noise levels are:

- Within the SCE and IFC guideline value of 70 dB(A) at:
  - NML 2, NML 4, NML 5 and NML 6 during weekday day time monitoring events,
  - NML 4, NML 5 and NML 6 during weekday night time monitoring events, and
  - NML 4, NML 5 and NML 6 during weekend day time monitoring events.
- Exceeding the SCE and IFC guideline value of 70 dB(A) at:
  - NML 3 during weekday day time monitoring events,
  - NML 2 and NML 3 during weekday night time monitoring events, and
  - NML 2 and NML 3 during weekend day time monitoring events.

- NML 1 was located next to accommodation and recreational area. The noise levels at NML 1 are exceeding IFC and SCE guideline values for residential areas during weekday day, night, and weekend day monitoring events. However, it is important to note that the accommodation and recreational area is located in a designated Special Nature Projects Area. Noise from the traffic on adjacent road and adjacent industries was a major contributor in the noise levels at NML 1.

The noise monitoring location NML 2 was located at north-east boundary of existing PS 5 next to gas metering station and NML 3 was located at proposed block 4 site close to the southern boundary of existing PS 5 Block 3. Operational noise from Power Station was a major contributor in the noise level exceedances.

Waste

During construction phase, expected waste would be coming from construction spoil / debris such as unusable materials from site preparation works, excavation etc. It may also include wood / steel trimmings, cement bags, plastic, paper board as material packaging, food waste and wrappers/plastic from the construction personnel and workers. Waste water generated from the sanitary facilities, and hand wash areas will be collected in septic tanks and transported to the nearest waste water treatment plant.

Operational wastes include air filter elements, lube oil wastes, hydraulic oil wastes, hydrocarbon liquid, hydrocarbon sludge, dust collected from the bag house, sulphur and ferrous sulphate, stormwater, gas turbine compressor cleaning solution, blow-down water, effluent resulting from plant commissioning, and ACC cleaning water. Anticipated waste streams including quantities, source and disposal routes are detailed in Section 11.2.2.

1.5 Stakeholder Consultations

1.6 Summary of Consultations

Stakeholder consultations were completed during the time of this report preparation. The major outline of the views and opinions received from stakeholders is presented below:

- No objections have been received from two government organizations - AEWRD and MTT.

- Eminent Packaging System, Bahrain Atomisers and Tylos Plastic Industries claimed that persistent brown colored deposits are visible on their office walls, cars, trucks, and stored products. During stakeholder consultations, Mr. Sayed Salah explained that Alba was also a victim of the brown spot deposition and as per the instructions from the Supreme Council for Environment Alba appointed an Environmental Consultant to study the phenomenon. The scope of the study was given by the SCE to the appointed consultant. The consultant did an extensive study in the area and collected samples from different locations and analyzed. A formal report was then submitted to the SCE as well as Alba. The report concludes that the depositions observed in the area are not generates from the operation of Aluminium Smelters. Mr. Sayed Salah shared a summary of the report to Stakeholders.

- Bahrain Atomisers made an observation that noise levels were very high in the area during the initial stages of commissioning of Line 6 but gradually decreased and are now stable.
- Empack informed that occasional smoke releases during the night-time which makes their operation area unworkable, affecting badly their employees resulting eyes burning, breathing difficulty and cough because of the smoke. Mr. Sayed Salah explained that smoke is releasing from carbon plant by-pass stacks in every four (4) to six (6) months. Alba keeps Supreme Council for Environment about the bypass stack releases. Mr. Sayed Salah ensured that Alba would contact Empack to inform about future bypass stack releases as and when it happens.
- Empack added that during the construction times of potline 6 expansion heavy vehicles parking outside the company's premises disturbing their vehicles movement. Mr. Sayed Amer ensured that the Project is small scale in comparison to potline 6 expansion Project. Thus, the traffic generation from the project will be very less.
- No objections have been received from Eminent Packaging Systems, Kymera, and Tylos Plastic Industries Co. W.L.L.
- Tylos Plastic Industries suggested Alba to develop greenbelt along their fence line by planting *Casuarina* and *Ficus* spp.

1.7 Potential Environmental Impacts

The study suggests that the impacts are of negligible and minimum to moderate adverse in nature, could be offset or minimized if the mitigation measures are adequately implemented.

CLIMATE

From information provided by Alba, the CO_2 emissions from the existing operational conditions and future operations are as follows:

- Scenario 1: Winter Base Case (3 PS 5 Units Operational) – 34.671 kg/MWh
- Scenario 2: Summer Base Case (3 PS 5 Units Operational) – 37.881 kg/MWh
- Scenario 3: Winter Base Case (4 PS 5 Units Operational) – 30.351 kg/MWh
- Scenario 4: Summer Base Case (4 PS 5 Units Operational) – 35.998 kg/MWh

From the above, it is evident that the CO_2 emissions from the Power Stations will **significantly decrease** by the implementation of Block 4 Project.

AIR QUALITY

In terms of air emissions, adverse impacts are expected during construction and operation phases of the Project. During construction phase, it is possible that the receptors located within 500m of a construction site may experience slightly elevated dust levels during the construction-phase. An elevation in local dust levels is possible during the construction works, particularly during summer and windy conditions. The impacts are assessed to be of **minor adverse**. However, by implementing appropriate mitigation measures, the magnitude of dust impact upon the identified receptors is predicted to be **negligible**.

Adverse impacts to local air quality during the operation phase of the plant may arise from the process emissions in terms of Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), and Carbon Monoxide (CO). A stack height of 55 meters is suggested to achieve efficient dispersion of criteria pollutants. Two scenarios in terms of Existing Operational Conditions (winter base case and summer base case) and Future Operational Conditions (winter base case and summer base case) were considered in the dispersion modeling study. The modeling results indicate that the maximum predicted hourly, daily, and annual ground level concentrations of the criteria pollutants are well below the ambient air quality standard limits for both scenarios. Thus, the impacts from process contributions are assessed to be of **negligible and minor to moderate adverse** in both Scenario 1 and Scenario 2 operational conditions. When background concentrations are included as appropriate, the cumulative concentrations of NO_2 and SO_2 emissions shows an increase. Hence, the impacts are assessed to be of **moderate adverse** for these parameters. By implementing the mitigation measures detailed in Section 9.5.2, the significance of impacts could be of **minor adverse**.

NOISE

Noise level has been identified as significant potential impact of the proposed Block 4 during both the construction and operation phases. The nearest sensitive receptor to the Block 4 Expansion Project is the accommodation and recreational area located 650 meters north from the site. Noise levels are not exceeding the IFC guideline values during day time, except when jack hammers are used during construction. Predicted noise levels are exceeding IFC guideline values while a number of equipments are operational. Considering these, the impacts are assessed to be of **minor adverse**.

To assess the impacts during operational phase, a noise modeling study was carried out considering existing operational conditions and anticipated future operational conditions. From the modeling results of Scenario 2, it can be concluded that the LAeq noise levels at all locations except receptor 1 – accommodation and recreational area are within the guideline values. In comparison to the predicted LAeq levels of Scenario 1, the noise level at receptor – 1 increased by 0.2 dBA. However, it should be noted that the Block 4 will be constructed on the Southern end of PS 5 which is away from receptor – 1. Considering this, the impact of Block 4 operations is assessed to be of **minor adverse**.

WASTE MANAGEMENT

Construction activities will generate waste are principally foundation works and erection of structures. However, wastes will be produced during construction from other sources such as excavated soil, formwork, waste concrete, excess steel reinforcement, packaging for plant and materials and domestic waste from the construction workforce. Some of these wastes can be recycled (e.g., scrap metal) or re-used (e.g., concrete scraps) after processing; but the remaining unusable waste would be disposed at the municipal landfill site. The impacts are assessed to be of **minor adverse**.

A number of hazardous and non-hazardous wastes are generated (refer Section 11.2.2). Improper storage, handling and transport of solid, semi-solid and liquid wastes can cause impacts on soil and human health. Hence, the impacts during operational phase are assessed to be of **minor adverse**. By implementing appropriate mitigation measures, significance of impacts can be of **negligible and minimum**.

SOCIO-ECONOMICS

The project is expected to generate **major beneficial** impacts on the local economy and livelihoods in terms of employment generation and local business opportunities through the procurement of goods and services during construction phase. Construction material will be sourced locally. Impacts on government revenues during construction and operational phases are assessed to be of **major beneficial**. Adverse impacts on air quality, noise, traffic, and health and safety are anticipated during both construction and operational phases.

OCCUPATIONAL, HEALTH AND SAFETY

During the construction phase of the Project, potential health impacts arise due to the increased traffic accessing the site and safety issues associated with noise exposure, eye hazards, heat stress, illumination, slips, trips etc. and exposure to construction dust.

During operational phase impacts are anticipated from exposure to aluminium dross and dust, chemical storage, gas releases, vehicle movement, physical and chemical hazards.

Impacts during construction and operation phases are assessed to be of **minor adverse**. However, by implementing appropriate mitigation measures, the impacts will be of **negligible and minimum**.

GEOLOGY, SOIL AND GROUNDWATER

The nature of construction works will require disturbance and exposure of soils during construction. This has the potential to cause soil erosion while soils are exposed. There is a potential impact on soils and geology from accidental spillages or leaks from vehicles on site during construction phase. Since the observed groundwater levels are deeper, no impacts are anticipated to groundwater resources. There are no deep excavations planned as part of Block 4 construction. There are no areas of soft ground on site and issues with regard to slope stability have been identified at the site. Hence, the impacts during construction phase are assessed to be of **minor adverse**.

During operational phase, A number of chemicals will be stored on site during normal operations. An assortment of lubricants, oils and greases will also be required to store on site. There is potential for soil contamination in the event of an accidental spillage or leak of above material. Since the groundwater levels are deeper, significant impacts are not anticipated during operational phase. Impacts during operational phase is assessed to be of **minor adverse**.

1.8 Conclusions

On completion of PS 5 Block 4 Expansion Project, the capacity of PS5 will increase from 1,800 MW to 2,481 MW. Rationale behind the expansion of PS5 Block 4 is the efficiency of this combined cycle power plant is much higher than combined cycle power plants of PS 3 and PS 4. Power Station 3, which is operating on a low load, will be shut down and will be kept as emergency standby. Power station 4 will be running partially. This will reduce the air emissions from the Alba Power Stations Significantly.

In the combined cycle mode, natural gas is combusted in the gas turbine generator producing electricity and the waste heat from the gas turbine is used to make steam to generate additional electricity via a Heat Recovery Steam Generator (HRSG) and a steam turbine. Combined Cycle Power Plants far exceed conventional Thermal Power Plants with efficiencies in a range of 54% to 57%.

A document by the Oxford Institute for Energy Studies (20:20 vision to reducing CO_2 emissions in the UK electricity market) states that a modern CCGT plant only produces 40% of the CO_2 that a conventional coal-fired Power Station produces, and 75% of that produced by a conventional oil-fired Power Station, for the same amount of electricity output.

Further, from the data provided by Alba it is calculated that the CO_2 emissions from the Power Stations will significantly decrease by the implementation of Block 4 Project (Refer Section 8.2.2.1).

The significance of the predicted positive and negative impacts associated with the proposed Block 4 has been investigated and assessed in this Environmental and Social Impact Assessment (ESIA) Report. The impacts are mostly occurring during the operation phase. No major adverse impacts are predicted, provided the recommended Best Practicable Environmental Options (BPEO) and mitigation measures are implemented effectively. It is proposed that the implementation or adoption of the mitigation measures are to be closely monitored to prevent or minimize the negative impacts and enhance the positive effects.

Successful implementation of the Project will reduce overall air emissions from the Power Stations in Alba and the greenhouse gas emissions.

2 INTRODUCTION

2.1 Need for ESIA Study

The Government of Bahrain introduced its first environmental legislation in 1996. Decree 21 (1996) and its amendment Decree 8 (1997), issued by the then Ministry of Housing, Municipalities and Environment, defines the environmental strategy of the country and sets the basis for future legislation.

Ministerial Order No.1, regarding Environmental Evaluations of Projects 1998, is the regulatory instrument that drives the country in a sustainable way. This legislation sets the requirements for assessing the environmental status of a proposed project or expansion of an existing project and facilitates informed decision-making during the permitting process. This project falls under the obligations of the regulation.

The Environmental Impact Assessment process consists of three major phases, namely,

- Environmental Screening,
- Environmental Scoping
- Environmental Impact Assessment

These phases follow a predefined sequence under the mandate of the Supreme Council for Environment (SCE). This project has been through the First Phase of screening subsequent to which SCE has issued guidelines dated 05th October 2020 to conduct the EIA study.

Alba has appointed Envirotech Consultancy W.L.L. to prepare an Environmental and Social Impact Assessment Study (ESIA) for the proposed Power Station 5 – Block 4 Expansion Project.

It is understood that Alba will seek finance for the Project from International Finance Corporation (IFC). IFC has prepared a set of Performance Standards on Environmental and Social Sustainability and Environmental Health and Safety (EHS) guidelines with general and industry specific examples of Good International Industry Practice (GIIP). This ESIA has also been prepared to demonstrate compliance to the environmental and social requirements of IFC Performance Standards, IFC General EHS Guidelines and IFC Sector EHS Guidelines.

It should be noted that the term ESIA is used throughout this report to maintain uniformity. The ESIA includes both Environmental Impact Assessment (EIA) requirements of Supreme Council for Environment and Environmental and Social Impact Assessment Requirements of IFC.

2.2 Contents of the ESIA Study

The ESIA Study provides a factual description of the proposed project and prepared based on the relevant technique and knowledge available at the time. The following information included in the ESIA:

- A description of the physical characteristics of the proposed development, its location and its land-use requirements during construction and operational phases;
- An estimate of expected residues and emissions (water, air and soil pollution, noise, vibration, light, heat, etc.) resulting from the operation of the Plant;
- A description of the environmental aspects likely to be significantly affected by the development, including direct and indirect effects, short, medium- and long-term effects, and cumulative effects; and the data required to identify and assess the main effects. The aspects considered will include the following:
  - Climatic Conditions and Air Quality;
  - Noise and Vibration;
  - Geology, Topography, Soil and Groundwater;
  - Socio-economic Status;
  - Access and Vehicular Traffic;
  - Occupational Health and Safety; and
  - Waste Streams.
- A description of the baseline scenario;
- A description of the reasonable alternatives studied and an indication of the main reasons for the option chosen, considering the effects of the development in the environment;
- A description of the measures proposed to reduce, avoid, prevent or where possible, offset any significant adverse effects on the environment; and
- A summary of the above including the main findings of the ESIA.

2.3 Project Proponent

The Project applicant is Aluminium Bahrain B.S.C. The details of the Project Proponent are as follows:

Table 2-1 Details of Project Proponent

Applicant	Aluminium Bahrain B.S.C
Representative	Mr. Mohamed Khalil Saeed
Designation	Director - HSE, Fire and Security
Postal Address	P.O Box 570, Manama, Kingdom of Bahrain
Telephone	+973 17830000
Facsimile	+973 17911112
Email	m.khalil@alba.com.bh

2.4 Environmental Consultant

Envirotech Consultancy W.L.L has been engaged by Aluminium Bahrain B.S.C., as the Environmental Consultant to carry out the Environmental and Social Impact Assessment studies for the proposed plant.

Envirotech has technical collaborations and associations with a number of international engineering consultancy companies and environmental laboratories to provide added value to its services. Envirotech provides technical and managerial expertise for the preparation and conduct of Environmental Impact Assessments (EIAs), Risk Assessments (RAs), Environmental monitoring for air quality, water quality, soil quality and analysis, bioremediation, green belt, waste management, marine and terrestrial ecological surveys etc.

Table 2-2 Details of Environmental Consultant

DETAIL	ENVIROTECH CONSULTANCY W.L.L		
Contact Persons	Mr. Rajith Chandran	Mr. Minhajuddin Ahmed Faruqi	Ms. Sweeja Sukumaran
Designation	Project Manager	Sr. Environmental Specialist	Environmental Engineer
Postal Address	PO Box 54005, Adilya, Kingdom of Bahrain	PO Box 54005, Adilya, Kingdom of Bahrain	PO Box 54005, Adilya, Kingdom of Bahrain
Telephone	+973 1771 6112	+973 1771 6112	+973 1771 6112
Facsimile	+973 1771 4481	+973 1771 4481	+973 1771 4481
E-mail	rajith@newtechgcc.com	minhaj@newtechgcc.com	sweeja@newtechgcc.com

DETAIL	ENVIROTECH CONSULTANCY W.L.L		
Qualification	Bachelor of Science in Chemistry	Master of Science in Environmental Science	Bachelor of Engineering in Environmental Engineering
Experience	15 years	15 years	6 years

3 REGULATORY FRAMEWORK AND REQUIREMENTS

3.1 National Regulation

The following are the relevant legislations applicable to the proposed development:

- Ministerial Order No. (1) of the year 1998 with respect to environmental evaluation of Projects;
- Ministerial Order No. (1) of the year 1999 with respect to control of the ozone layer depleting substances;
- Decision No. (4) of the year 1999 with respect to licensing work in the maintenance of equipment and buildings containing Asbestos, and removing and transporting their waste;
- Resolution No. (10) of the year 1999 with respect to Environmental Standards (Air and Water);
- Ministerial Order No. (6) of 2000 with Respect to Organization of Industrial Safety in the Establishment;
- Decision No. (1) of the year 2001with respect to management of hazardous waste of health care;
- Decision No. (2) of the year 2001 on amendments to Ministerial Order No. (10) of 1999 with Respect to Environmental Standards (Air and Water);
- Decision No. (3) of the year 2001 relating to the modification of some tables attached to Decision No. (10) of the year 1999 concerning the environmental measurements (air and water) ratified by the Decision No. (2) of the year 2001;
- Decision No. (7) of the year 2002 with respect to the Controlling the Import and Use of Banned and Restricted Chemicals;
- Decision No. (3) of the year 2005 on the environmental requirements and standards in work sites;
- Decision No. (4) of the year 2005 with respect to the management of used oil;
- Decision No. (3) of the year 2006 with respect to the Management of Hazardous Materials,
- Decision No. (4) of the year 2006 with respect to Management of Hazardous Chemicals;
- Decision No. (10) of the year 2006 with respect to emissions of air pollutants from point sources;
- Decision No. (6) of the year 2013 with respect to amending Decision No. 4/2006 with respect to Hazardous Chemicals Management;

- Decision No. (7) of the year 2013 with respect to amending Decision No. 3/2006 with respect to Hazardous Waste Management;
- Decree No. 32 of 2013 on ratifying the Beijing Amendment to the Montreal Protocol Concerning the Substances that Deplete the Ozone Layer;
- Law No. 54 of 2014 Approving the Unified Law (Regulation) of the Gulf Cooperation Council (GCC) for the Arab States on the Control of Substances that Deplete the Ozone Layer;
- Royal Decree 75 of 2016 on ratifying the Paris Agreement within the United Nations Framework Convention on Climate Change (UNFCCC);
- Resolution No. (2) of the Year 2021 with respect to the Environmental Standards (Air); and
- Resolution No. (3) of the Year 2021 with respect to Environmental Standards (Water).

The regional and international conventions and agreements and guidelines thereof relevant to the project are:

- Arab Convention No. (1) of 1981 on Work Environment;
- Vienna Convention for the Protection of the Ozone Layer;
- Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and Their Disposal, and its amendment;
- Arab Convention No. 7 of 1977 and Recommendation No. 1 of 1977 concerning occupational safety and health;
- United Nations Framework Convention on Climate Change;
- Vienna Convention for the Protection of the Ozone Layer, (March 22, 1985) and the Montreal Protocol on Substances that Deplete the Ozone Layer (September 16, 1987);
- Convention on Biological Diversity;
- Regional Protocol on the Control of Marine Trans-boundary Movements and Disposal of Hazardous Wastes and Other Wastes;
- Stockholm Convention on Persistent Organic Pollutants;
- Kyoto Protocol to the United Nations Framework Convention on Climate Change;
- 1999 Beijing Amendment to the Montreal Protocol Concerning the Substances that Deplete the Ozone Layer;
- Convention concerning the Protection of Workers against Occupational Hazards in the Working Environment Due to Air Pollution, Noise and Vibration, signed in Geneva, 1977.

ENVIROTECH CONSULTANCY W.L.L.

3.2 International Finance Corporation Requirements

In accordance with IFC policies and commitments, the Project shall meet the following key requirements during all phases:

- International Finance Corporation's (IFC) Performance Standards (2012);
- IFC General Environmental Health and Safety (EHS) Guidelines (2007);
- IFC EHS Guidelines for Thermal Power Plants (2008); and
- IFC EHS Guidelines for Electric Power & Distribution (2007).

3.2.1 IFC Performance Standards – Environmental and Social Sustainability

IFC's Environmental and Social Performance Standards define IFC clients' responsibilities for managing their environmental and social risks.

The 2012 edition of IFC's Sustainability Framework, which includes the Performance Standards, applies to all investment and advisory clients whose projects go through IFC's initial credit review process after January 1, 2012.

The following table presents IFC Performance Standards on Environmental and Social Sustainability (2012) and their objectives:

Table 3-1 IFC Performance Standards

Performance Standard	Details and Objectives
PS 1	**Assessment and Management of Environmental and Social Risks and Impacts** Performance Standard 1 underscores the importance of managing environmental and social performance throughout the life of a project. The client, in coordination with other responsible government agencies and third parties as appropriate, will conduct a process of environmental and social assessment, and establish and maintain an ESMS appropriate to the nature and scale of the project and commensurate with the level of its environmental and social risks and impacts. Objectives are to: — Identify and evaluate environmental and social risks and impacts of the project. — Adopt a mitigation hierarchy to anticipate and avoid, or where avoidance is not possible, minimize, and, where residual impacts remain, compensate/offset for risks, and impacts to workers, Affected Communities, and the environment. — Promote improved environmental and social performance of clients through the effective use of management systems. — Ensure that grievances from Affected Communities and external communications from other stakeholders are responded to and managed appropriately.

Performance Standard	Details and Objectives
	— Promote and provide means for adequate engagement with Affected Communities throughout the project cycle on issues that could potentially affect them and to ensure that relevant environmental and social information is disclosed and disseminated.
PS 2	**Labor and Working Conditions:** Performance Standard 2 recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental1 rights of workers. The requirements set out in this Performance Standard have been in part guided by a number of international conventions and instruments, including those of the International Labour Organization (ILO) and the United Nations (UN). Objectives are to: — Promote the fair treatment, non-discrimination, and equal opportunity of workers. — Establish, maintain, and improve the worker-management relationship. — Promote compliance with national employment and labor laws. — Protect workers, including vulnerable categories of workers such as children, migrant workers, workers engaged by third parties, and workers in the client's supply chain. — Promote safe and healthy working conditions, and the health of workers. — Avoid the use of forced labor.
PS 3	**Resource Efficiency and Pollution Prevention:** This Performance Standard outlines a project-level approach to resource efficiency and pollution prevention and control in line with internationally disseminated technologies and practices. During the project life-cycle, the client will consider ambient conditions and apply technically and financially feasible resource efficiency and pollution prevention principles and techniques that are best suited to avoid, or where avoidance is not possible, minimize adverse impacts on human health and the environment.3 The principles and techniques applied during the project life-cycle will be tailored to the hazards and risks associated with the nature of the project and consistent with good international industry practice (GIIP). Objectives are to: — Avoid or minimize adverse impacts on human health and the environment by avoiding or minimizing pollution from project activities. — Promote more sustainable use of resources, including energy and water. — Reduce project related GHG emissions.
PS 4	**Community Health, Safety and Security:** Performance Standard 4 recognizes that project activities, equipment, and infrastructure can increase community exposure to risks and impacts. The client will evaluate the risks and impacts to the health and safety of the Affected Communities during the project life cycle and will establish preventive and control measures consistent with good international industry practice (GIIP). The client will identify risks and impacts and propose mitigation measures that are commensurate with their nature and magnitude. Objectives are to:

Performance Standard	Details and Objectives
	— Anticipate and avoid adverse impacts on the health and safety of the Affected Community during the project life from both routine and non-routine circumstances. — Ensure that the safeguarding of personnel and property is carried out in accordance with relevant human rights principles and in a manner that avoids or minimizes risks to the Affected Communities.
PS 5	**Land Acquisition and Involuntary Resettlement:** Performance Standard 5 recognizes that project-related land acquisition and restrictions on land use can have adverse impacts on communities and persons that use this land. Involuntary resettlement refers both to physical displacement (relocation or loss of shelter) and to economic displacement (loss of assets or access to assets that leads to loss of income sources or other means of livelihood) as a result of project-related land acquisition and/or restrictions on land use. Where involuntary resettlement is unavoidable, it should be minimized and appropriate measures to mitigate adverse impacts on displaced persons and host communities should be carefully planned and implemented. Objectives are to: — Avoid, and when avoidance is not possible, minimize displacement by exploring alternative project designs. — Avoid forced eviction. — Anticipate and avoid, or where avoidance is not possible, minimize adverse social and economic impacts from land acquisition or restrictions on land use by (i) providing compensation for loss of assets at replacement cost and (ii) ensuring that resettlement activities are implemented with appropriate disclosure of information, consultation, and the informed participation of those affected. — Improve, or restore, the livelihoods and standards of living of displaced persons.
PS 6	**Biodiversity Conservation and Sustainable Management of Living Natural Resources:** Performance Standard 6 recognizes that protecting and conserving biodiversity, maintaining ecosystem services, and sustainably managing living natural resources are fundamental to sustainable development. The risks and impacts identification process as set out in Performance Standard 1 should consider direct and indirect project-related impacts on biodiversity and ecosystem services and identify any significant residual impacts. Objectives are to: — Protect and conserve biodiversity. — Maintain the benefits from ecosystem services. — Promote the sustainable management of living natural resources through the adoption of practices that integrate conservation needs and development priorities.
PS 7	**Indigenous Peoples:** Performance Standard 7 recognizes that Indigenous Peoples, as social groups with identities that are distinct from mainstream groups in national societies, are often

Performance Standard	Details and Objectives
	among the most marginalized and vulnerable segments of the population. In many cases, their economic, social, and legal status limits their capacity to defend their rights to, and interests in, lands and natural and cultural resources, and may restrict their ability to participate in and benefit from development. Objectives are to: — Ensure that the development process fosters full respect for the human rights, dignity, aspirations, culture, and natural resource-based livelihoods of Indigenous Peoples. — Anticipate and avoid adverse impacts of projects on communities of Indigenous Peoples, or when avoidance is not possible, to minimize and/or compensate for such impacts. — Promote sustainable development benefits and opportunities for Indigenous Peoples in a culturally appropriate manner. — Establish and maintain an ongoing relationship based on informed consultation and participation with the Indigenous Peoples affected by a project throughout the project's life-cycle. — Ensure the Free, Prior, and Informed Consent (FPIC) of the Affected Communities of Indigenous Peoples when the circumstances described in this Performance Standard are present. — Respect and preserve the culture, knowledge, and practices of Indigenous Peoples.
PS 8	**Cultural Heritage:** Performance Standard 8 recognizes the importance of cultural heritage for current and future generations. Consistent with the Convention Concerning the Protection of the World Cultural and Natural Heritage, this Performance Standard aims to ensure that clients protect cultural heritage in the course of their project activities. In addition, the requirements of this Performance Standard on a project's use of cultural heritage are based in part on standards set by the Convention on Biological Diversity. Objectives are to: — Protect cultural heritage from the adverse impacts of project activities and support its preservation. — Promote the equitable sharing of benefits from the use of cultural heritage.

3.2.2 IFC EHS Guidelines (30 April 2007) and Industry Sector Guidelines

World Bank Group Environmental, Health, and Safety Guidelines are 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.

The EHS Guidelines contain the performance levels and measures that are normally acceptable to the World Bank Group, and that are generally considered to be achievable in new facilities at reasonable costs by existing technology.

The World Bank Group requires borrowers/clients to apply the relevant levels or measures of the EHS Guidelines. When host country regulations differ from the levels and measures presented in the EHS Guidelines, projects will be required to achieve whichever is more stringent.

The following are relevant to this Project:

- Environmental
  - Air Emissions and Ambient Air Quality
  - Energy Conservation
  - Wastewater and Ambient Water Quality
  - Water Conservation
  - Hazardous Materials Management
  - Waste Management
  - Noise
  - Contaminated Land
- Occupational Health and Safety
  - General Facility Design and Operation
  - Communication and Training
  - Physical Hazards
  - Chemical Hazards
  - Biological Hazards
  - Radiological Hazards
  - Personal Protective Equipment (PPE)
  - Special Hazard Environments
  - Monitoring
- Community Health and Safety
  - Water Quality and Availability
  - Structural Safety of Project Infrastructure
  - Life and Fire Safety (L&FS)
  - Traffic Safety
  - Transport of Hazardous Materials
  - Disease Prevention
  - Emergency Preparedness and Response
- Construction and Decommissioning
  - Environment
  - Occupational Health and Safety
  - Community Health and Safety

IFC have specific industry standards that will be applicable to the Project. This includes:

- EHS Guidelines for Thermal Power Plants; and
- EHS Guidelines for Electric Power and Distribution; Environmental Standards

3.3 Applicable Standards and Guidelines

Applicable standards and guidelines relevant to the project are detailed in the relevant sections in the ESIA Report.

4 DESCRIPTION OF THE PROJECT

4.1 Introduction and Background

Alba PS 5 Block 4 Combined Cycle Power Plant is an expansion of the existing Power Station 5, which was commissioned in 2019 – 2020 and consists of 3 x CCGT Blocks of 1:1:1 configuration, with H class gas turbine technology, GE A650 steam turbine, GE (Alstom legacy) heat recovery steam generator, GE Mark VIe distribute control system. PS5 power is exported to the Alba islanded grid through a recently completed (2019) Siemens 220kV indoor gas insulated switchgear Substation.

PS5 Block 4 Project is the addition of a fourth Block of similar 1:1:1 configuration with J-class gas turbine technology and with minimum nominal ISO rating of a 680.8 MW and it also includes tie into the existing 220kV Substation. A Consortium of Mitsubishi Power Ltd. (MPW) and SEPCO III Electric Power Construction Co. Ltd. (SEPCO III) will execute PS5 Block 4. PS5 capacity will increase from 1,800 MW to 2,481 MW. Block 4 Gas turbine unit will have the capability to operate on 100% Khuff gas, 100% Residual will also have the capability to operate on any proportionate mixture of Khuff-residual gas. Generally, concept for the new Block 4 is similar to the existing Blocks 1 to 3, and the services will be provided from the common facilities from the existing PS5 or other plants within the Alba complex.

4.2 Existing Power Stations at Alba Complex

Alba currently have five (5) Power Stations including the newly built Power Station 5 as part of Potline 6 Expansion within the complex. Further to the completion of Potline 6 expansion, the capacity of PS5 has increased to 1,800 MW. As a result, there is a reduction in the requirement to operate PS 3 and PS 4. On completion of Pot line 6 Expansion project, Power station 1 was largely de-commissioned. As of September 2020, fifteen out of nineteen Gas Turbines, originally installed, has been disconnected electrically and are no longer available for generation.

Further to the completion of Block 4, the capacity of PS5 will increase from 1,800 MW to 2481 MW The baseline operating scenario is shown in Table 4-1.

Table 4-1 Baseline Operating Scenario of Alba Power Stations

Power Station	No. of Units	Total Capacity (MW)	Operating Load (MW)	Load Factor (%)
Winter Without PS 5 – Block 4				
PS1	5 GTs	80	0	-
PS2	5 GTs, 0 ST	100	0	-
PS3	6 GTs, 2 STs	833	145	18

Power Station	No. of Units	Total Capacity (MW)	Operating Load (MW)	Load Factor (%)
PS4	4 GTs, 2 STs	913	867	95
PS5	3 GTs, 3 STs	1758	1688	96
Total		**3,584**	**2,700**	**75**
Summer without Block 4				
PS1	4 GTs	68	0	-
PS2	5 GTs, 0 ST	85	0	-
PS3	6 GTs, 2 STs	755	283	38
PS4	4 GTs, 2 STs	837	837	95
PS5	3 GTs, 3 STs	1580	1580	96
Total		**3,325**	**2,700**	**81**

4.2.1 Load Flow

Load flow during summer as well as winter seasons considering the existing and future operational scenarios are presented in Table 4-2.

Table 4-2 Alba Power Stations - Load Flow during Summer and Winter Seasons

Power Stations	Operational Units (In-Service)
Winter Base Case (3 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, and ST 82
PS 4	GT 51, GT 52, ST 53, GT 61, GT 62, and ST 63
PS 3	1GT and 1ST
PS 2	No Units Operational
Summer Base Case (3 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, and ST 82
PS 4	GT 51, GT 52, ST 53, GT 61, GT 62, and ST 63
PS 3	2 GTs and 1 ST
PS 2	No Units Operational
Winter Base Case (4 PS 5 Units Operational)	

Power Stations	Operational Units (In-Service)
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83, and ST 84
PS 4	2 GTs and 1 ST
PS 3	No Units Operational
PS 2	No Units Operational
Summer Base Case (4 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83, and ST 84
PS 4	GT 51, GT 52, ST 53, GT 61, GT 62, and ST 63
PS 3	No Units Operational
PS 2	No Units Operational

4.3 Rationale / Needs

On completion of Pot line 6 Expansion project, Power station 1 was largely de-commissioned. As of September 2020, fifteen out of nineteen Gas Turbines, originally installed, were disconnected electrically and are no longer available for generation. Remaining four gas Turbines are connected to the network system and will remain physically available for possible future use as a black start and emergency reserve.

Power Station 2 will remain in a black start and emergency reserve capacity. One of the Gas Turbine is dedicated to start the Power station 5 Gas Turbine during the blackout condition and other Gas Turbines are emergency reserve. Power Station 2 steam generator will be decommissioned and disposed of the following the power requirement review.

On completion of PS 5 Block 4 Expansion Project, the capacity of PS5 will increase from 1,800 MW to 2,481 MW. Rationale behind the expansion of PS5 Block 4 is the efficiency of this combined cycle power plant is much higher than combined cycle power plants of PS 3 and PS 4. Power Station 3, which is operating on a low load, will be shut down and will be kept as emergency standby. Power station 4 will be running partially.

4.4 Location

The proposed Block will be set up within Alba complex. The site is located South of the existing Power Station 5. Area allocated for the Block 4 expansion is approximately 20,000 m^2.

The site is close to the existing PS5 and allows reasonable access to the shared utilities from Alba complex. Figure 4-1 presents the proposed Block 4 location, boundaries along with the existing Blocks 1 to 3, access roads and shared utilities.

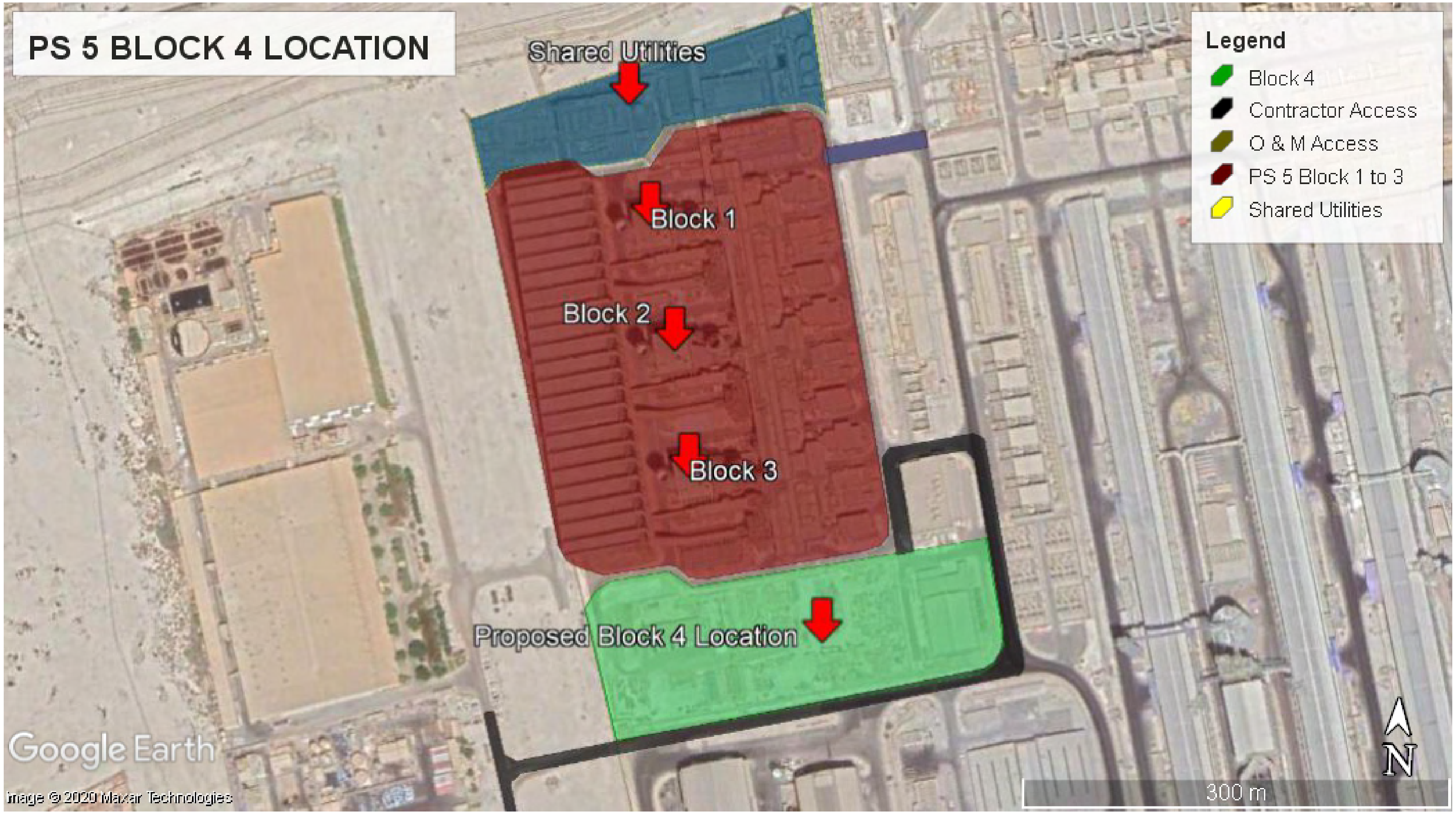

Figure 4-1Google Earth Image of the Project Location

4.5 Land Use and Sensitive Receptors

4.5.1 Site Conditions

At present the proposed land is used as the Power Station 5 project offices and as temporary storage yard (refer Figure 4-2). Demobilization of the portable cabins and the material stored at site will be completed prior to construction of Block 4.

East of the Proposed Block 4 Site

South of the Proposed Block 4 Site

West of the Proposed Block 4 Site

Temporary Storage of Materials at Site

Figure 4-2 Site Photographs

4.5.2 Land Use

Land use map indicating surrounding areas is given in Figure 4-3 and land use summary is presented in Table 4-3. In the surrounding area:

- Immediate neighboring facilities are as below:
  - Existing Power Station 5 Blocks 1 to 3 in North;
  - Alba complex in South, South East, East, and North East;
  - West Point Home and Middle East Recycling Company in the West;

  – Road 5146 in the West.

- Industries and commercial facilities such as Bahrain Atomisers International, Sayed Kadem Durazi lay down, Al Salam Furnitures, Middle East Fiber Glass, Ameeri Industries Co. (AMGARD), Down Town Group, and Tylos Plastics are in the North, North-West, West, and South West quadrants of the 1 – Km radius of the plot.
- Labor accommodations are situated in the North and North-West quadrants of the 1 – Km radius of the plot.
- EWA Hawar substation is in the North East Quadrant.
- Rest all the areas are either vacant or un-barricaded or mixed use.

Table 4-3 Land Use Summary – 1 Kilometer Radius

Sl. No.	Land Use	Area (Sq. m.)	Percentage Cover
1	AB Pipeline	193,856	6.17
2	Accommodation & Commercial	104,652	3.33
3	Alba Smelter	1,392,481	44.35
4	Dump Yard	31,273	1.00
5	EWA Substation	9,591	0.31
6	Industries	423,677	13.49
7	Mixed use	29,716	0.95
8	Open spaces	800,218	25.48
9	Quarry	54,762	1.74
10	Roads	99,774	3.18
	Total	**3,140,000**	**100.00%**

4.5.3 Sensitive Receptors

Figure 4-4 presents the key sensitive receptors within 5-kilometer radius of the project site particularly in terms of the air quality impacts. A brief input of the receptors is provided in Table 4-4.

Table 4-4 Key Sensitive Receptors

Receptor ID	Receptor	Type	Description
SNR 1	Camp Areas	Residential / Commercial	Accommodation camp and commercial area located at ~700 m North
SNR 2	Camp Areas	Residential / Commercial	Accommodation camp and commercial area located at ~750 m North
SNR 3	Riffa Views	Residential / Recreational	Residential area and recreational facilities located at ~2.75 Km West
SNR 4	Princess Sabeeka Oasis	Conservation Area	Conservational area located 1.7 Km South-East within Alba Complex
SNR 5	BSPCA	Animal Protection	Animal protection centre located 2 Km South
SNR 6	Camp Areas	Residential / Commercial	Accommodation camp and commercial area located at ~2 Km South
SNR 7	Askar Village	Residential / Commercial	Residential and commercial area located at 3.5 Km South-East
SNR 8	Camp Areas	Residential / Commercial	Accommodation camp and commercial area located at ~2.7 Km South-East
SNR 9	Camp Areas	Residential / Commercial	Accommodation camp and commercial area located at ~2.2 Km East
SNR 10	Camp Areas	Residential / Commercial	Accommodation camp and commercial area located at ~1.7 Km North-East
SNR 11	Mameer Village	Residential / Commercial	Residential and commercial area located at 4.2 Km North-East
SNR 12	Riffa	Residential / Commercial	Residential and commercial area located at 4.0 Km North
SNR 13	Tatweer Petroleum	Offices	Tatweer Petroleum headquarters located at 2.7 Km South-West
SNR 14	Muaskar Camp	Defence	BDF camp located at 1.4 Km North

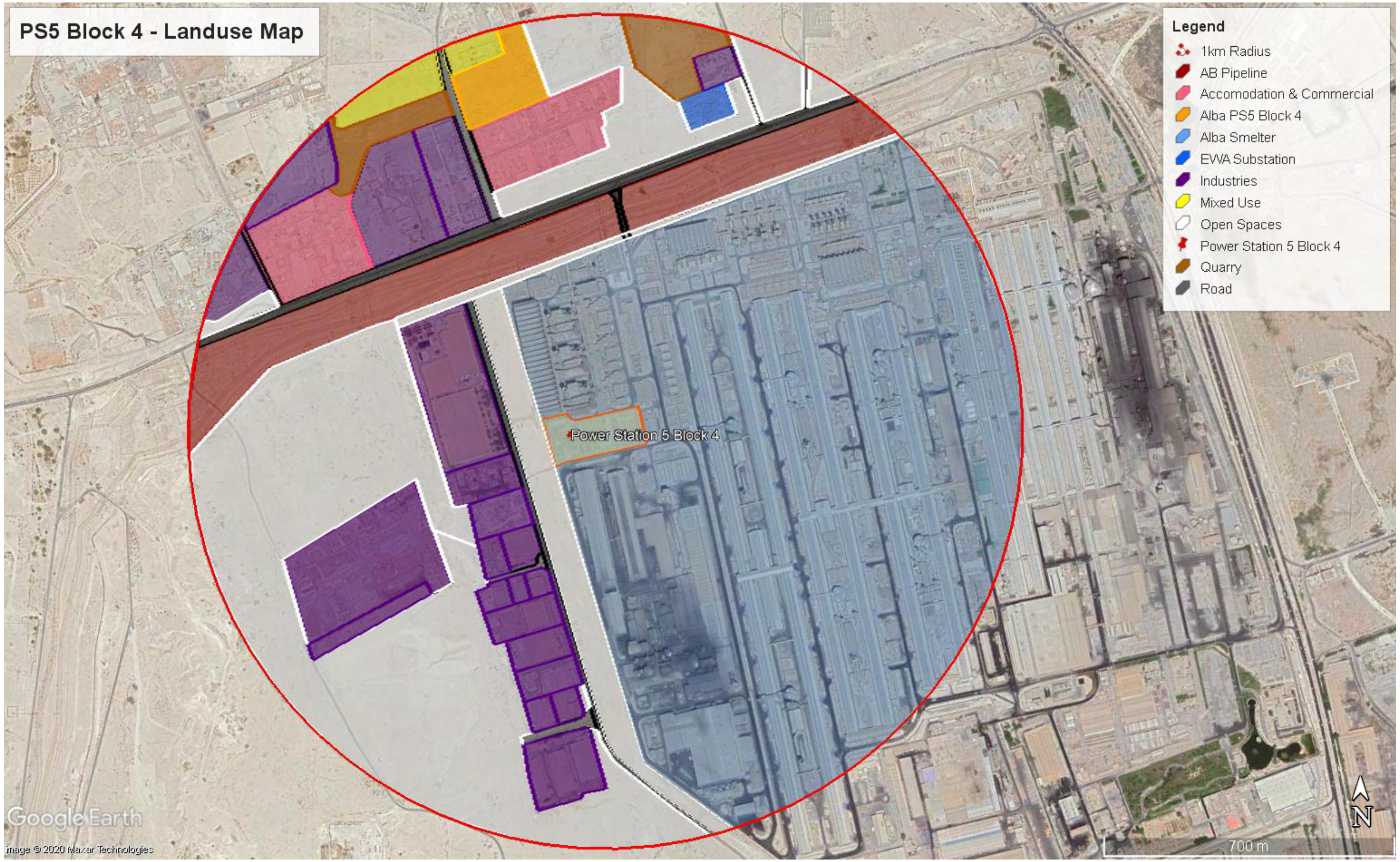

Figure 4-3 Surrounding Land Use / Land Cover within 1 Kilometer Radius of the PS 5 Block 4 Project Location

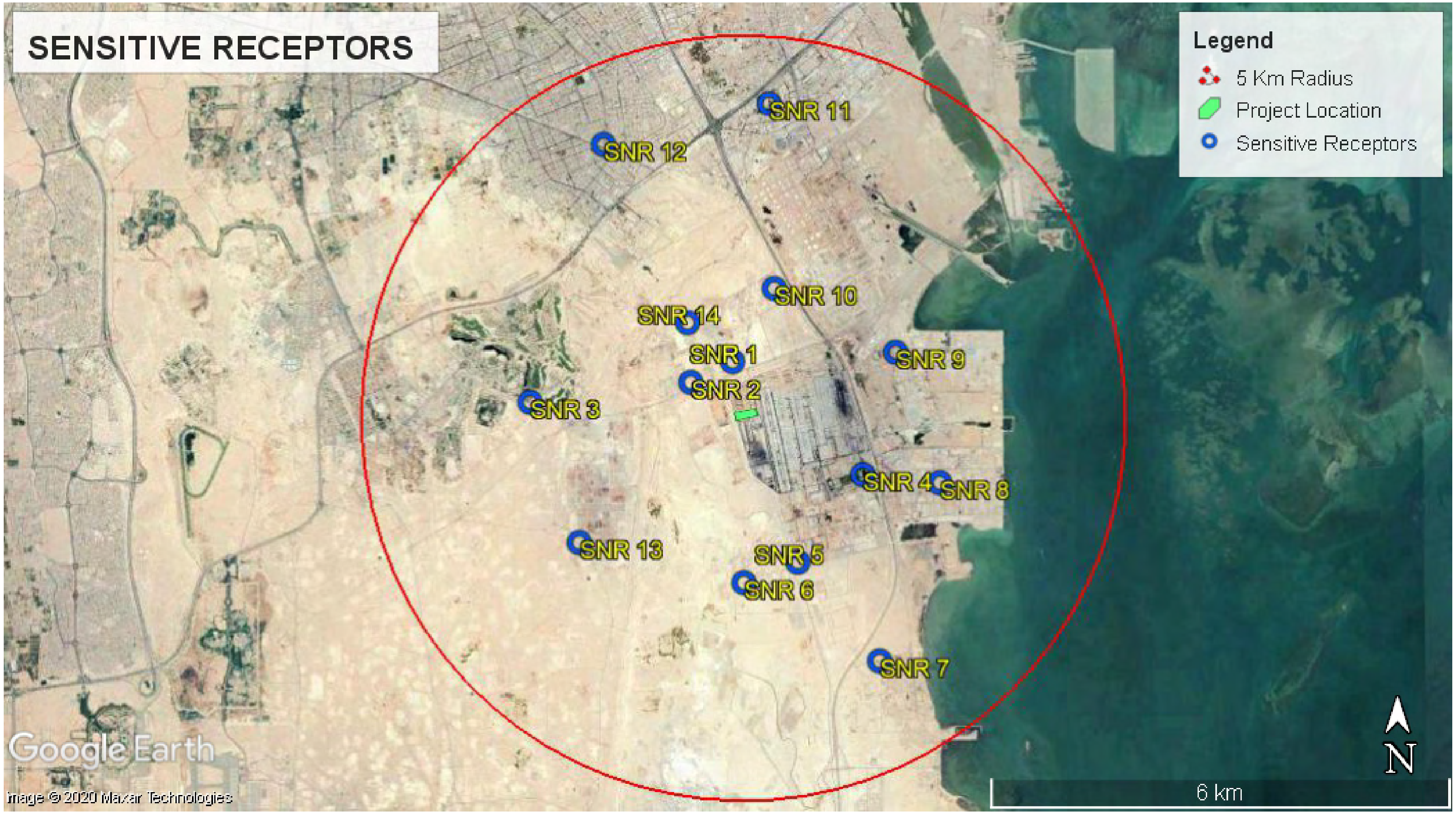

Figure 4-4 Key Sensitive Receptors within 5 Kilometer Radius of the PS 5 Block 4 Project Location

4.6 Project Description

4.6.1 Description of the Proposed Site Layout

The site is predominantly flat generally ranging in elevation between 25 meter to 29 meters. The site layout of the proposed facility is shown in Figure 4-5. Plant layout with Blocks 1 to 3 of PS 5 is given in Appendix A.

It is proposed to access the site from Road 5146 through existing entrance (Gate A) to the site. This will be used as the main entrance to the proposed plot and is located on the South-West Area.

The power generation building comprising gas turbine halls, steam turbine halls and heat recovery steam generator halls will be constructed as one structure with different roof heights determined by the plant components within. The total footprint of the power generation building will be 6,000 m^2. The tallest structures on the site will be the two (2) exhaust stacks from the HRSG units. Main stack will be of 55-meter height and by-pass stack will be of 43 meters height and the ACC structure which will be 47.4 meters tall.

Table 4-5 below provide details of footprints of the main structures on the site and their heights, if applicable.

Table 4-5 Size Details of Facility Components

Component	No. of Units	Foot Print on Site (m^2)	Height (m)
Gas Turbine	1	1250	11.2
Steam Turbine	1	800	10.5
Heat recovery steam generator	1	580	42
Air cooled condenser	1	4,830.72	47.4
GT generator	1	170	8.5
ST generator	1	270	9
GT Transformer	1	299.16	8.35
ST Transformer	1	182	8
Feed water pumps	2	12	3
Cooling water pump (1)	1	10	2.3
Cooling water pump (2)	1	7	1.3
Fin fan coolers	6	810	3
Main Stacks	1	120	55
Bypass Stacks	1	270	43
Electrical and control building	1	514.5	12.5

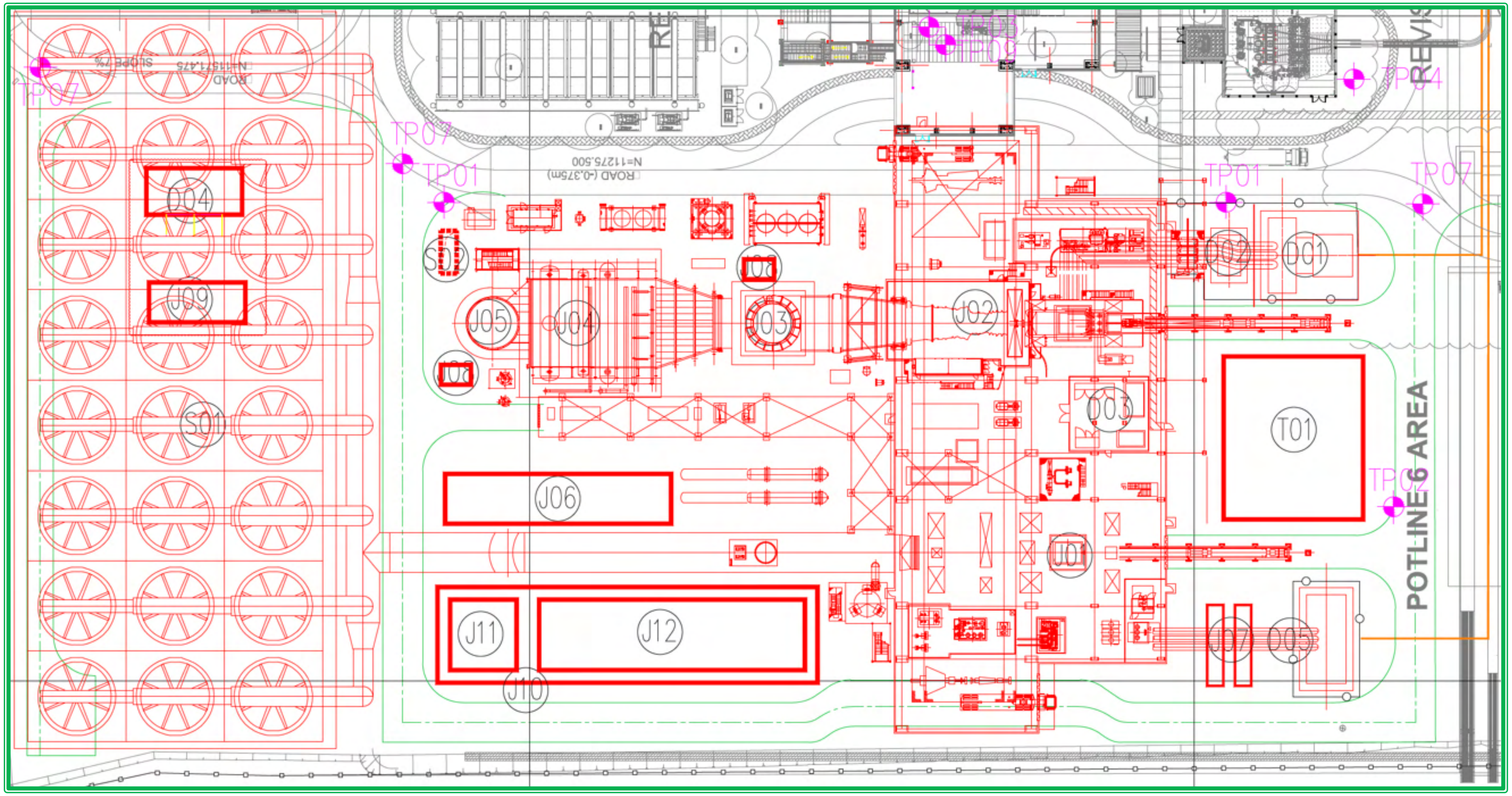

Figure 4-5 Proposed PS 5 Block 4 Layout

4.6.2 Description of Proposed Plant Design

The proposed plant will have capability of producing up to a maximum of 680.8 MW of power. The plant itself (house load) will consume approximately 16,700 Kw/h of the total output. The power generation plant will be constructed as one power Block and will be capable of running in combined cycle mode. 1. The proposed power Block will comprise 475.4 MW J Class gas turbine, heat recovery steam generator (HRSG) and Two-cylinder tandem – compound, single axial exhaust type steam turbine generator producing 217.3 MW.

The combined cycle plant performance specifications are given in table below:

Table 4-6 Proposed Combined Cycle Plant Performance Specifications

CC Net Output (MW)	680.8
CC Net Heat Rate (kJ/kWh, LHV)	5943
CC Net Plant power MW	60.56
CC Net Efficiency (%, LHV)	Summer 384.6MW
Plant Turndown – Minimum Load (%)	Winter 393.5MW
Ramp Rate (MW/min)	72
Startup Time (RR Hot, Minutes)	70

The power plant will be designed and configured to allow for high efficiency base load, while also providing for peak power capacity throughout a wide load range. In combined cycle mode, typical start-up times are as follows:

- From cold start, the plant will take approximately 245 minutes to reach full load
- From warm start, the plant will take approximately 180 minutes to reach full load
- From hot start, the plant will take approximately 70 minutes to reach full load.

4.6.3 Combined Cycle Process

In combined cycle plant, Natural gas is fired in the combustor, then the hot gas from the combustor passes through the Gas turbine and the electricity is generated. Waste exhaust hot gas leaving the Gas turbine passes through the heat recovery steam Generator (HRSG) and steam is generated. Steam generated in the HRSG is admitted into the steam turbine and the electricity is generated. Steam leaving the steam turbine is cooled in the Air-Cooled Condenser (ACC) and the condensate water is send to the HRSG and returned as steam again as water steam cycle as a closed circuit.

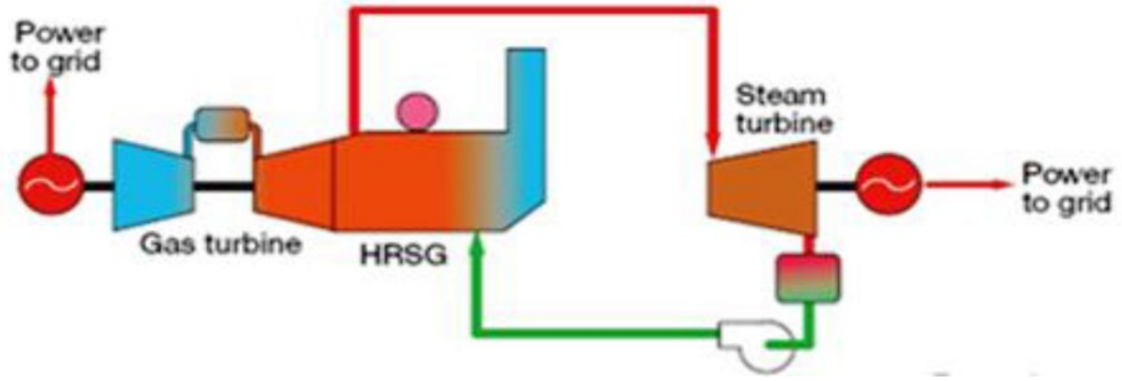

Figure 4-6 Schematic of Process Flow

A detailed process flow chart is provided in Appendix B.

4.6.4 Description of Proposed Plant Components

4.6.4.1 Gas Turbine

The gas turbine is based on M 701 J class Air Cooled technology, which is one of the most efficient gas turbines. The unit also comply with the minimum emissions at part load operations and is rated 475.4 MW. Air enters the gas turbine where it is compressed, mixed with natural gas, and ignited at the combustor, which causes it to expand. Pressure created on the turbine blades due to the expansion of the hot gases rotates the turbine shaft. Generator rotor shaft rigidly coupled with Gas turbine rotor rotates and generates the electricity. Hot exhaust gas exits from the turbine and passes through the Heat Recovery Steam Generator (HRSG). Exhaust temperature of the gas turbine is 670^{0}C.

4.6.4.2 Heat Recovery System Generator (HRSG)

In HRSG, there are layers of tube bundles and are filled with high purity water. The hot exhaust gas coming from the gas turbine passes through these tube bundles, boils the water inside the tubes, and converts that water into steam. The gas then exits HRSG through exhaust stack at lower temperature, after having given up most of its heat to the steam process.

Exhaust gas temperature of gas turbine at site base rating being about 670^{0}C, the maximum pressure and temperature of steam are considered to be 169.7 bar and 601.9^{0}C respectively, with corresponding steam output of 439.8 ton / hour. Care has to be taken to keep the exhaust gas temperature sufficiently above 120^{0}C to avoid condensation of vapor.

4.6.4.3 Steam Turbine

Steam turbine is two-cylinder tandem – compound, single axial exhaust type model and rated for 217.3MW. The steam generated in HRSG is admitted into the steam turbine. Steam enters into the turbine at very high temperature, high pressure and expands. Due to the expansion, pressure of the steam on the turbine blades rotates the turbine shaft. Generator rotor shaft rigidly coupled with Gas turbine rotor rotates and generates the electricity. Steam leaves the turbine after losing the pressure and temperature at low pressure and temperature into an air-cooled condenser and converted into water. By using a combined cycle, the plant is capable of producing more electricity. A CCGT generator can reach efficiency levels of up to 60.56%. The efficiency of the proposed CCGT unit means that this type of generator emits the lowest levels of greenhouse gases per unit of electricity generated when compared to any conventional generation type.

The steam turbine will receive steam at 169.7 bar and temp. 601.9C while exhaust at 78.3 mmHg (abs) on winter and summer at 166.0 mmHg (abs) with corresponding temperature. HP steam flow to the turbine is 439.8 ton/hr, IP steam flow to the Turbine is 62 tons/hr and LP steam flow to the turbine is 0 tons /hr.

4.6.4.4 Air Cooled Condenser

An air-cooled condenser (ACC) with 24 cells is used to condense the exhaust steam from the steam turbine. Steam from the steam turbine exhaust flows through the bundles of tubes and the cooling airflows across the outer surface of the tubes and cools the steam. The cooling air is supplied by forced draught fans. Specially designed fins are attached to the outer surface of the tube to create a large surface heat transfer area for more effective cooling. The heat transfer rate is a function of the fins' surface area and the velocity of the airflow. The mechanical design of the exchanger considers the operating parameters such as pressure temperature flow etc. and also factors in fouling factors, corrosion allowance and preventives and also oxygen scavenging etc. including condensate collection and storage. While the ACC is larger in appearance than alternative cooling options, it significantly reduces the demand for water (closed loop).

Condensate from the ACC is collected in the condensate storage tank and pumped by the condensate extraction pumps to LP pre heater in the HRSG and then to the de-aerator cum LP drum. Feed water from the LP drum is pumped to HP and IP drums by HP feed water pumps to complete the steam water cycle.

4.6.5 Associated Utilities and Facilities

4.6.5.1 Natural Gas

Natural gas will be supplied from existing Alba PS5 gas station. 117.059 mmscfd natural gas will be required during the operation of Block 4.

Khuff and Residual gases are supplied to Power station 5 from the AGS, Alba Gas Station, situated near the Northeast corner of Power Station 5. 2 x 24" Residual gas lines and 2 x 18" Khuff gas lines are supplying gases to Power station 5 from AGS. Each residual gas line will supply at pressure 18 bar and flow 227 mmscfd. Each Khuff gas line will supply at pressure 55 bar and flow 312 mmscfd.

Residual gas lines pass through the knock out drums, filters, metering station and to the gas compressors. There are four gas compressors installed, these compressors compress the gas to 37 bar, and supplies to the gas distribution manifold where all the Blocks' gas-supply lines are connected.

Khuff gas line passes through the knock out drums, filters, metering station, gas heaters where the gas temperature is increased and then to the gas reducing station where the gas pressure is reduced from 55 bar to 37 bar and supplies the gas to the gas distribution manifold where all the Blocks gas-supply lines are connected.

4.6.5.2 Electricity Requirement

Electricity requirement during construction phase is about 4,600 MWh and that during operation phase is 16,700 KW/h. The electricity will be supplied from existing Power Station 5 during the construction and commissioning phase and during operation phase of the plant; the power will be supplied from the unit itself for all the auxiliaries.

4.6.5.3 Water Requirement

Water requirement will be met through Alba's potable water supply network. Water requirement during construction phase is estimated to be 3,600 m^3/month.

During normal operation phase water requirement is estimated to be 180 m^3/month without evaporation. Cooling will require an estimated quantity of 5,000 m^3/month.

4.6.5.4 Diesel Generator

Two 1.25 MVA / 400V Emergency Diesel generators will be installed exclusively for Block 4 to supply to DC systems and the essential loads during black out for safe shut down of the unit.

4.6.5.5 Administration and Control Rooms

All 3 Blocks at PS 5 are monitored and operated from the Main control room. Plant operators monitor and operate the facility, via the plant's 'Distributed Control System', with the click of a mouse, viewing graphic representations of all MEC systems on various screens. The system gives operators both audible and visual signals to keep them informed of plant conditions at all time. Block 4 also will be operated from the same control room. In case of failure of DCS, Block 4 will be operated from the Local control room.

4.6.5.6 Transformers

220KV/ 21.5KV Gas Turbine Generator step up transformer rated for 726 MVA and one 220KV/20KV Steam Turbine Generator step up transformer rated for 293.4 MVA will be connected to the 220KV switch House SH9 where all the existing Power Station 5 machines are connected.

4.6.5.7 Switch Yard

220KV Switch House SH9 was installed and commissioned in 2018. SH9 is getting power primarily from Power Station 5 Block 1 to 3 and supplying power to Potline 6 Rectiformers and for Potline 6 auxiliaries through 220KV/33KV /11.5KV substations. SH9 is connected with 4 x 450MVA reactor to power station 4; 3 x 315 MVA inter bus transformers to Power Station 3; and 4 x 60MVA inter bus transformers to Power Station 1. Power can be transferred from SH9 to all other Power Station and vice versa. Block 4 Gas Turbine and Steam Turbine power generation will be connected to the available SH 9 spare feeders.

4.6.5.8 Process Waste Water Treatment

Process wastewater consists of wastewater generated from boiler blow-down. Boiler blow-down comprises water which has been circulating in the water/steam cycle. If allowed to accumulate, these contaminants can reduce boiler performance. Process wastewater will be continuously generated from the plant while in combined cycle operation mode. There is little wastewater generated while in open cycle mode. Typical normal wastewater volumes generated is approximately 3,600 m^3/Month.

Steam generated in the HRSGs is used to drive the steam turbine generators. The steam is then condensed back to water via the air-cooled condensers for reuse in the process. Therefore, no cooling waters will be discharged. Process effluents from the plant will be routed to existing effluent treatment plant in Alba. Treated water will be used for irrigation.

The following describes plant's process effluent streams and corresponding treatment:

4.6.5.8.1 Gas Turbine Compressor Cleaning Solution

In order to avoid/reduce the gas turbines performance degradation, offline compressor washing, and on-line washing will be performed at certain intervals. The used gas turbine cleaning solution will be temporarily stored in a drain tank and then disposed to outside by the tanker services to the treatment plant. Water requirement for off line compressor wash cycle is estimated at 10.5 m^3 and on-line compressor wash cycle is 0.87 $m^{3.}$ Average water consumption for one online wash per week and three offline wash per year is estimated 0.01 m^3/hr.

4.6.5.8.2 Blow-Down

During blow-down operation, water is blown down into the blow-down tank. Normal
Blowdown volume is estimated at 5 m^3 per hour per gas turbine. This is a water/steam flashing mixture when it enters the blow-down tank. Here, the effluent is cooled prior to being discharged to the effluent treatment plant where it is treated prior to being discharged to irrigation pond.

4.6.5.8.3 Effluents Resulting from Plant Commissioning

During plant commissioning effluent related to plant cleaning procedures (e.g., condensate resulting from pre-operational steam blowing of steam piping) will be produced. If not classified as hazardous liquid waste, these effluents will be diverted to the effluent treatment plant.

If it is not meeting the SCE Criteria, then the contractor shall prepare a method statement extracted from his OESMP related to Effluents handling. Method statement shall describe the scope of work, chemical's quantities to be used, expected effluents quantities, cleaning stages, temporary storage, spillage prevention, disposal stages, third party analysis, treatments, transportation, disposal destinations etc. in adherence to supreme council of environment and Alba environment section procedures and guidelines. Disposal of all hazardous waste shall be in accordance with the thus approved method statement. .

4.6.5.8.4 ACC Cleaning Water

During the cleaning of ACC, 1,700 m^3/year wastewater will be generated. This is comparably low volume of water with potential for oil contamination and will be collected separately through oily water drainage system and routed through a water/oil separator prior to discharge. The water will be disposed in authorized disposal facility after obtaining permission from the SCE. Oily Water Drainage System drawing is provided in Appendix C.

4.6.5.9 Surface / Stormwater

Surface water collected from roofed and paved areas will be delivered to the site storm water drainage system. Surface / Stormwater drainage layout is provided in Appendix D.

4.6.5.10 Chemical Storage

Chemicals will be stored in designated areas and provided with bunding where appropriate. Material Safety Data Sheets are provided in Appendix F. The following is a typical estimate and list of chemicals which will be stored on site:

Table 4-7 Chemicals Requirement during Operation of Block 4

Name	Major Constituents	Consumption (litres/month)	CAS No.	Source
Ammonia	NH_3	150	7664-41-7	Local Suppliers
Carbo Hydrazide	CH_6N_4O	100	497-18-7	Local Suppliers
Tri-Sodium Phosphate	Na_3O_4P	70	7601-54-9	Local Suppliers

4.6.5.11 Lubricants

The following lubricants will be required during the operation of Block 4.

Table 4-8 Lubricants Requirements during Operation of Block 4

Material Identification	Unit	Quantity
Gas Turbine Lube Oil	Liters	15,000
Steam Turbine Lube Oil	Liters	8,000
Gas Turbine Transformer Oil	Liters	6,000
Steam Turbine Transformer Oil	Liters	5,000
Assorted Lubricating Oil	Liters	800
Assorted Grease	Kgs	45

4.7 Construction of the Block 4

4.7.1 Temporary Construction Facilities

Figure 4-7 presents proposed plan for temporary construction facilities and access route to the Block 4 site. Temporary construction areas will be located to the West of project site. At present the area is empty barren land.

The temporary construction area is expected to include construction site offices, material storage area, and sanitary facilities.

Accommodation for the construction staff will be organized by the EPC contractor outside Alba.

4.7.2 Construction Utilities

Electricity and water required during construction phase will be supplied from the existing Alba facilities. Wastewater generated during the construction phase will be stored in septic tanks and hauled to sewage treatment plant.

4.7.3 Construction Timeline

Anticipated construction timeline is presented in the table below:

Table 4-9 Anticipated Construction Timeline

Sl. No.	Activity	Indicative Timeline
1	**Commencement Date**	**31st December 2021(*)**
2	**Site Access start**	**31st December 2021**
3	**Site Mobilization**	
3.1	Start of Piling (if required)	08th February 2022

Sl. No.	Activity	Indicative Timeline
3.2	Start of Foundations	04th July 2022
3.3	Completion of Buildings	31st January 2024
4	**Delivery of Main Equipment to Site**	
4.1	Gas Turbine	10th April 2023
4.2	HRSG	15th July 2023
4.3	Steam Turbine	21st May 2023
4.4	Generator	21st May 2023
4.5	Mechanical Plant	NA
4.6	Electrical Plant	NA
4.7	Generator Transformers	14th June 2023
4.8	C & I	3rd June 2023
4.9	ACC	4th Jan 2023
5	**Start of Erection (Latest Start Date)**	
5.1	Gas Turbine	11th April 2023
5.2	HRSG	18th March 2023
5.3	Steam Turbine	22nd May 2023
5.4	Generator	22nd May 2023
5.5	Mechanical Plant	NA
5.6	Electrical Plant	NA
5.7	Generator Transformers	12th May 2023
5.8	C & I	4th June 2023
5.9	ACC	20th January 2023
6	**Erection Completion**	
6.1	Gas Turbine	18th October 2023
6.2	HRSG	05th February 2024
6.3	Steam Turbine	16th January 2024
6.4	Generator	16th January 2024

Sl. No.	Activity	Indicative Timeline
6.5	Mechanical Plant	NA
6.6	Electrical Plant	NA
6.7	Generator Transformers	11th September 2023
6.8	C & I	11th September 2023
6.9	ACC	15th December 2023
6.10	Mechanical Completion	16th February 2024
7	**Commissioning**	
7.1	Start Block 4	19th October 2023
7.2	Gas Turbine for First Fire	27th November 2023
8	**Chemical Cleaning of Main Water / Stream Circuits**	**5th February 2024**
9	**Steam Blow Commencement**	**16th February 2024**
10	**Steam Turbine Commissioning**	**15th March 2024**
11	**Performance Testing**	**30th May 2024**
12	**Commence Reliability Run**	**31st May 2024**
13	**Complete Reliability Run**	**29th June 2024**
14	**Final Completion**	**29th June 2024**
15	**Take Over Date of the Plant / Commercial Operation**	**29th June 2024**

*LNTP will be required prior to Commencement Date to keep the project schedule.

Detailed construction Schedule is provided in Appendix E.

4.7.4 Work Force

It is expected that a workforce of approximately 1,500 will be at site during peak construction period.

Figure 4-7 Proposed Plan for Construction Access and Temporary Construction Facility Location

5 ALTERNATIVE ANALYSIS

5.1 Site Alternatives

The Block 4 location is close to the existing bocks of Power Station 5 and allows reasonable access to utilities required during the construction and operational phases. The site identified for Block 4 meets the immediate space requirements of the proposed process and ancillary equipment. Further, the location is within the Alba Complex premises. Hence, no site alternatives were considered.

5.2 'No Project' Alternative

On completion of PS 5 Block 4 Expansion Project, the capacity of PS5 will increase from 1,800MW to 2,410MW. Rationale behind the expansion of PS5 Block 4 is the efficiency of this combined cycle power plant is much higher than the combined cycle power plants of PS 3 and PS 4.

Further to the completion of the expansion project, Power Station 3 – which is operating on a low load – can be shut down and kept as emergency standby. Power Station 4 will be running partially.

From the above it can be concluded that commissioning of Block 4 will be more environmentally sustainable than operating the older PS 3 and PS4 plants. Hence, 'No Project' alternative is not considered.

5.3 Technology Alternatives

5.3.1 Combined Cycle Power Generation

Combined-cycle power plants are compound gas turbine–steam turbine systems wherein the extreme hot exhaust from a gas turbine is employed to run a boiler, and the steam thus produced is fed into a steam turbine to generate power.

The idea of combined cycles has grown out of the need to improve the simple Joule cycle efficiency by utilizing the waste heat in the turbine/engine exhaust gas. This is a natural solution because the gas turbine/engine is a relatively high-temperature machine and the steam turbine a relatively low-temperature machine. The flue-gas temperature at a gas turbine outlet for example is about 500°C or more. This temperature creates the possibility to apply an additional steam cycle process. Such a system combination optimizes the gas and steam processes to increase the overall electric or mechanical efficiency [6, JRC BREF].

Combined Cycle Power Plants can deliver high power output at efficiencies as high as 50%–60% with low emissions and produce 50% more electricity than a simple-cycle plant consuming the same amount of fuel. Due to their high efficiency and the fact that they usually burn natural gas fuel, gas turbine–based power plants also emit far less carbon dioxide than other types of fossil fuel power plants.

The advantages of Combined Cycle Power Plants include, but not limited to, the following:

- Capital cost is lower than other power plants.
- They have a small footprint and do not require much space when compared to other modes of power generation.
- Less operating and maintenance staff is required.
- Construction time is short compared to other types of power plants.
- Due to its ability to start up quickly and respond to demand changes rapidly, the combined cycle power plant has become the ideal companion for renewable power generation sources such as wind energy and solar energy, whose output is variable.

Hence, the development of CCP has been identified by Alba as the most feasible technology alternative for the electricity generation.

5.3.2 Cooling Technology

Alba propose to use air-cooled condenser (ACC) to condensate the exhaust steam from the steam turbines. Steam from the steam turbine exhaust flows through the bundles of tubes and the cooling airflows across the outer surface of the tubes and cools the steam. The cooling air is supplied by forced draught fans.

The most evident advantages of air-cooled condensers are:

- No problem arising from thermal and chemical pollution of cooling fluids;
- Flexibility for any plant location and plot plan arrangement because equipment requiring cooling need not be near a supply of cooling water;
- Reduction of maintenance costs;
- Easy installation;
- Lower environmental impact than water cooled condenser due to the elimination of an auxiliary water supply resulting in water saving;
- No use of water treatment chemicals and no need for fire protection system.

6 ESIA APPROACH AND METHODOLOGY

This chapter describes the proposed methodology which will be used to predict the magnitude of environmental and social impacts, and to assess the significance of the effect on project activities.

6.1 Study Area

An environmental study area of 5 km (particularly in terms of air quality impacts) radius and a social study area of 1 km radius have been established to define the scope of the areas that will be studied for the purpose of the ESIA (Figure 6-1). Sections 7 to **Error! Reference source not found.** details the proposed field and desktop studies that will be undertaken to determine baseline conditions and potential impacts of the project.

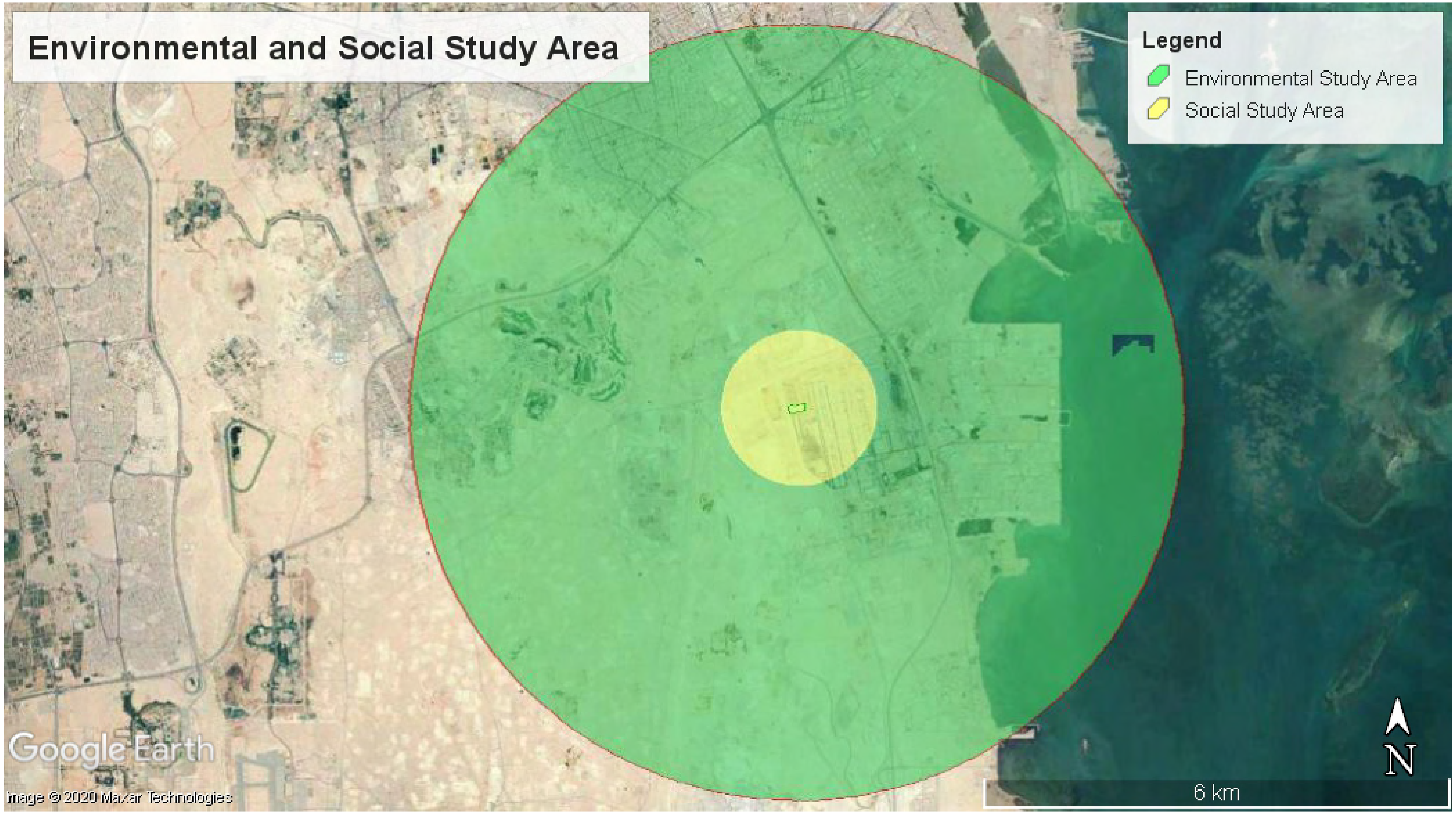

Figure 6-1 Environmental and Social Study Area

6.2 Determining Significance of Environmental Impacts

Impacts will be considered based on their magnitude, duration, and reversibility. Cumulative and combined effects will also be considered where appropriate. Significance will be evaluated based on the scale of the impact and importance or sensitivity of the receptors, in accordance with standard assessment methodologies, as per the EIA – 2 (Topics to be covered in the Environmental Impact Assessment Report) of Supreme Council for Environment (SCE).

The criteria for the assessment of significance of the impacts in terms of classification, magnitude, duration, and extent of impacts are presented in Table 6-1 to Table 6-4.

Table 6-1 Classification of Impacts

Beneficial and positive	Aspects which support the Project through construction including providing environmentally friendly treatment processes and systems, judicious use of resources, employment generation, enhancement of local infrastructures, and enhancement and boosting of national image.
No impacts	Aspects in which no harm or risk is assessed to be caused during the project implementation.
Negligible and minimum	Actions which individually or cumulatively may not affect the environment and public health.
Adverse and negative	Operations which may be intolerable, undesirable, and unacceptable and require some action and mitigation for its improvement, minimization, and elimination.

Table 6-2 Magnitude of Impacts

Magnitude of Impacts	
Major Beneficial	The impact is large scale and likely to give rise to a significant gain to environment, public health, and economy.
Moderately Beneficial	The impact will be provided a moderate gain to the environment, public health, and economy.
Minor Beneficial	The impact is limited and of small dimension and will have slight benefit to the environment, public health, and economy.
Minor Adverse	The impact is limited and of small dimensions. The impact is undesirable but acceptable and will have slight negative impact to the environment, public health, and economy.
Moderately Adverse	The impact will give rise to some concerns but is likely to be tolerable on short term basis and can be manageable after implementation of the mitigation measures, management, and monitoring plans. The impact will require a value judgment as to its acceptability.

Magnitude of Impacts	
Major Adverse	The impact is large scale giving rise to generate concern and is assessed as unacceptable and requires appropriate mitigation measures, compensation or a significant change in the development sequence and form. If possible, economical, and technically feasible alternatives will be considered. If no mitigation is possible, then the impact will require the value judgment for acceptability by the receptors and beneficiaries.

Table 6-3 Duration of Impacts

Duration of Impacts	
Temporary	Impacts which can be abated within a short period of time
Short-Term	Short-term impacts or effects of the project are those that would occur during the life of the project.
Long-Term	Long-term impacts from the project are those that would persist beyond the final closure.
Permanent / Irreversible	Impacts whose abatement will be impractical or impossible.

Table 6-4 Extent of Impacts

Extent of Impacts	
On-Site	Limited to the confines of the construction area and its direct immediate vicinity
Local	Limited to an area of approximately 1-km radius of the project area.
National	Limited to the entire country
Regional	Limited to the Gulf region

Where likely significant environmental impacts are identified in the assessment process, economically; environmentally and technically viable mitigation measures to ameliorate the impacts as far as practicable and achievable will be put forward in the form of recommendations to be undertaken as part of the Project development. Any residual impact i.e., the impacts still outstanding following the successful implementation of mitigation measures needs to be addressed in the Environmental Management and Monitoring Plans (EMMP). This approach is intended to enhance and conserve environmental resources and safeguard public health.

7 STAKEHOLDER ENGAGEMENT

7.1 Introduction

Any establishment or community which influence the project or can influence the project or is affected by the project and its activities is termed as a stakeholder. Consultation with stakeholders is an important process in ESIA Study which provides stakeholders an opportunity to understand the project and present their opinions and views on the project and its associated activities. The consultation process includes informing the stakeholders regarding the project and its anticipated environmental impacts during construction as well as operation phases. Their responses are compiled and presented to the project proponent. Mitigation measures are proposed for the concerns raised by stakeholders and critical responses may lead to change in project processes and design.

Stakeholder Consultations were carried out in compliance with the Equator Principles and the IFC Performance Standards.

7.2 Identification of Stakeholders

It is envisaged that impacts of the project will be limited to the environs within 1km radial distance, during Construction as well as Operation phase. Hence, the target receptors for the project are deemed distance-bound and stakeholders located within 1km radius of the project were consulted for the ESIA study. Stakeholders identified for the project is given in Table 7-1 and Table 7-2.

Table 7-1 Stakeholders Identified for Alba PS 5 Block 4 Expansion ESIA Study – Government Organizations

Sl. No.	Organizations	Area of Interest
1	Aluminium Bahrain B.S.C	Project Owner
2	**Government Organizations**	
2.1	Supreme Council for Environment (SCE)	— Ambient Air Quality — Water and liquid waste — Biodiversity / Ecology — Waste
2.2	Agricultural Engineering and Water Resources Directorate	Groundwater Resources
2.3	Ministry of Transport and Telecommunications	Upcoming projects in the vicinity
2.4	Southern Area Governorate	Local Governorate

Sl. No.	Organizations	Area of Interest
2.5	Southern Area Municipality	Local Municipality
2.6	Roads and Planning Projects Directorate	Traffic, Roads and ROW

Table 7-2 Stakeholders Identified for Alba PS 5 Block 4 Expansion ESIA Study – Private and Residences / Localities

Sl. No.	Organization	Sector	Location w.r.t Project Site
Private Organizations			
1	AMGARD (Ameeri Industries)	Hot dip galvanizing for Steel materials and manufacturer of Safety Road Guard Rails, Bridge Parapets and Street Light Poles	630m South
2	Middle East Fiber Glass	Manufacturer of a fiber glass especially Glass reinforced plastic (GRP) and Unplasticized polyvinyl chloride (uPVC) products	540m South
3	Gulf Pumps Factory W.L.L	Designing and assembling of high technology pumps and pumping systems	530m South
4	Polycon Bahrain	Manufacturer of polyethylene water tanks, road barriers and roto-molded products	465 m South
5	Tylos Plastic Industries Co. W.L.L	Manufacturer of Plastic Pipes and Fittings	385m South
6	Empack (Eminent Packaging System, W.L.L)	Manufacturer of plastics products using injection molding and extrusion techniques	310m South
7	Downtown Contracting Company	Construction, Electrical and Mechanical contracting company	335 m South-west
8	Justa Star Kitchens Manufacturing Co. W.L.L	Manufacturer of stainless-steel kitchen equipment	310m South-west
9	Dona Tissue	Manufacturer of soft paper rolls	275m South-west

Sl. No.	Organization	Sector	Location w.r.t Project Site
10	Green Products Industries WLL	Manufacturer of fire-resistant external insulation panel board products	250m South-west
11	Unichem Chemicals & Asphalt W.L.L.	Production of High-performance construction chemicals using modified Bitumen products	225m South-west
12	Al Salam Furniture Industries W.L.L.	Furniture manufacturers primarily in the field of carpentry, joinery, and Aluminium works	155 m South-west
13	Bahrain Bitumen (MERCO)	Petrochemicals & Bitumen manufacturing company	90 m West
14	WestPoint Home - Finish & Stitching Unit	Home and fashion Textile manufacturing unit	100 m West
15	Sayed Kadhem Al Durazi Laydown yard	Contractors for Infra-structure, machinery, construction, ready-mix and concrete	745m North-west
16	Bahrain Atomisers International	Atomised Aluminium grit and powder producers	500m North-west
Residences / localities			
There are no residences within 1km radius of the project. Accommodation and Commercial facilities are located at 570 m North-west and 600 m north from the project site.			

Stakeholders and facilities in 1 km radius of the PS5 Block 4 plant is presented in Figure 7-1.

The stakeholders have the potential to get influenced by one or more environmental parameters of the project during construction as well as the operation phase. A summary of possible influence (beneficial / non-beneficial) of the environmental parameters on these stakeholders is given in Table 7-3.

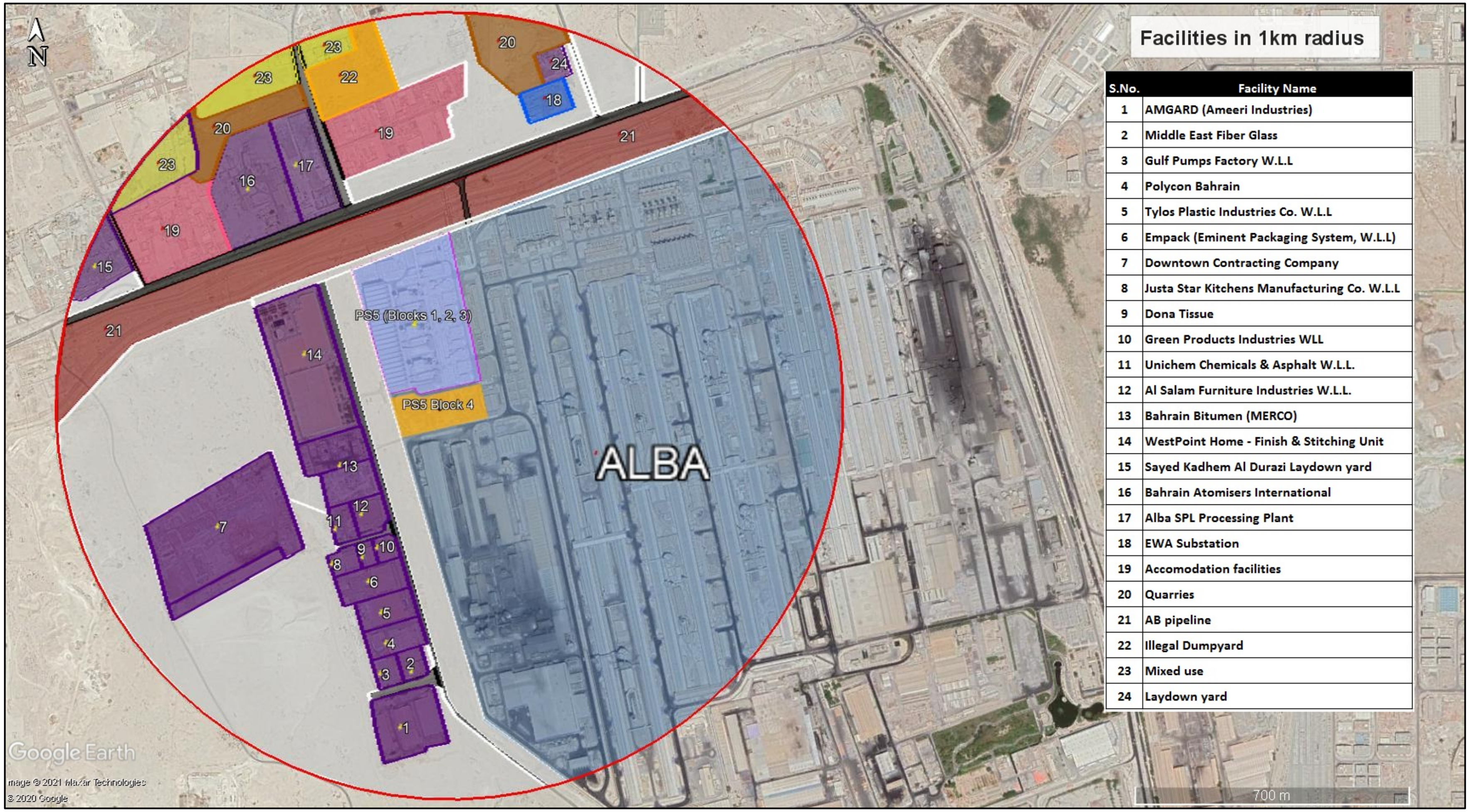

Figure 7-1 Stakeholders and Facilities within 1 Kilometer Radius

Table 7-3 Influence of Environmental Parameters on the Stakeholders

Stakeholder	Environmental parameters							
	Air quality	Noise & vibration	Traffic	Geology & Ground water	Ecology	Health & safety	Waste	Accidental Impacts
Southern Area Governorate	x	x	✓	x	x	✓	✓	✓
Southern Area Municipality	x	x	x	x	x	✓	✓	✓
Agriculture Engineering and Water Resources Directorate (AEWRD)	x	x	x	x	x	x	x	✓
Ministry of Transport and Telecommunications (MTT)	x	x	x	x	x	x	x	✓
Roads Planning & Design Directorate (RPPD)	x	x	✓	x	x	x	x	✓
EWA substation	x	x	x	x	x	x	x	✓
AMGARD (Ameeri Industries)	✓	x	✓	x	x	x	x	✓
Middle East Fiber Glass	✓	✓	✓	x	x	✓	x	✓
Gulf Pumps Factory W.L.L	✓	x	✓	x	x	✓	x	✓
Polycon Bahrain	✓	x	✓	x	x	✓	x	✓
Tylos Plastic Industries Co. W.L.L	✓	✓	✓	x	x	✓	x	✓
Empack (Eminent Packaging System, W.L.L)	✓	✓	✓	x	x	✓	x	✓
Downtown Contracting Company	✓	x	✓	x	x	✓	x	✓

Stakeholder	Environmental parameters							
	Air quality	Noise & vibration	Traffic	Geology & Ground water	Ecology	Health & safety	Waste	Accidental Impacts
Justa Star Kitchens Manufacturing Co. W.L.L	✓	x	✓	x	x	✓	x	✓
Dona Tissue	✓	x	✓	x	x	✓	x	✓
Green Products Industries WLL	✓	x	✓	x	x	✓	x	✓
Unichem Chemicals & Asphalt W.L.L.	✓	x	✓	x	x	✓	x	✓
Al Salam Furniture Industries W.L.L.	✓	x	✓	x	x	✓	x	✓
Bahrain Bitumen (MERCO)	✓	✓	✓	x	x	✓	x	✓
WestPoint Home - Finish & Stitching Unit	✓	✓	✓	x	x	✓	x	✓
Sayed Kadhem Al Durazi Laydown yard	x	x	✓	x	x	x	x	✓
Bahrain Atomisers International	✓	x	x	x	x	x	x	✓
Bahrain Society for the Prevention of Cruelty to Animals (BSPCA)	✓	x	x	x	x	x	x	x
Environment Friends Society (EFS)	✓	x	x	x	x	x	x	x
General Public	✓	✓	✓	x	x	✓	✓	✓

7.3 Methodology

Envirotech carried out extensive consultations with deemed target receptors i.e. government and non-government agencies, private establishments and community members to make them aware and appreciate the project and to secure their concerns and recommendations on the proposed project. Correspondence with the target receptors was done in the form of:

- Phone
- Email
- Formal meetings
- Online meeting portals (Zoom Cloud /Microsoft teams)

Details of communication carried out with the stakeholders for the ESIA is provided table below.

Table 7-4 Timeline of Stakeholder Consultations

Sl. No.	Organizations	Details of communication
Project Owner		
1	Aluminium Bahrain B.S.C	Main stakeholder
Government Organizations		
1	Agriculture Engineering and Water Resources Directorate (AEWRD)	• Project details submitted on 7th December 2020 • NOC obtained on 14th January 2021
2	Ministry of Transport and Telecommunications (MTT)	• Project details submitted on 23rd November 2020 • NOC obtained on 3rd December, 2020
3	Roads Planning & Design Directorate (RPDD)	Project details submitted on 23rd November 2020. No responses received.
4	Southern Area Governorate	Project details submitted on 15th November 2020. No responses received.
Private Industries/Facilities		
1	AMGARD (Ameeri Industries)	Communication for Consultation sent on 15th November 2020. No responses received.
2	Middle East Fiber Glass	• Communication for Consultation sent on 2nd December 2020 • Consultation held on 7th December 2020 • Waiting for signed Minutes of meeting

Sl. No.	Organizations	Details of communication
3	Gulf Pumps Factory W.L.L.	Communication for Consultation sent on 15th November 2020. No responses received.
4	Polycon Bahrain	Communication for Consultation sent on 15th November and 2nd December 2020. No responses received.
5	Tylos Plastic Industries Co. W.L.L.	• Communication for Consultation sent on 2nd December 2020 • Consultation held on 7th December 2020 • Communication for Consultation sent on 28th December 2021 • Consultation held on 04th January 2022 • Minutes of meeting signed
6	Empack (Eminent Packaging System, W.L.L)	• Communication for Consultation sent on 2nd December 2020 • Consultation held on 13th December 2020 • Communication for Consultation sent on 23rd December 2021 • Consultation held on 28th December 2021 • Minutes of meeting signed
7	Downtown Contracting Company	Communication for Consultation sent on 15th November 2020. No responses received.
8	Justa Star Kitchens Manufacturing Co. W.L.L.	Communication for Consultation sent on 15th November 2020. No responses received.
9	Dona Tissue	Communication for Consultation sent on 15th November 2020. No responses received.
10	Green Products Industries WLL	Communication for Consultation sent on 15th November 2020. No responses received.
11	Unichem Chemicals & Asphalt W.L.L.	Communication for Consultation sent on 15th November and 2nd December, 2020
12	Al Salam Furniture Industries W.L.L.	Communication for Consultation sent on 15th November 2020. No responses received.
13	Bahrain Bitumen (MERCO)	Communication for Consultation sent on 15th November 2020. No responses received.
14	WestPoint Home - Finish & Stitching Unit	• Communication for Consultation sent on 15th November 2020 • Consultation held on 18th November 2020 • WestPoint Home did not sign on the minutes of meeting.

Sl. No.	Organizations	Details of communication
15	Sayed Kadhem Al Durazi Laydown yard	Communication for Consultation sent on 15th November 2020. No responses received.
16	Bahrain Atomisers International	• Communication for Consultation sent on 15th November 2020 • Consultation held on 17th November 2020 • Communication for Consultation sent on 28th December 2021 • Consultation held on 30th December 2021 • Minutes of meeting signed
Non-Government Organizations		
1	Bahrain Society for the Prevention of Cruelty to Animals (BSPCA)	Communication for Consultation sent on 15th November 2020. No responses received.
2	Bahrain Environment Society	Communication for Consultation sent on 15th November 2020. No responses received.

During the stakeholder interaction, Envirotech presented project information to the stakeholders and allowed them to provide their views and opinions. All the required technical documents were circulated to the stakeholders during the interactions. The minutes of these meetings were recorded, and draft minutes were shared with the stakeholders before finalizing them. The minutes of stakeholder meetings are annexed along with communication details with non-responsive stakeholders.

7.4 Summary of Consultations

Stakeholder consultations were ongoing during the time of this report preparation. The major outline of the views and opinions received from stakeholders is presented below:

- No objections have been received from two government organizations - AEWRD and MTT.
- Eminent Packaging Systems, Bahrain Atomisers and Tylos Plastic Industries claimed that persistent brown colored deposits are visible on their office walls, cars, trucks, and stored products. Mr. Sayed Salah explained that Alba was also a victim of the brown spot deposition and as per the instructions from the Supreme Council for Environment Alba appointed an Environmental Consultant to study the phenomenon. The scope of the study was given by the SCE to the appointed consultant. The consultant did an extensive study in the area and collected samples from different locations and analyzed. A formal report was then submitted to the SCE as well as Alba. The report concludes that the depositions observed in the area are not generates from the operation of Aluminium Smelters. Mr. Sayed Salah shared a summary of the report to Stakeholders.

- Empack informed that occasional smoke releases during the night-time which makes their operation area unworkable, affecting badly their employees resulting eyes burning, breathing difficulty and cough because of the smoke. Mr. Sayed Salah explained that smoke is releasing from carbon plant by-pass stacks in every four (4) to six (6) months. Alba keeps Supreme Council for Environment about the bypass stack releases. Mr. Sayed Salah ensured that Alba would contact Empack to inform about future bypass stack releases as and when it happens.
- Empack added that during the construction times of potline 6 expansion heavy vehicles parking outside the company's premises disturbing their vehicles movement. Mr. Sayed Amer ensured that the Project is small scale in comparison to potline 6 expansion Project. Thus, the traffic generation from the project will be very less.
- Bahrain Atomisers made an observation that noise levels were very high in the area during the initial stages of commissioning of Line 6 but gradually decreased and are now stable.
- No objections have been received from Eminent Packaging Systems, Kymera, and Tylos Plastic Industries Co. W.L.L.
- Tylos Plastic Industries suggested Alba to develop greenbelt along their fence line by planting *Casuarina* and *Ficus* spp.

8 CLIMATE

8.1 Baseline

Bahrain is characterized by hot to extremely hot summers (June to September) and warm to mild winters (December to March) with little precipitation. The country is classified as semi-arid desert, although relative humidity remains at fairly high levels due to the proximity of the Arabian Gulf. Visibility is generally good. In winter, occasional heavy rain showers and thunderstorms can be expected.

Temperature - The maximum temperature reaches up to the high 45°C during daytime in summer while the minimum night temperature ranges from low 30's°C in summer to a low of 9°C in winter.

Relative humidity – The mean relative humidity ranges between 38.7% and 69.4%.

Rainfall – The annual rainfall averages approximately 71 mm with nearly all the precipitation occurring during the wet season (November to April). Most of this occurs over a relatively short period in only a few intense storms.

Wind – The prevailing wind direction in Bahrain is from the north-west quadrant (330-360°, 'Shamal' winds). Mean monthly maximum wind velocities can reach 30-32 km/h from February through August. Wind velocities in February and March can reach peaks (gusts) of 125 km/h.

Climatic conditions at the Southern Governorate obtained from Lakes Environmental Canada is presented in Table 8-1.

8.1.1 Wind

Wind roses comprise of 16 spokes which represents the direction from which the winds blew during the period under review. The colors reflect the different categories of wind speeds. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories.

Based on the evaluation of the meteorological data obtained from the Lakes Environmental, Canada and Figure 8-1 below, the predominant wind direction is for the area under review occurs mainly from North Eastern and North Western regions. Secondary winds were noted from the South Eastern Quadrant.

Figure 8-2 illustrates the wind class frequency distribution for the 2016 to 2020 period. 39.1% of the total wind speeds experienced fell within the 3.6 – 5.7 m/s wind class, while 29.9 % of the total wind speeds fell within the 2.1 – 3.6 m/s wind class. Calm winds were 0.5% during this period.

Table 8-1 Climatic Conditions during the Period from 01st January 2016 to 31st December 2020

Parameters		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
YEAR 2016													
Temperature (^0C)	Minimum	8.1	10.2	16.2	16.0	22.4	24.6	26.5	26.4	23.7	20.7	16.7	11.9
	Maximum	27.4	29.2	35.5	38.0	40.9	44.1	45.7	45.7	42.2	37.8	33.2	30.5
	Average	17.4	18.4	22.8	25.7	31.6	33.4	34.8	34.3	32.4	27.9	23.9	19.8
Relative Humidity (%)	Minimum	25.0	11.0	14.0	11.0	8.0	6.0	7.0	9.0	10.0	7.0	26.0	20.0
	Maximum	100.0	100.0	99.0	100.0	99.0	100.0	100.0	98.0	99.0	100.0	99.0	100.0
	Average	63.7	59.6	55.3	50.5	43.3	43.5	54.4	65.2	55.3	56.3	65.5	66.4
Wind Speed (m/s)	Minimum	0.5	0.3	0.3	0.4	0.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Maximum	10.6	9.2	13.9	12.8	13.2	10.7	11.1	7.7	10.4	7.2	9.7	8.9
	Average	4.5	4.5	4.4	3.9	4.4	4.6	4.4	3.5	4.0	3.4	3.7	4.2
Precipitation (mm/hr)	Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maximum	0.2	0.0	1.4	1.3	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0
	Average	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
YEAR 2017													
Temperature (^0C)	Minimum	10.3	6.8	12.6	16.9	24.1	23.3	25.8	28.0	25.8	22.6	18.2	13.0
	Maximum	26.5	30.2	32.9	39.0	44.0	46.6	46.0	42.8	41.5	38.9	33.2	29.2
	Average	17.9	16.9	21.5	27.0	32.6	34.2	34.8	34.4	32.8	30.0	25.3	19.9
Relative Humidity (%)	Minimum	15.0	15.0	18.0	10.0	6.0	5.0	6.0	14.0	16.0	12.0	20.0	16.0
	Maximum	97.0	99.0	99.0	98.0	90.0	100.0	100.0	99.0	96.0	98.0	91.0	92.0

ENVIROTECH CONSULTANCY W.L.L.

Parameters		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	Average	62.8	61.4	63.5	50.4	41.1	38.7	58.3	68.0	65.4	58.0	57.2	57.0
Wind Speed (m/s)	Minimum	0.5	0.4	1.0	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.4
	Maximum	8.8	14.3	14.9	11.0	13.7	12.1	8.1	7.3	7.6	8.1	8.3	9.6
	Average	4.2	4.6	4.3	4.4	4.7	5.2	3.5	3.6	3.3	3.5	3.6	4.0
Precipitation (mm/hr)	Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maximum	0.0	7.1	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0
	Average	0.00	0.05	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
YEAR 2018													
Temperature (^{0}C)	Minimum	11.1	11.6	16.0	19.5	22.7	26.4	27.0	27.6	26.1	22.3	18.6	14.0
	Maximum	27.7	33.0	36.5	41.4	44.2	45.3	46.4	45.3	40.8	39.6	34.5	28.9
	Average	17.8	19.4	23.5	26.7	30.8	35.0	35.4	34.6	32.8	30.3	25.9	21.5
Relative Humidity (%)	Minimum	10.0	12.0	9.0	8.0	6.0	7.0	8.0	9.0	9.0	14.0	26.0	24.0
	Maximum	92.0	100.0	99.0	92.0	100.0	97.0	100.0	100.0	99.0	100.0	95.0	92.0
	Average	57.8	64.3	53.3	49.6	42.7	41.4	46.3	54.0	68.4	60.3	60.5	63.2
Wind Speed (m/s)	Minimum	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.4	0.3	0.3	0.8	0.3
	Maximum	8.6	9.8	9.2	13.8	14.1	12.6	12.0	10.3	7.0	8.0	11.0	8.1
	Average	4.1	3.9	3.6	4.4	3.5	4.9	4.5	4.3	3.3	3.9	5.3	3.7
Precipitation (mm/hr)	Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maximum	0.1	20.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	1.3	0.0
	Average	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Parameters		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
YEAR 2019													
Temperature (^{0}C)	Minimum	11.3	13.1	12.4	18.0	22.7	27.1	27.2	27.3	25.9	24.2	15.5	13.7
	Maximum	29.4	27.3	30.0	38.7	43.1	45.4	44.8	44.6	42.4	39.4	31.7	27.6
	Average	19.7	18.7	19.9	25.2	31.0	34.7	34.8	33.9	32.6	30.0	24.2	20.3
Relative Humidity (%)	Minimum	16.0	26.0	17.0	7.0	6.0	7.0	7.0	7.0	11.0	19.0	24.0	24.0
	Maximum	97.0	98.0	98.0	93.0	94.0	99.0	100.0	100.0	100.0	100.0	94.0	98.0
	Average	61.4	61.9	58.2	48.2	40.4	45.4	45.9	58.0	63.3	69.2	58.0	67.5
Wind Speed (m/s)	Minimum	0.3	0.5	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Maximum	10.0	11.6	16.0	12.3	12.5	12.5	10.5	9.9	7.1	7.5	9.0	11.6
	Average	4.7	4.8	4.7	4.8	3.6	4.0	4.5	3.9	3.4	3.5	3.7	4.0
Precipitation (mm/hr)	Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maximum	0.0	0.3	3.8	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.5
	Average	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01
YEAR 2020													
Temperature (^{0}C)	Minimum	9.9	7.3	11.9	18.4	21.3	24.4	26.1	25.1	23.5	19.2	15.7	12.6
	Maximum	30.1	32.9	30.9	42.5	40.7	45.2	46.3	45.1	42.5	36.3	33.1	31.1
	Average	17.1	18.1	20.9	26.7	30.1	34.1	34.4	34.1	31.4	27.6	24.0	19.5
Relative Humidity (%)	Minimum	20.0	15.0	19.0	8.0	9.0	5.0	5.0	7.0	10.0	15.0	18.0	30.0
	Maximum	96.0	100.0	100.0	94.0	100.0	100.0	98.0	100.0	100.0	100.0	100.0	99.0
	Average	61.8	63.3	61.9	51.3	47.1	40.7	61.2	52.8	69.4	64.5	68.1	68.4

Parameters		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Wind Speed (m/s)	Minimum	0.3	0.3	0.3	0.4	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
	Maximum	10.1	10.2	15.8	10.6	10.9	11.8	10.3	8.9	8.3	6.9	8.4	8.4
	Average	4.4	4.4	4.7	4.7	3.9	5.0	4.1	4.3	3.6	3.4	3.8	3.9
Precipitation (mm/hr)	Minimum	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Maximum	3.1	0.0	1.6	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
	Average	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

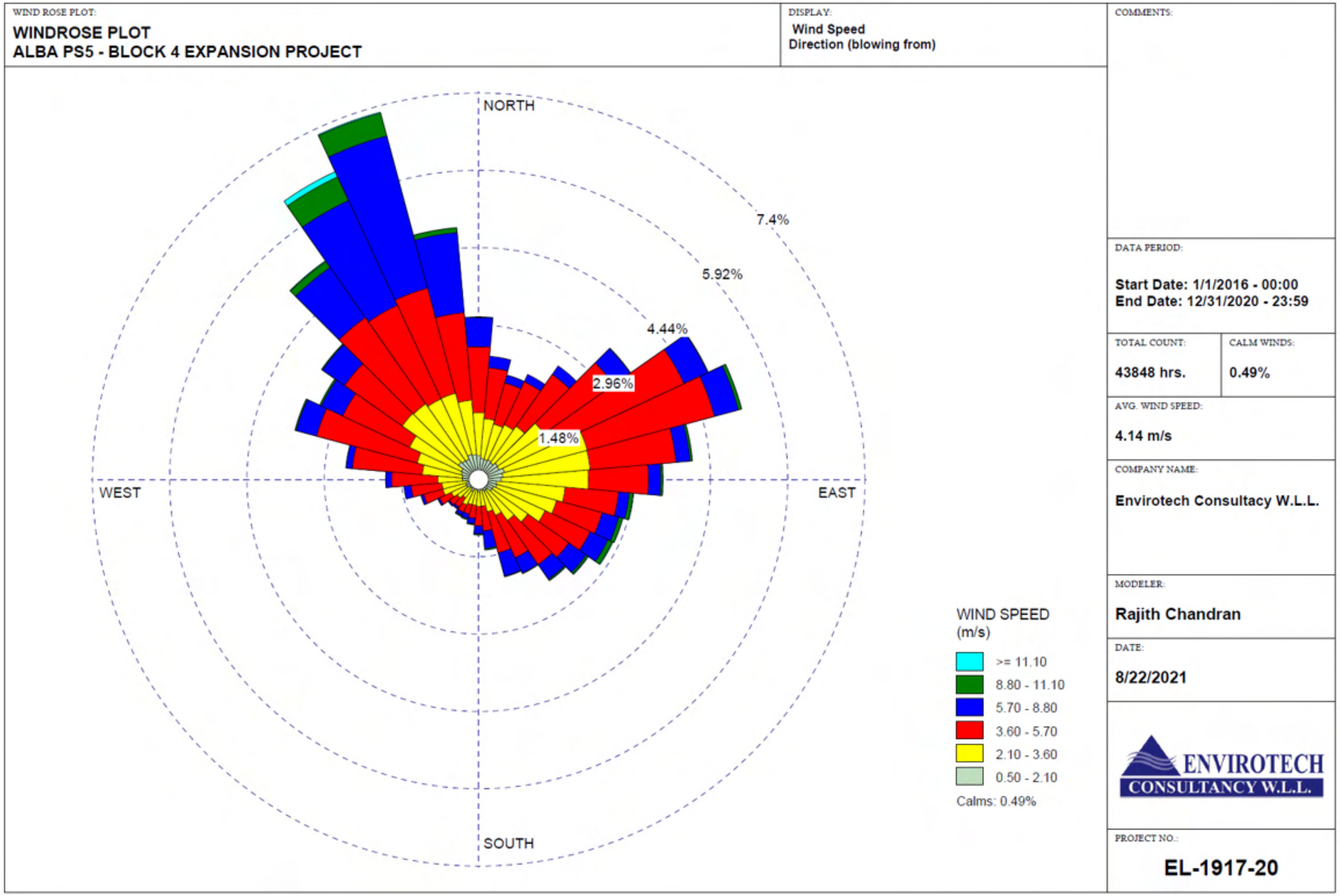

Figure 8-1 Wind Rose Plot Detailing Wind Speed and Direction (blowing from) from 2016 to 2020

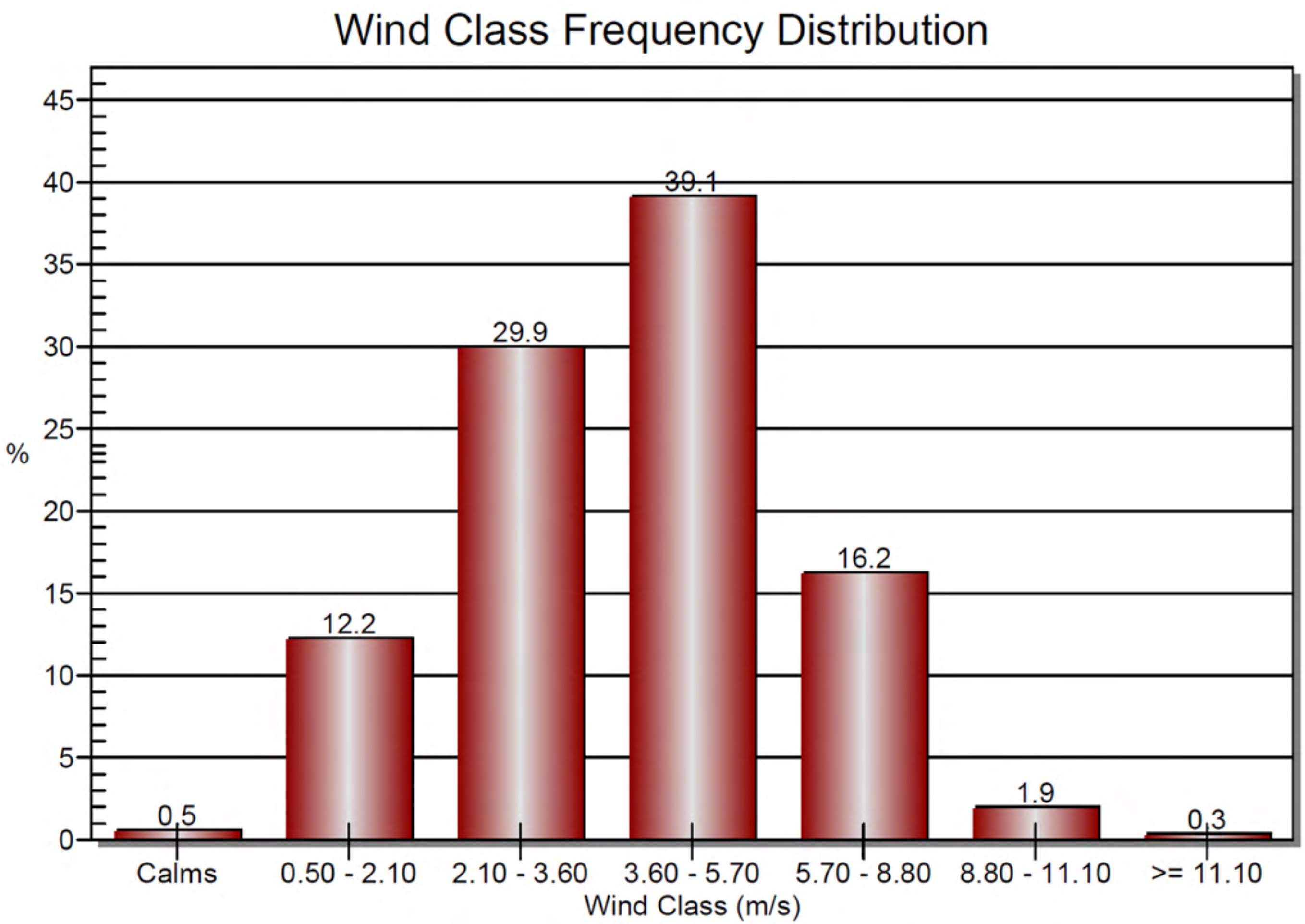

Figure 8-2 Wind Speed Frequency Distribution (2016 – 2020)

8.1.2 Temperature and Humidity

Temperature affects the formation, action, and interactions of pollutants in various ways (Kupchella & Hyland, 1993). Chemical reaction rates tend to increase with temperature and the warmer the air, the more water it can hold and hence the higher the humidity. Temperature also provides an indication of the rate of development and dissipation of the mixing layer as well as determining the effect of plume buoyancy; the larger the temperature difference between the plume and ambient air, the higher the plume is able to rise.

Higher plume buoyancy will result in an increased lag time between the pollutant leaving the source and reaching the ground. This additional time will allow for greater dilution and ultimately a decrease in the pollutant concentrations when reaching ground level.

Humidity is the mass of water vapor per unit volume of natural air. When temperatures are at their highest the humidity is also high, the moisture is trapped inside the droplets of the water vapor. This makes the moisture content of the air high. When relative humidity exceeds 70%, light scattering by suspended particles begins to increase, as a function of increased water uptake by the particles (CEPA/FPAC Working Group, 1999). This results in decreased visibility due to the resultant haze. Many pollutants may also dissolve in water to form acids, as well as secondary pollutants within the atmosphere.

The average monthly temperature and relative humidity for the January 2016 to December 2020 are presented in **Error! Reference source not found.** and **Error! Reference source not found.**.

8.1.3 Precipitation

Precipitation cleanses the air by washing out particles suspended in the atmosphere (Kupchella & Hyland, 1993). It is calculated that precipitation accounts for about 80-90% of the mass of particles removed from the atmosphere (CEPA/FPAC Working Group, 1999).

Summary of the total rainfall profile for the period of January 2016 – December 2020 is illustrated in **Error! Reference source not found.** below.

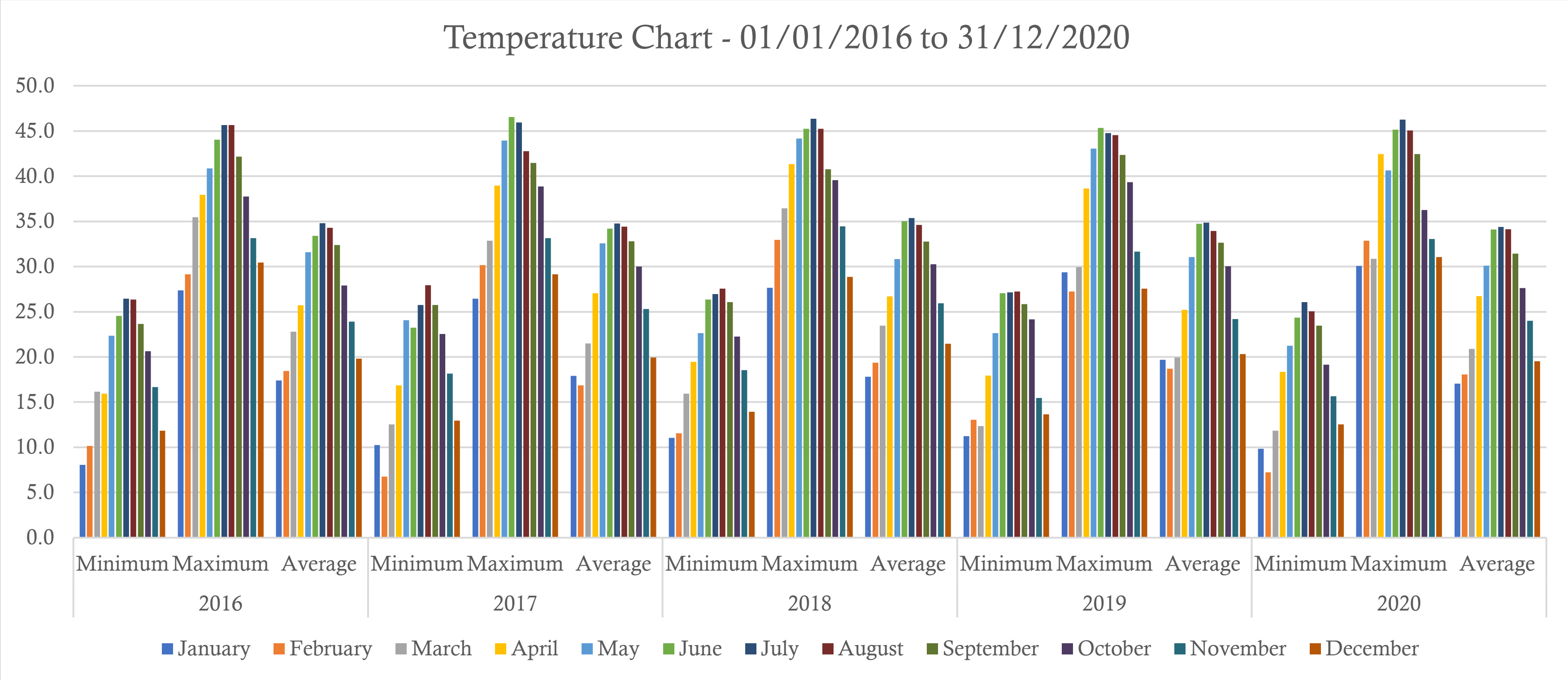

Figure 8-3 Temperature Chart – 01st January 2016 to 31st December 2020

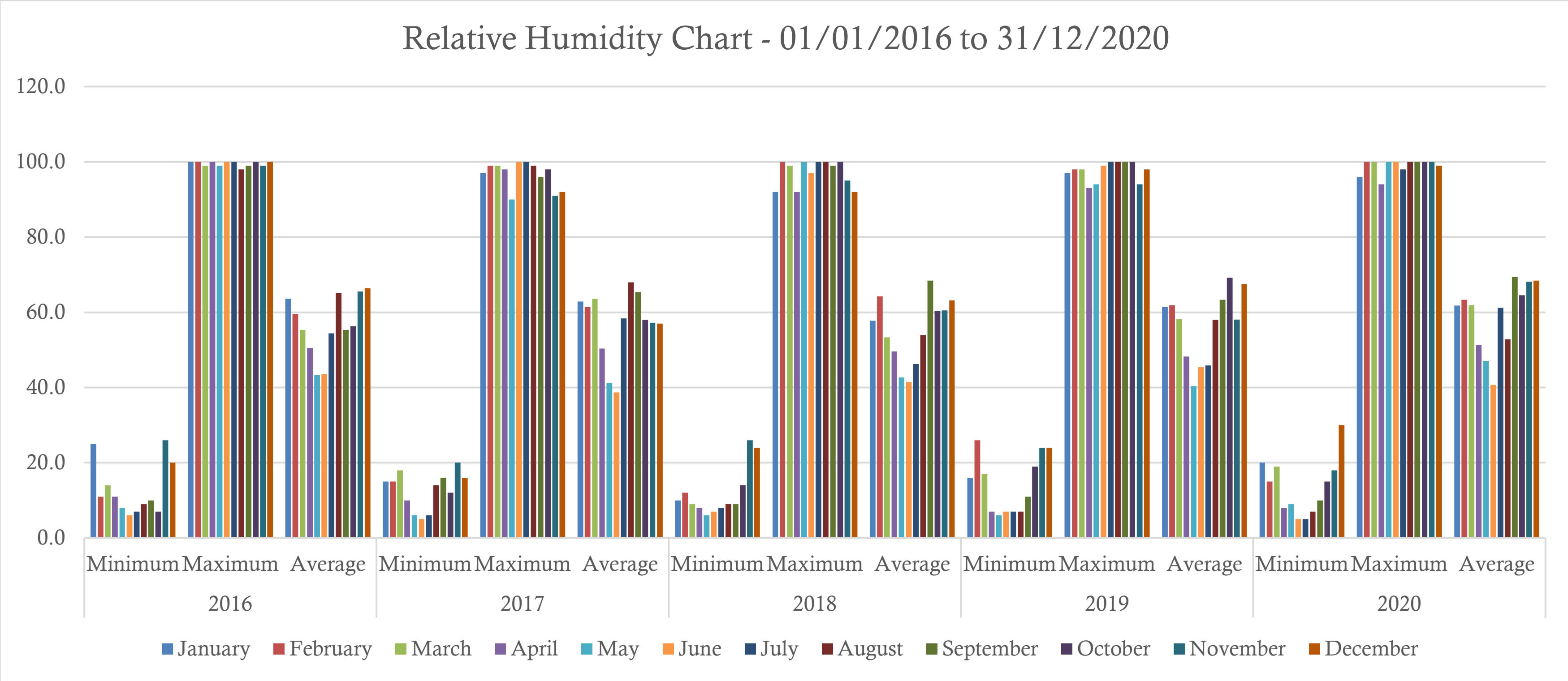

Figure 8-4 Relative Humidity Chart – 01st January 2016 to 31st December 2020

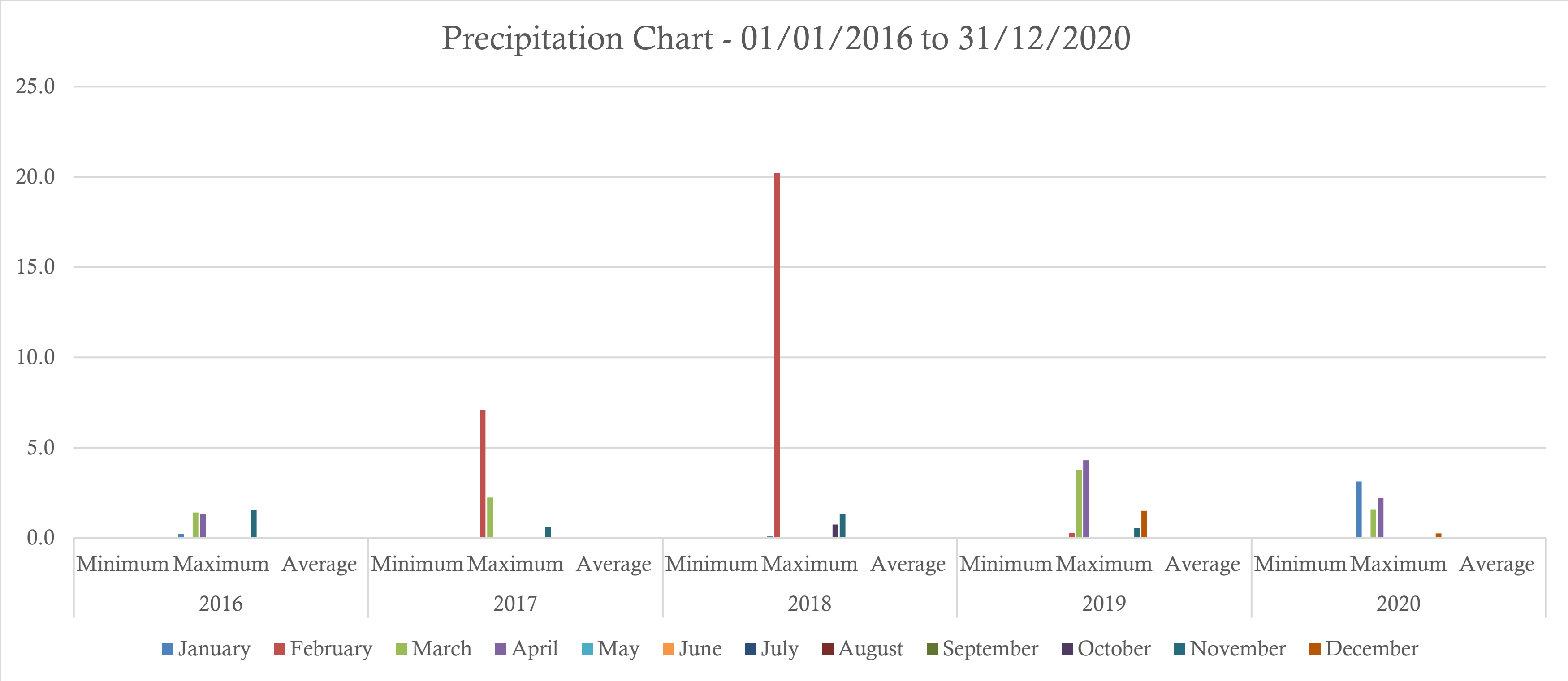

Figure 8-5 Precipitation Chart – 01st January 2016 to 31st December 2020

8.1.4 Existing Power Production and Load Flow

8.1.4.1 Current Power Production in Alba

Alba currently have five (5) Power Stations including the newly built Power Station 5 as part of Potline 6 Expansion. Further to the completion of Potline 6 expansion, the capacity of PS5 has increased to 1,800 MW. As a result, there is a reduction in the requirement to operate PS 3 and PS 4. On completion of Pot line 6 Expansion project, Power Station 1 was largely de-commissioned. As of September 2020, fifteen out of nineteen Gas Turbines, originally installed, has been disconnected electrically and are no longer available for generation.

Further to the completion of Block 4, the capacity of PS5 will increase from 1,800 MW to 2481 MW The baseline operating scenario is shown in Table 8-2.

Table 8-2 Baseline Operating Scenario of Alba Power Stations

Power Station	No. of Units	Total Capacity (MW)	Operating Load (MW)	Load Factor (%)
Winter Without PS 5 – Block 4				
PS1	5 GTs	80	0	-
PS2	5 GTs, 0 ST	100	0	-
PS3	6 GTs, 2 STs	833	145	18
PS4	4 GTs, 2 STs	913	867	95
PS5	3 GTs, 3 STs	1758	1688	96
Total		**3,584**	**2,700**	**75**
Summer Without PS 5 - Block 4				
PS1	4 GTs	68	0	-
PS2	5 GTs, 0 ST	85	0	-
PS3	6 GTs, 2 STs	755	283	38
PS4	4 GTs, 2 STs	837	837	95
PS5	3 GTs, 3 STs	1580	1580	96
Total		**3,325**	**2,700**	**81**

8.1.4.2 Load Flow

Load flow during summer as well as winter seasons considering the existing and future operational scenarios are presented in Table 4-2.

Table 8-3 Alba Power Stations - Load Flow during Summer and Winter Seasons

Power Stations	Operational Units (In-Service)
Winter Base Case (3 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, and ST 82
PS 4	GT 51, GT 52, ST 53, GT 61, GT 62, and ST 63
PS 3	1GT and 1ST
PS 2	No Units Operational
Summer Base Case (3 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, and ST 82
PS 4	GT 51, GT 52, ST 53, GT 61, GT 62, and ST 63
PS 3	2 GTs and 1 ST
PS 2	No Units Operational
Winter Base Case (4 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83, and ST 84
PS 4	2 GTs and 1 ST
PS 3	No Units Operational
PS 2	No Units Operational
Summer Base Case (4 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83, and ST 84
PS 4	GT 51, GT 52, ST 53, GT 61, GT 62, and ST 63
PS 3	No Units Operational
PS 2	No Units Operational

8.2 Impact Assessment

Given the nature of the proposed Project, it is anticipated that it will not have a significant adverse impact on the local climate. Potential release of GHG emissions will occur during both construction and operation phases.

8.2.1 Construction Phase

The potential impacts on climate will be those associated with construction traffic (heavy vehicle and equipment movements, light vehicles) entering and exiting the site. This will result in minor GHG emissions, CO_2, and acid gases NOx and SO_2. Levels of the pollutants emitted to atmosphere will be low and will be well below the regulatory guideline values. Therefore, the impacts on climate will not be of any significance. There will be no ozone depleting substances used or emitted during the construction phase of the project.

8.2.2 Operational Phase

The proposed PS 5 Block 4 will have an electricity generation capacity of 680.8 MW. The 4th Block will operate as essentially one power Block and will be capable of running in combined cycle mode. The proposed power Block will comprise 475.4 MW J Class gas turbine, heat recovery steam generator (HRSG) and Two-cylinder tandem – compound, single axial exhaust type steam turbine generator producing 217.3 MW.

In the combined cycle mode, natural gas is combusted in the gas turbine generator producing electricity and the waste heat from the gas turbine is used to make steam to generate additional electricity via a Heat Recovery Steam Generator (HRSG) and a steam turbine. Combined Cycle Power Plants far exceed conventional Thermal Power Plants with efficiencies in a range of 54% to 57%.

8.2.2.1 Carbon Dioxide Emissions

A document by the Oxford Institute for Energy Studies (20:20 vision to reducing CO_2 emissions in the UK electricity market) states that a modern CCGT plant only produces 40% of the CO_2 that a conventional coal-fired Power Station produces, and 75% of that produced by a conventional oil-fired Power Station, for the same amount of electricity output.

From information provided by Alba, the CO_2 emissions from the existing operational conditions and future operations are as follows:

- Scenario 1: Winter Base Case (3 PS 5 Units Operational) – 34.671 kg/MWh
- Scenario 2: Summer Base Case (3 PS 5 Units Operational) – 37.881 kg/MWh
- Scenario 3: Winter Base Case (4 PS 5 Units Operational) – 30.351 kg/MWh
- Scenario 4: Summer Base Case (4 PS 5 Units Operational) – 35.998 kg/MWh

From the above, it is evident that the CO2 emissions from the Power Stations will significantly decreases by the implementation of Block 4 Project.

8.3 Mitigation Measures

The Project will adhere to the mitigation measures provided in Section 9.5.1 and good site practices during the construction phase to ensure emissions that may impact climate are minimized.

Ozone depleting substances will not be used during operational phases of the Project. Oxides of Nitrogen and Sulphur Dioxide emissions are anticipated during operational phase. Mitigation measures to reduce the impacts are provided in Section 9.5.2.

8.4 Residual Impacts

Minimal residual impact is expected from the operation of the proposed development due to the comparatively low GHG emissions associated with the CCP gas power generation.

9 AIR QUALITY

9.1 Applicable Standards and Guidelines

9.1.1 Process Emissions

9.1.1.1 Air Emission Standards from Various Sources – Kingdom of Bahrain

Ministerial Order No. (2) of the year 2021 – Table No. 1 Air Emission Standards from Various Sources – stipulates air emission standards from combustion units and are outlined in Table 9-1.

Table 9-1 Air Emission Standards from Various Sources – Combustion Units

Pollutant	Unit	Standard
Particulate Matter (PM)	mg/Nm^3	50 (Oil Fired)
H_2S	mg/Nm^3	20
SO_2	mg/Nm^3	150
NOx	mg/Nm^3	100 – Gas Fired
CO	mg/Nm^3	100

9.1.1.2 Emission Guidelines for Combustion Turbine – International Finance Corporation

The IFC Guidelines for emissions from combustion turbines are presented in Table 9-2. These emission guidelines are extracted from IFC Environmental, Health and Safety Guidelines for Thermal Power Plants (December 10, 2008), Page No. 21, Table 6(B).

Table 9-2 Emission Guidelines (in mg/Nm^3 or as indicated) for Combustion Turbine

Combustion Technology / Fuel	Particulate Matter (PM)		Sulfur Dioxide (SO_2)		Nitrogen Oxides (NOx)	Dry Gas Excess O_2 Content (%)
Combustion Turbine	NDA	DA	NDA	DA	NDA / DA	
Natural Gas (all turbine types of Units > 50MWth)	N/A	N/A	N/A	N/A	51 (25 ppm)	15%
Fuels other than Natural Gas (Unit > > 50MWth)	50	30	Use of 1% or less S Fuel	Use of 0.5% or less S Fuel	152 (74 ppm)[a]	15%

General Notes:

- MWth = Megawatt thermal input on HHV basis; N/A = not applicable; NDA = Non-degraded airshed; DA = Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly; S = sulfur content (expressed as a percent by mass); Nm^3 is at one atmospheric pressure, 0 degree Celsius; MWth category is to apply to single units; Guideline limits apply to facilities operating more than 500 hours per year. Emission levels should be evaluated on a one-hour average basis and be achieved 95% of annual operating hours.
- If supplemental firing is used in a combined cycle gas turbine mode, the relevant guideline limits for combustion turbines should be achieved including emissions from those supplemental firing units (e.g., duct burners).
- (a) Technological differences (for example the use of Aeroderivatives) may require different emissions values which should be evaluated on a cases-by-case basis through the EA process, but which should not exceed 200 mg/Nm^3.

Comparison of the Guideline limits with standards of selected countries / region (as of August 2008):

- Natural Gas-fired Combustion Turbine – NOx
  - Guideline limits: 51 (25 ppm)
  - EU: 50 (24 ppm), 75 (37 ppm) (if combined cycle efficiency > 55%), 50*η / 35 (where η = simple cycle efficiency)
  - US: 25 ppm (> 50 MMBtu/h (≈ 14.6 MWth) and ≤ 850 MMBtu/h (≈ 249MWth)), 15 ppm (> 850 MMBtu/h (≈ 249 MWth))
  - (Note: further reduced NOx ppm in the range of 2 to 9 ppm is typically required through air permit)

Source: EU (LCP Directive 2001/80/EC October 23, 2001), and US (NSPS for Stationary Combustion Turbines, Final Rule – July 6, 2006)

9.1.1.3 Proposed Emission Standards

Proposed Emission standards for the PS 5 Block 4 expansion is presented in the table below:

Table 9-3 Proposed Emission Standards

Pollutant	Unit	Standard
Hydrogen Sulphide	mg/Nm^3	20
Sulphur Dioxide (SO_2)	mg/Nm^3	150
Oxides of Nitrogen (NOx)	mg/Nm^3	51
Carbon Monoxide (CO)	mg/Nm^3	100

Notes:

1. *Combustion gases shall be dry, under temperature of 273K, pressure 101.3kPa and the Oxygen content is adjusted to 15% V O_2/V total.*

9.1.2 Ambient Air Quality Criteria

9.1.2.1 National Ambient Air Quality Standards – Kingdom of Bahrain

Ambient Air Quality Standards Adopted from Decree No. (2) of the Year 2021 with respect to Environmental Standards (Air) are presented in the table below:

Table 9-4 National Ambient Air Quality Standards

Pollutant	Averaging Period	Standard in µg/m^3
Nitrogen Dioxide (NO_2)	1 – Hour Mean	200 (106 ppb)
	24 – Hour Mean	150 (80 ppb)
	Annual Mean	40 (21 ppb)
Sulphur Dioxide (SO_2)	1 – Hour Mean	300 (115 ppb)
	24 – Hour Mean	125 (48 ppb)
	Annual Mean	50 (19 ppb)
Particulate Matter (PM_{10})	24 – Hour Mean	340
	Annual Mean	80
Particulate Matter ($PM_{2.5}$)	24 – Hour Mean	50
	Annual Mean	25
Ozone (O_3)	8 – Hour Mean	150 (76 ppb)
	1 – Hour Mean	200 (100 ppb)
Carbon Monoxide (CO)	1 – Hour Mean	20,000 (17 ppm)
	8 – Hour Mean	10,000 (9 ppm)
Benzene (C_6H_6)	24 – Hour Mean	13 (4 ppb)
	Annual Mean	5 (1.6 ppb)
Toluene (C_7H_8)	24 – Hour Mean	1130 (300 ppb)
	Annual Mean	400 (106 ppb)
Xylene (C_8H_{10})	24 – Hour Mean	434 (100 ppb)
	Annual Mean	100 (23 ppb)
Total Non-Methane Hydrocarbons (TNMHC's)	3 – Hour Mean	160 (0.240 ppm)
Hydrogen Sulphide (H_2S)	1 – Hour Mean	42 (30 ppb)
	24 – Hour Mean	15 (11 ppb)

Pollutant	Averaging Period	Standard in µg/m^3
Ammonia (NH_3)	1 – Hour Mean	420 (604 ppb)
	24 – Hour Mean	100 (144 ppb)

9.1.2.2 Ambient Air Quality Guidelines – International Finance Corporation

IFC adopted ambient air quality guidelines of World Health Organization (WHO) - Air Quality Guidelines Global Update, 2005 which is presented in Table 9-5.

Table 9-5 WHO Ambient Air Quality Guidelines

Pollutant	Averaging Period	Guideline Value in µg/m^3	Interim Targets (IT) in µg/m^3
Sulphur Dioxide (SO_2)	24 – hours	20	125 (IT-1) 50 (IT-2)
	10 – minute	500	-
Nitrogen Dioxide (NO_2)	1 – year	40	-
	1 – hour	200	
Particulate Matter (PM_{10})	1 – year	20	70 (IT-1) 50 (IT-2) 30 (IT-3)
	24 – hours	50	150 (IT-1) 100 (IT-2) 75 (IT-3)
Particulate Matter ($PM_{2.5}$)	1 – year	10	35 (IT-1) 25 (IT-2) 15 (IT-3)
	24 - hours	25	75 (IT-1) 50 (IT-2) 37.5 (IT-3)
Ozone (O_3)	8 – hour daily maximum	100	160 (IT-1)

Note:

1. *World Health Organization (WHO). Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.*

Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.

9.2 Methodology

9.2.1 Ambient Air Quality Monitoring

9.2.1.1 CO, NOx, and SO_2 Passive Sampling

Background concentrations of CO, NOx and SO_2 were determined using passive sampler monitoring.

The passive sampler for Carbon monoxide is based on the principle of the diffusion of CO molecules onto an absorbing medium, in this case Palladium Chloride. Metallic Palladium is formed, which can be determined by the Focaltin Reaction [8]. The passive samplers are composed of a polypropylene housing with an opening of 20 mm diameter.

NOx sampler is based on that of Palmes. The absorbing medium contains an oxidant, which transform NO to NO_2. The amount of NOx is trapped as total nitrite. The measurement of NOx is carried out with two different samplers: firstly, NO_2 is assessed with Triethanolamine and secondly NO + NO_2 is trapped after transforming NO into NO_2 with an oxidizing agent in the TEA.

The passive sampler for sulphur dioxide is based on the principle of the diffusion of sulphur dioxide molecules onto an absorbent medium, in this case a mixture of potassium carbonate and glycerol. The passive samplers are composed of a polypropylene housing with an opening of 20 mm diameter.

The passive samplers were placed at six (6) monitoring locations (refer Figure 9-1). A brief description of the monitoring locations is provided in the table below:

Table 9-6 Description of Passive Sampler Locations

Location ID	Location Name	Coordinates	Description
AQ 1	Residential Area	459454.00 m E 2886387.00 m N	Accommodation and Recreational Area.
AQ 2	Near West Point Home	459228.00 m E 2885986.00 m N	Adjacent Industrial Facility.
AQ 3	Princess Sabeeka Oasis	461127.00 m E 2884901.00 m N	Garden established by Alba which is located on the south side of the Alba plant.
AQ 4	BSPCA	460311.00 m E 2883705.00 m N	Animal Kennel in the South Direction.
AQ 5	Askar Village	461167.00 m E 2882441.00 m N	Accommodation and Recreational Area.

Location ID	Location Name	Coordinates	Description
AQ 6	Onsite	459549.00 m E 2885653.00 m N	Alba PS 5 Block 4 Site Expansion Site

9.2.1.2 Continuous Ambient Air Quality Monitoring

Continuous ambient air quality monitoring was undertaken using Scentinal SL 50 ambient air quality monitoring station. Monitoring was carried out from 22nd August – 11th September 2021. Priority pollutants which were assessed using SL50 monitoring station include: Carbon Monoxide (CO), Nitrogen Dioxide (NO_2), Ozone (O_3), Sulphur Dioxide (SO_2) and Particulate Matter (PM_{10} and $PM_{2.5}$).

9.2.2 Air Dispersion Modeling

The potential ground level concentrations (GLC) of gaseous pollutants at receptors in the vicinity of the site have been predicted using the AERMOD atmospheric dispersion model.

AERMOD, a sixth-generation Gaussian dispersion model, was considered to be the most appropriate model for assessment as it is capable of handling multiple sources and the effects of building downwash on pollutant dispersion. The input required for AERMOD includes five years of local, hourly meteorological data, terrain elevations for the site and vicinity, and the characteristics of the buildings and emission sources at the project site. The model uses these input parameters to predict the resultant ground level air concentrations at offsite receptor locations and is capable of predicting these effects for each of the relevant averaging periods.

AERMOD (Version 9.9.0) View is a true, native Microsoft Windows application and runs in Windows applications. The AMS/EPA Regulatory Model (AERMOD) was specially designed to support the EPA's regulatory modeling programs. AERMOD is a regulatory steady-state plume modeling system with three separate components – AERMAP, AERSURFACE and AERMET.

- AERMAP extracts topographical information from USGS digital maps.
- AERSURFACE extracts surface information in 12 wind directions for each month from the same map.
- AERMET determines the atmospheric stability factors in three-dimensional space for each hour using meteorological data from the National Weather Service National Climate Data Center

The package titled ISC-AERMOD VIEW has three interfaces viz. AERMOD, ISCST3 and ISC-PRIME as highlighted below:

— AERMOD is based on planetary boundary layer theory and uses essentials of ISC model. It also incorporates the plume rise enhancements of ISC-PRIME model;

— ISCST3 is a steady state Gaussian plume model widely used to access pollutant concentrations from a wide variety of sources; and

— ISC-PRIME includes enhanced plume dispersion coefficients due to the building turbulent wake and also reduced plume rise caused by a combination of descending streamlines in the lee of the building and the increased entertainment in its wake.

AERMOD has also a 3D view output which can be used to illustrate the results in a pictorial manner. It has various other features such as multiple chemicals modeling, integrated contouring, digital terrain data, graphical input, etc. It also includes meteorological tools such as AERMET View (processes metrological data for AERMOD), RAMMET view (processes meteorological data for ISCST3 and ISCST-PRIME) and WRPLOT view (generates wind rose, frequency tables and graphs from the surface data files).

Modeling capabilities of AERMOD and model application for the present study are as presented in Table 9-7.

Table 9-7 Modeling Capabilities of AERMOD and model setup for PS5-Block 4

Sl. No.	Modeling Capabilities of AERMOD	Model Setup
1	AERMOD requires two types of meteorological data files, a file containing surface scalar parameters and a file containing vertical profiles.	Present study is based on multi-year (Five years) meteorological data provided by the U.S. EPA AERMET meteorological pre-processor programme supplied by Lakes Environmental, Canada is considered.
2	The model can account for the effects of aerodynamic downwash due to buildings that are nearby point source emissions.	BPIP- PRIME of AERMOD is applicable to incorporate the concepts and procedures expressed in the "Good Engineering Practice" (GEP) of Section 123 of the Clean Air Act and 40 CFR 51.1
3	Source emission rates can be treated as constant or may be varied by month, season, hour-of-day, or other optional periods of variation.	As per manufacturer's emission specifications SO_2, NO_2, CO and PM_{10} are expected pollutants. As per IFC and SCE guidelines, an averaging period of 1-hour, 24-hours and annual are to be considered for the study.

Sl. No.	Modeling Capabilities of AERMOD	Model Setup
4	Variable emission rate factors may be specified for a single source or for a group of sources.	Single point source is considered for sulphur dioxide, nitrogen dioxide and carbon monoxide. Group source is considered for particulate matter (PM_{10}).
5	Receptor locations can be specified as gridded and/or discrete receptors in a Cartesian or polar coordinate system.	Modeling is carried out to cover receptors within 5 km radius including 17 identified sensitive receptors specified as gridded (Uniform grid size of 250 m or 500 m) discrete receptors.
6	For applications involving elevated terrain, the U.S. EPA AERMAP terrain pre-processing program is incorporated into the model to generate hill height scales as well as terrain elevations for all receptor locations.	Proposed project site is at an elevated area (Approx. 31m from sea level) and terrain is a mixture of Urban and desert shrub land. A 30 m DEM downloaded from SRTM was used as a terrain input.

9.2.2.1 Interpretation of Dispersion Modeling Results

At present, there are no policies or guidelines that provide criteria for assessment of acceptable process contribution from industrial facilities. Hence, the significance assessment criteria prescribed by UK Environment Agency through the Guidance Environmental permitting: air dispersion modelling reports were adopted.

Modeling results are presented as follows:

- The process contribution (PC);
- Predicted environmental concentration (PEC) - which is the PC plus ambient background concentration values; and
- PCs and PECs as a percentage of the relevant environmental standard for air.

The Process Contribution (PC) is insignificant if it is less than:

- 10% of a short-term environmental standard
- 1% of a long-term environmental standard

At the detailed modelling stage there are no criteria to determine whether:

- PCs are significant
- PECs are insignificant or significant

9.3 Baseline Environment

Air quality in the Kingdom of Bahrain is affected mainly by the stationary sources, including oil & gas production, refining, power/desalination plants, petrochemical, and Aluminium industries, as well as mobile sources, especially motor vehicles and trans-boundary pollution coming from any nearby industrial sources.

9.3.1 Long Term Passive Sampler Monitoring Results

Background concentrations of CO, NOx and SO_2 were determined using passive sampler monitoring. The passive samplers were placed at six (6) monitoring locations labelled AQ 1 to AQ 6 from 08th November 2020 to 6th December 2020. Following completion of the monitoring survey, the passive samplers were capped, and placed in a protective container and sent to the passam laboratory for analysis. The sample locations, date and time were recorded for each sample. The results are expressed in $\mu g/m^3$ and compared to relevant annual average limit values. The results of the baseline monitoring are presented in Table 9-19 and the laboratory analysis reports are provided in Appendix G.

Table 9-8 Passive Sampler Monitoring Results

Monitoring Location	Monitoring Results ($\mu g/m^3$)		
	CO	NOx	SO_2
AQ 1	<500	40.0	122.2
AQ 2	<500	40.1	76.8
AQ 3	590.0	42.5	76.2
AQ 4	544.0	43.3	44.9
AQ 5	<500	34.2	27.9
AQ 6	<500	31.4	103.4
SCE Limit Value	-	**40**	**50**

NOx concentration exceeding annual mean guideline values at locations near West Point Home, Princess Sabeeka Oasis and BSPCA Animal Kennel. Sulphur Dioxide Concentrations are exceeding the annual mean guideline values at all locations except BSCPCA animal kennel and Askar Village.

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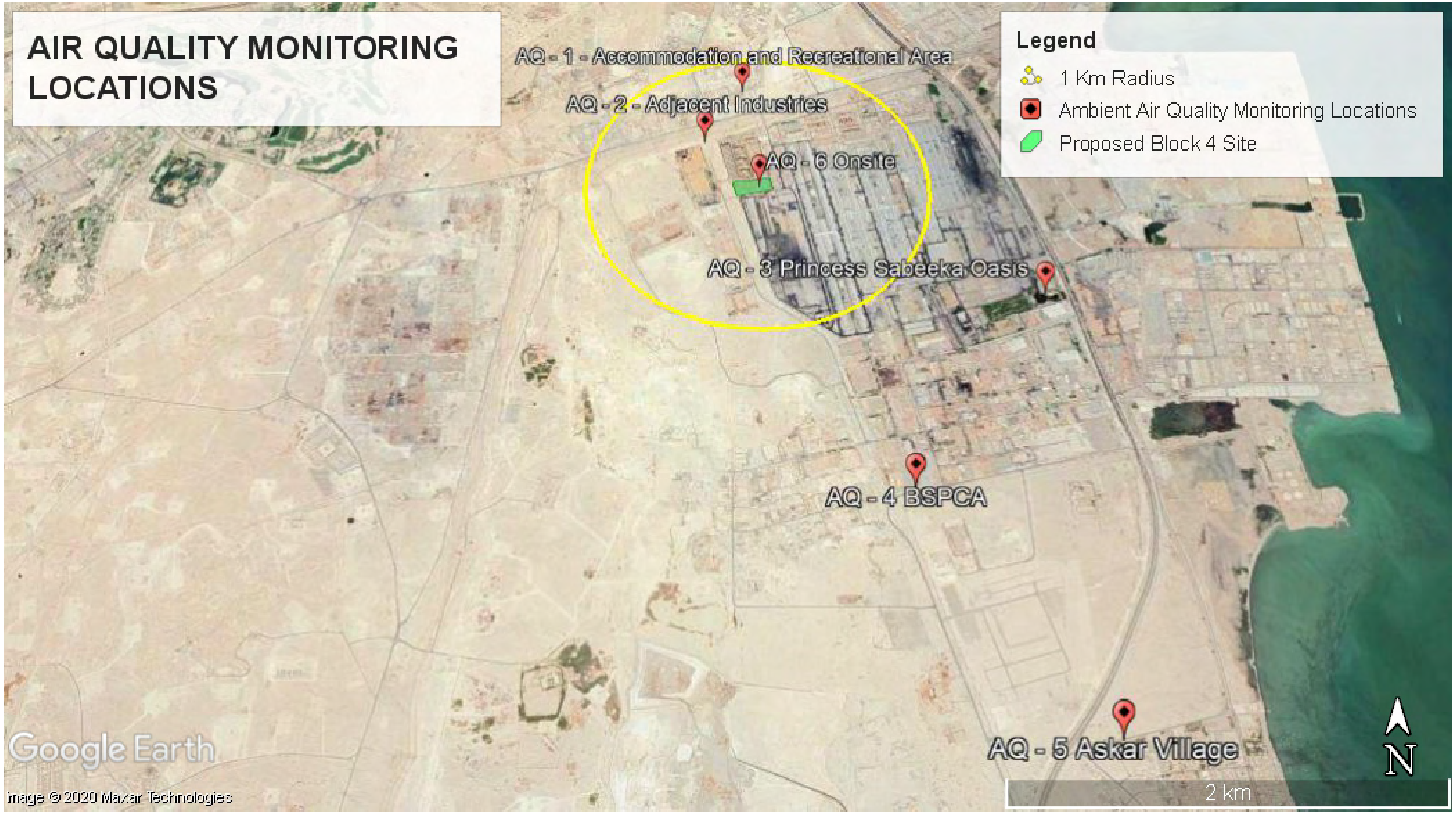

Figure 9-1Proposed Ambient Air Quality Monitoring Locations

9.3.2 Continuous Ambient Air Quality Monitoring

Ambient air quality monitoring was conducted at PS 5 Block 4 site from 22nd August to 11th September 2021. The monitoring field data sheets are provided in Appendix H. Monitoring results are detailed in the following sub-sections.

9.3.2.1 Nitrogen Dioxide (NO_2)

Table 9-9 and Table 9-10 presents Nitrogen Dioxide hourly and daily measurement summary.

Figure 9-2 and Figure 9-3 represents the hourly and daily concentrations and compared with SCE and IFC Guideline Values.

Table 9-9 Nitrogen Dioxide Measurement Summary – Hourly Averages

Station ID	# Valid Hours	% Valid Hours	Hourly Mean Concentration (ppb)	1 – Hour Maximum (ppb)	Guideline Values (ppb)	
					SCE	IFC
SL031906	493	100	56.6	155.6	106	106

Table 9-10 Nitrogen Dioxide Measurement Summary – Daily Averages

Station ID	# Valid Hours	% Valid Hours	Daily Mean Concentration (ppb)	Daily Maximum (ppb)	Guideline Values (ppb)	
					SCE	IFC
SL031906	493	100	57.2	85.7	80	-

Ten (10) exceedances were recorded in comparison to the SCE and IFC hourly mean guideline values whereas one (1) exceedance was recorded against the daily mean guideline value.

9.3.2.2 Sulphur Dioxide (SO_2)

Table 9-11 and Table 9-12 presents Sulphur Dioxide hourly and daily measurement summary. Figure 9-4 and Figure 9-5 represents the hourly and daily concentrations and compared with SCE and IFC Guideline Values.

Table 9-11 Sulphur Dioxide Measurement Summary – Hourly Averages

Station ID	# Valid Hours	% Valid Hours	Hourly Mean Concentration (ppb)	1 – Hour Maximum (ppb)	Guideline Values (ppb)	
					SCE	IFC
SL031906	493	100	61.7	151.8	115	-

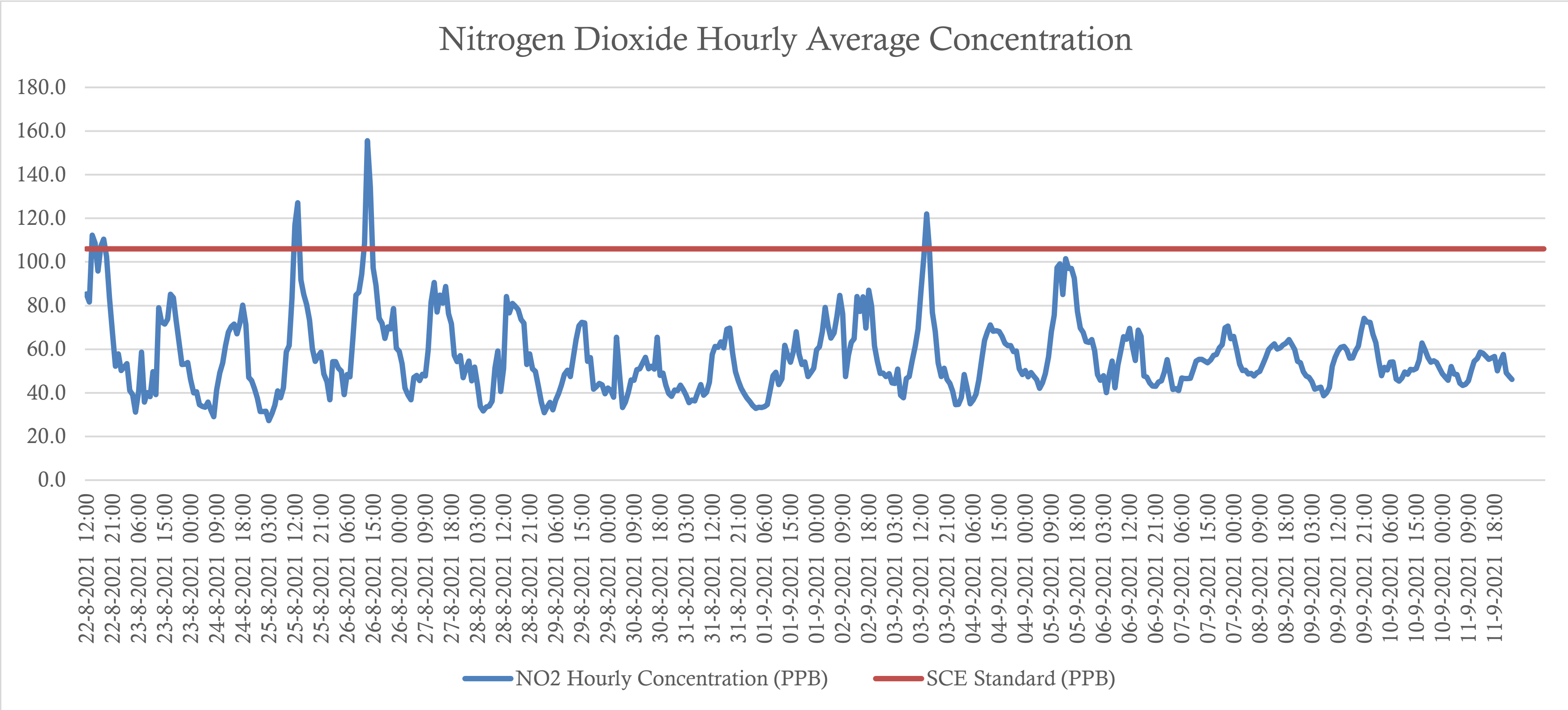

Figure 9-2 Nitrogen Dioxide – Hourly Average Concentrations

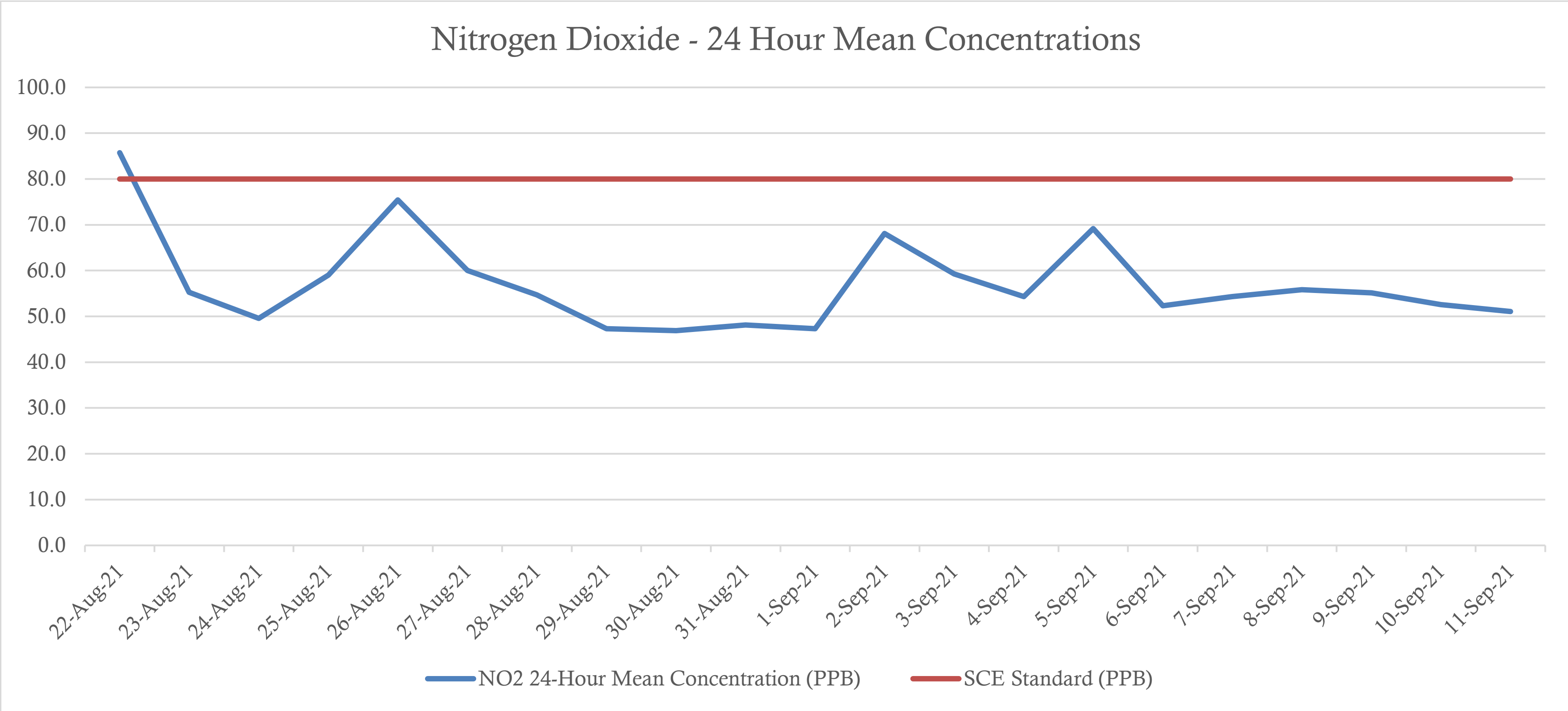

Figure 9-3 Nitrogen Dioxide – Daily Average Concentrations

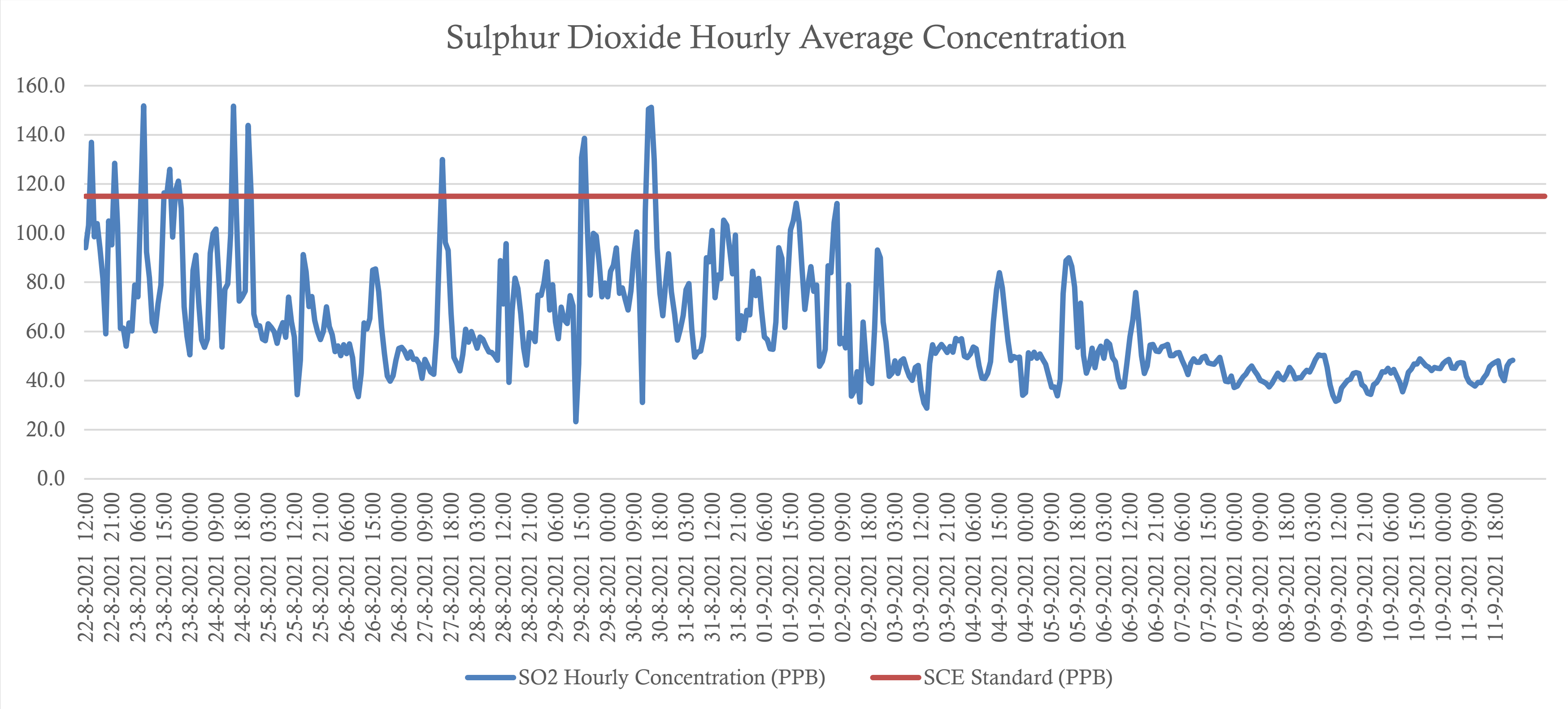

Figure 9-4 Sulphur Dioxide Hourly Average Concentrations

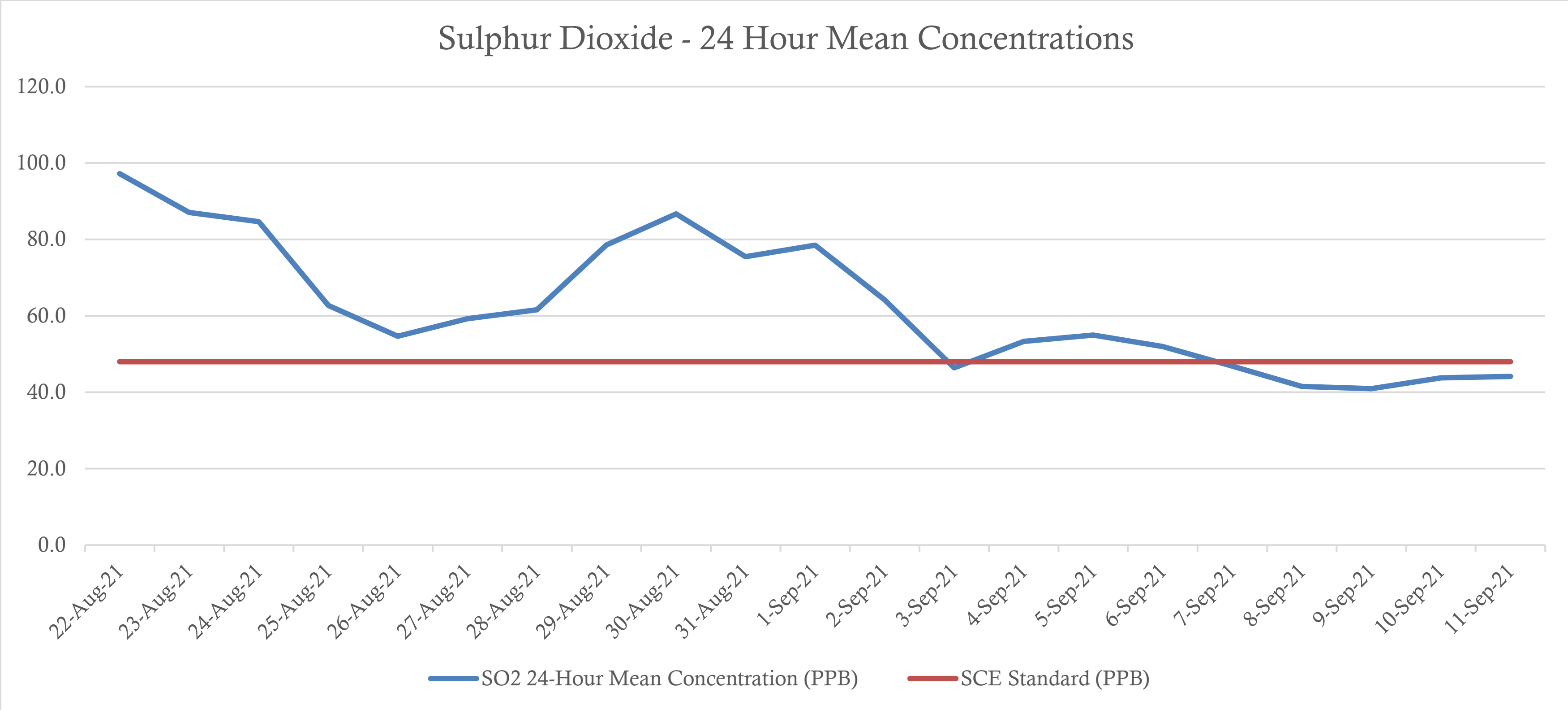

Figure 9-5 Sulphur Dioxide Daily Average Concentrations

Table 9-12 Sulphur Dioxide Measurement Summary – Daily Averages

Station ID	# Valid Hours	% Valid Hours	Daily Mean Concentration (ppb)	Daily Maximum (ppb)	Guideline Values (ppb)	
					SCE	IFC
SL031906	493	100	62.6	97.2	48	48 IT-1

17 exceedances were recorded in comparison to the SCE and IFC hourly mean guideline values whereas 15 exceedances were recorded against the daily mean guideline value.

9.3.2.3 Carbon Monoxide (CO)

Table 9-13 and Table 9-14 presents Carbon Monoxide hourly and 8 - hour measurement summary. Figure 9-6 and Figure 9-7 represents the hourly and 8 - hour concentrations and compared with SCE Guideline Values.

Table 9-13 Carbon Monoxide Measurement Summary – Hourly Averages

Station ID	# Valid Hours	% Valid Hours	Hourly Mean Concentration (ppm)	1 – Hour Maximum (ppm)	SCE Guideline Values (ppm)
SL031906	493	100	0.4	2.5	17

Table 9-14 Carbon Monoxide Measurement Summary – 8 Hours Average

Station ID	# Valid Hours	% Valid Hours	8 - Hour Mean Concentration (ppm)	8 - Hour Maximum (ppm)	Guideline Values (ppm)
SL031906	493	100	0.4	1.4	9

No exceedances were recorded in comparison with the one hour or 8 hour mean guideline values.

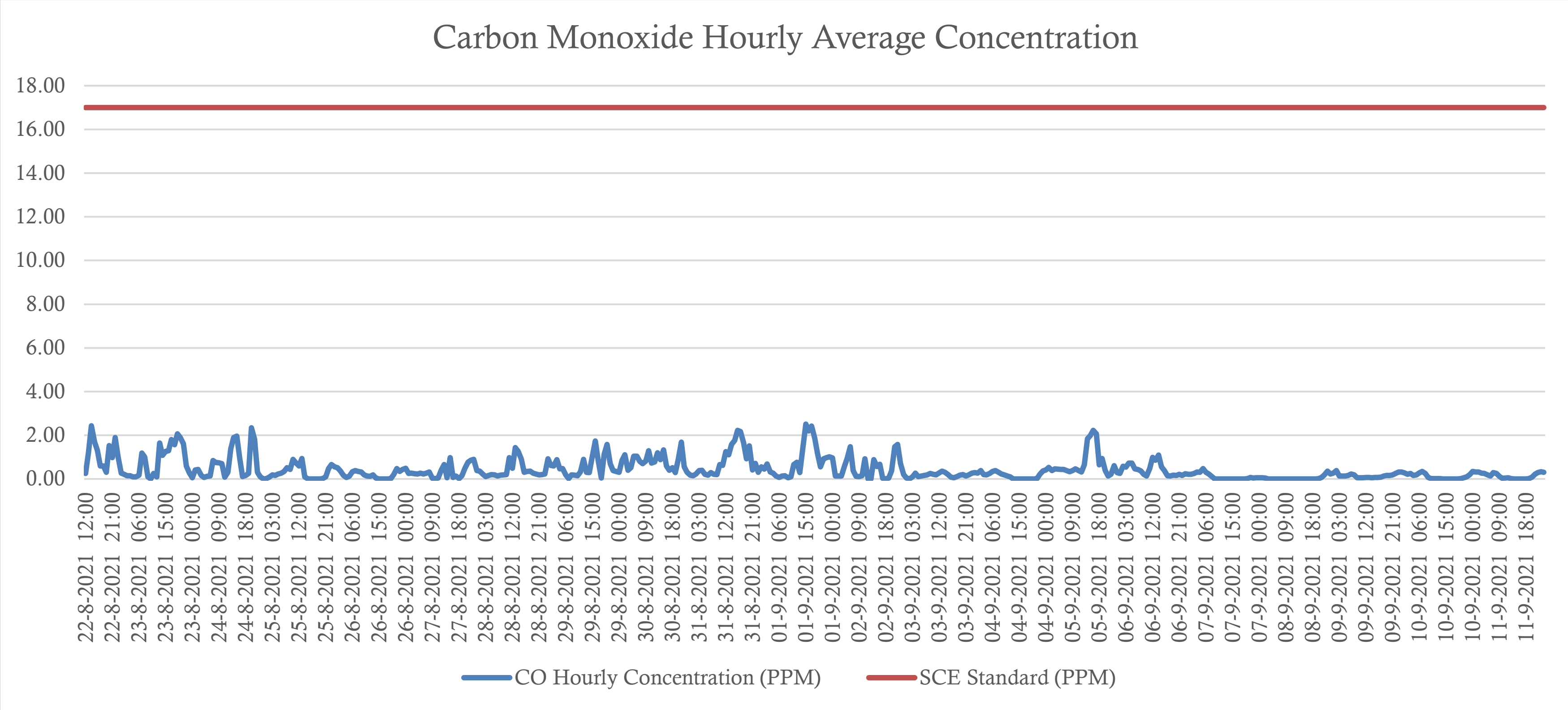

Figure 9-6 Carbon Monoxide Hourly Average Concentrations

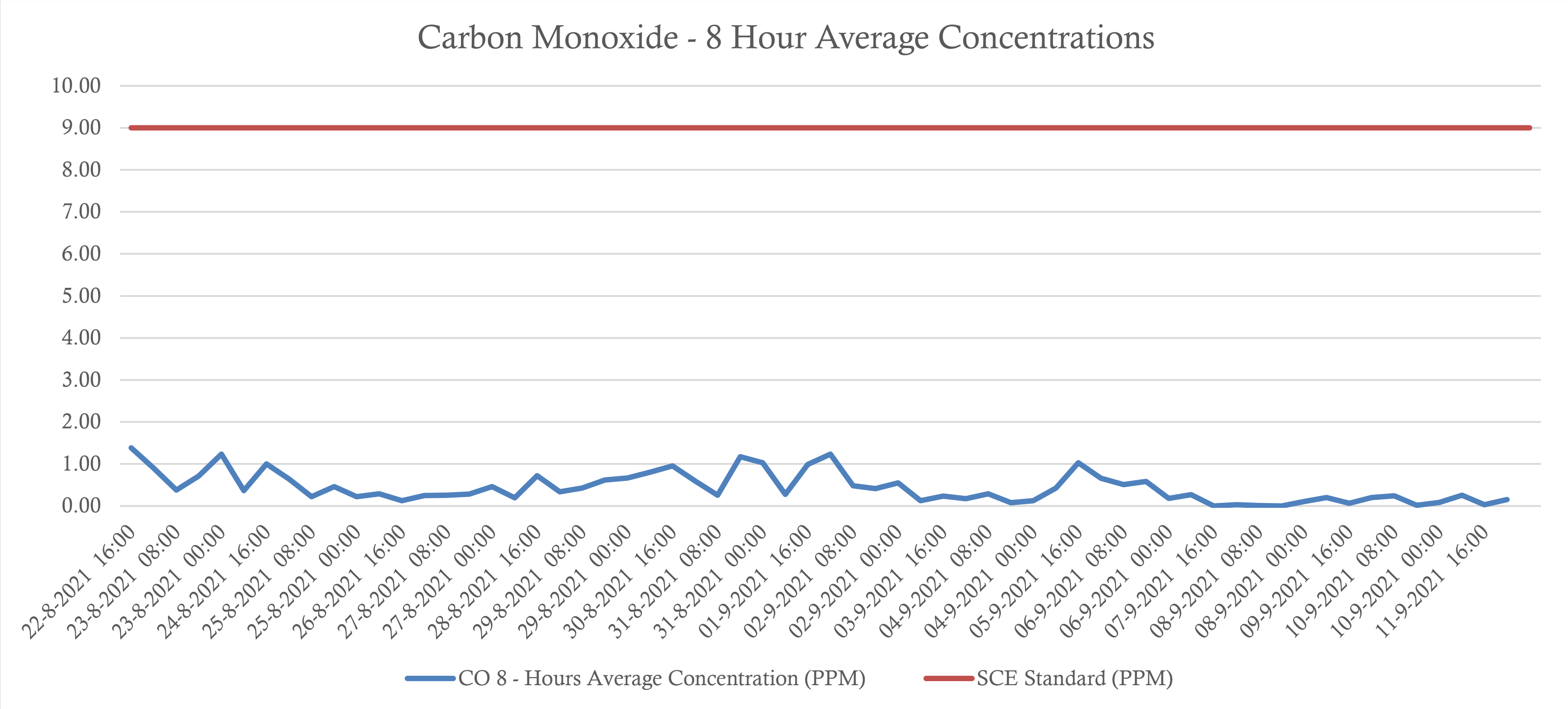

Figure 9-7 Carbon Monoxide 8 – Hour Average Concentrations

9.3.2.4 Ozone (O_3)

Table 9-15 and Table 9-16 presents Ozone hourly and 8 - hour measurement summary. Figure 9-8 and Figure 9-9 represents the hourly and 8 - hour concentrations and compared with SCE Guideline Values.

Table 9-15 Ozone Measurement Summary – Hourly Averages

Station ID	# Valid Hours	% Valid Hours	Hourly Mean Concentration (ppb)	1 – Hour Maximum (ppb)	SCE Guideline Values (ppb)
SL031906	493	100	55.1	239.0	100

Table 9-16 Ozone Measurement Summary – 8 Hours Average

Station ID	# Valid Hours	% Valid Hours	8 – Hour Mean Concentration (ppb)	8 – Hour Maximum (ppb)	Guideline Values (ppb)	
					SCE	IFC
SL031906	493	100	62.6	97.2	76	50

63 exceedances were recorded in comparison to the SCE hourly mean guideline values whereas 15 exceedances were recorded against the 8 – hour mean guideline value. 26 exceedances were recorded in comparison to the IFC 8 – hour mean guideline values.

9.3.2.5 Particulate Matter (PM_{10})

Table 9-17 presents Particulate Matter (PM_{10}) daily measurement summary. Figure 9-10 represents daily concentrations and compared with SCE and IFC Guideline Values.

Table 9-17 Particulate Matter (PM_{10}) Measurement Summary – Hourly Averages

Station ID	# Valid Hours	% Valid Hours	Mean Concentration ($\mu g/m^3$)	24 – Hour Maximum ($\mu g/m^3$)	Guideline Values ($\mu g/m^3$)	
					SCE	IFC
SL031906	493	100	48.4	68.2	340	50

6 exceedances were recorded when the monitoring results are compared against IFC guideline values.

9.3.2.6 Particulate Matter ($PM_{2.5}$)

Table 9-18 presents Particulate Matter ($PM_{2.5}$) daily measurement summary. Figure 9-11 represents daily concentrations and compared with SCE and IFC Guideline Values.

Table 9-18 Particulate Matter ($PM_{2.5}$) Measurement Summary – Hourly Averages

Station ID	# Valid Hours	% Valid Hours	Mean Concentration (µg/m³)	24 – Hour Maximum (µg/m³)	Guideline Values (µg/m³)	
					SCE	IFC
SL031906	493	100	45.7	65.5	50	25

5 exceedances were recorded when the monitoring results are compared against SCE guideline values while 21 exceedances were recorded in comparison to IFC guideline values.

9.3.2.7 Conclusions

- During the monitoring period the temperature and relative humidity at Alba ranged from 30.1°C to 50.4°C and 17.5% to 74.0% respectively.
- Hourly average concentration of nitrogen dioxide was 56.6 ppb and Daily average concentration of nitrogen dioxide was 57.2 ppb. The recorded maximum hourly concentration was 155.6 ppb and the recorded maximum daily concentration was 85.74 ppb. 10 exceedances were recorded as compared to SCE and IFC Standard of 106 ppb (hourly average).and 1 exceedance was recorded as compared to SCE standard of 80 ppb (daily average).
- Hourly average concentration of Sulphur dioxide was 61.7 ppb and Daily average concentration of Sulphur dioxide was 62.6 ppb. The recorded maximum hourly concentration was 151.8 ppb, and the recorded maximum daily concentration was 97.21 ppb. In comparison with SCE guideline value of 115 ppb, 17 exceedances was recorded (hourly average) and 15 exceedances were recorded as compared to SCE standard of 48 ppb (daily average).
- Hourly average concentration of Ozone was 55.1 ppb and 8-hours average concentration of Ozone was 55.51 ppb. There were 63 exceedances when compared to SCE standard of 100 ppb (Hourly Average). There were 15 and 26 exceedances when compared with SCE standard of 76 ppb (8-hours average) and IFC standard of 50 ppb (8-hours average) respectively. Meteorological conditions conductive to ozone formation, coupled with other precursor pollutant concentrations (Nitrogen Dioxide and Volatile Organic Compounds) August lead to elevated ozone concentrations at monitoring sites.

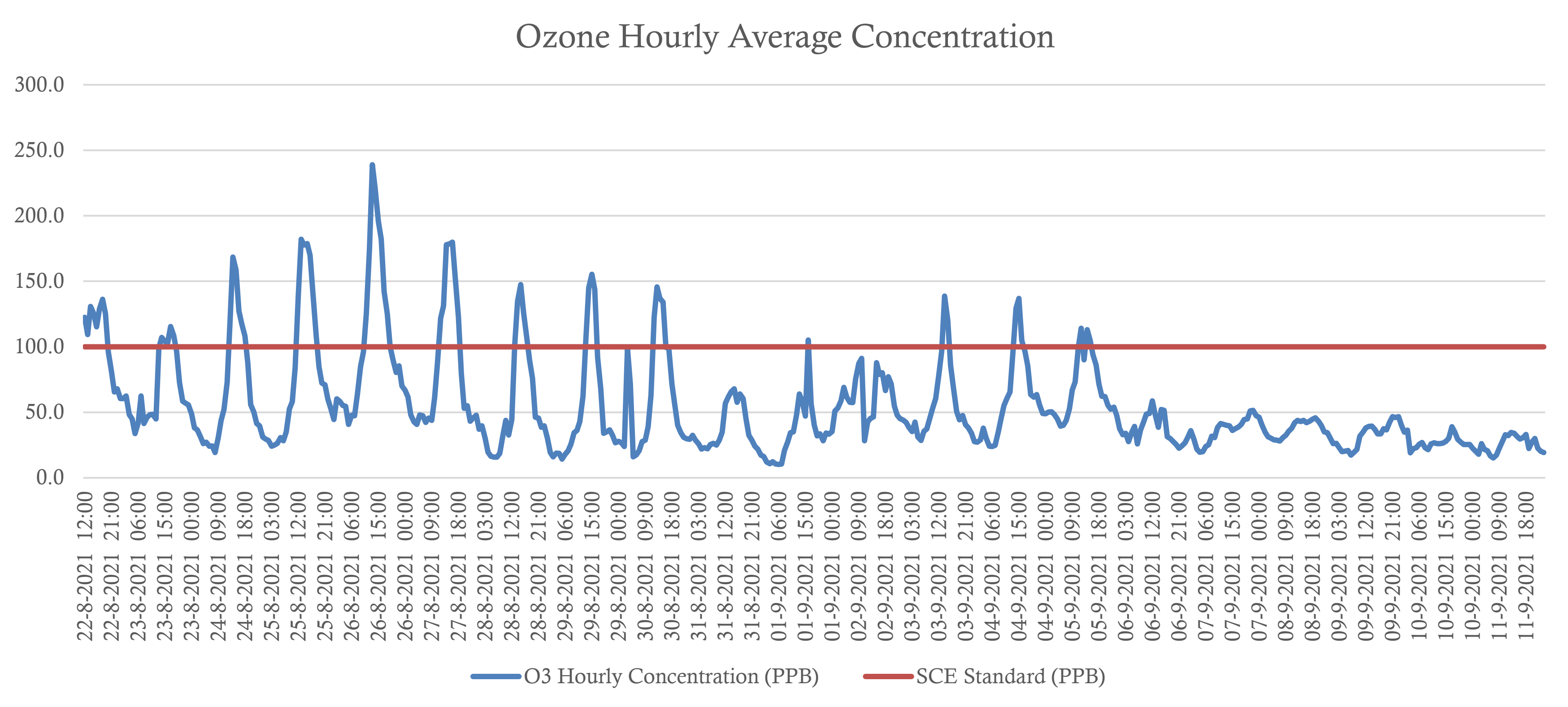

Figure 9-8 Ozone Concentrations – Hourly Average Values

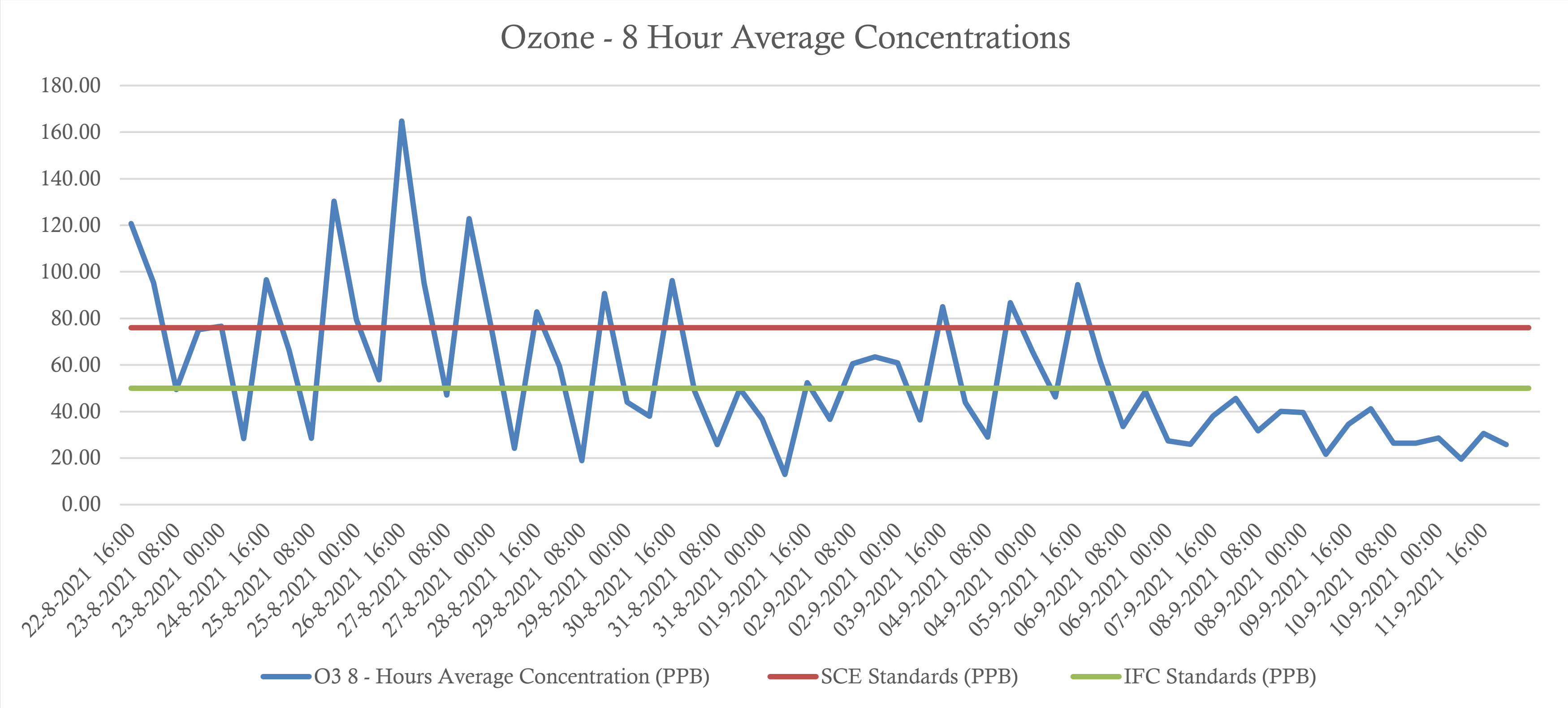

Figure 9-9 Ozone Concentrations – 8 Hour Average Values

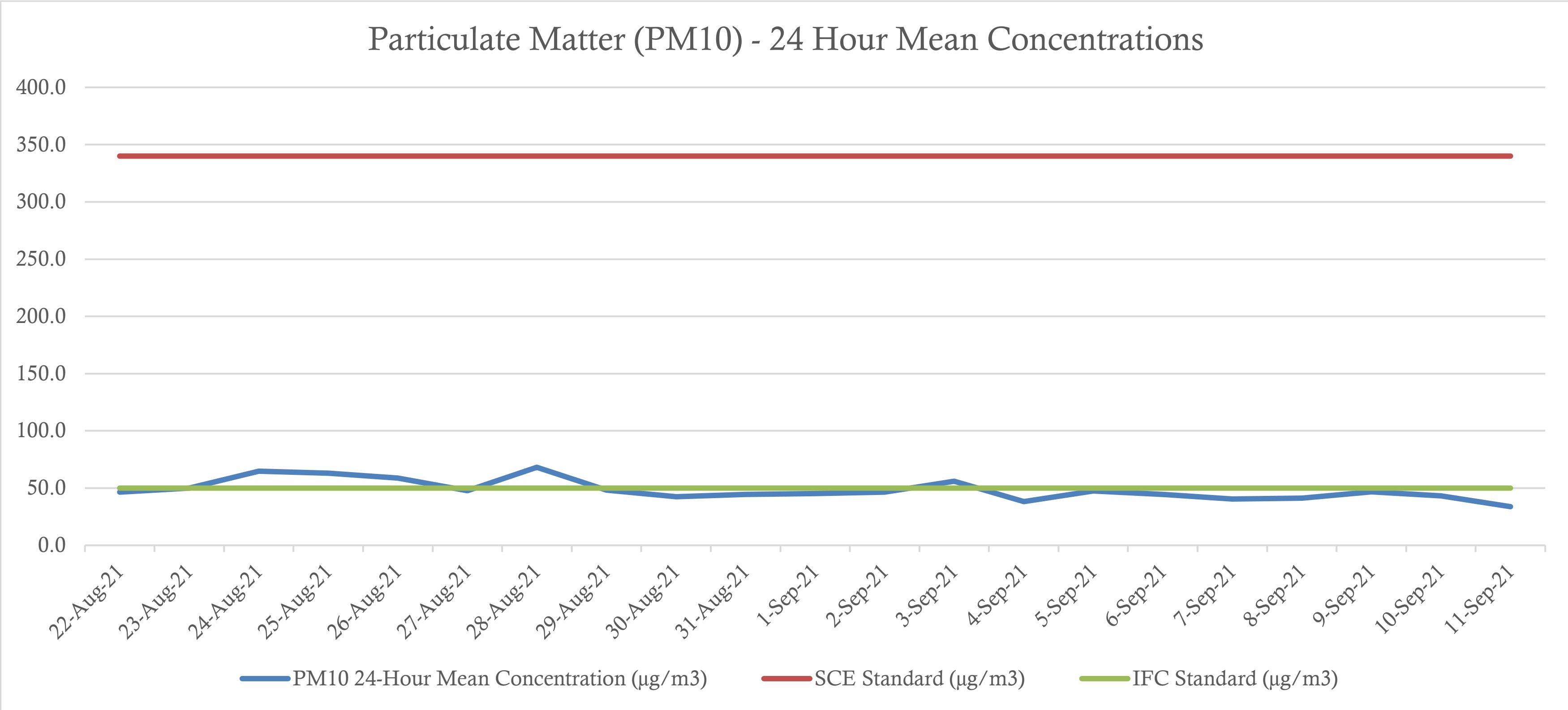

Figure 9-10 Particulate Matter (PM10) Concentrations – Daily Average

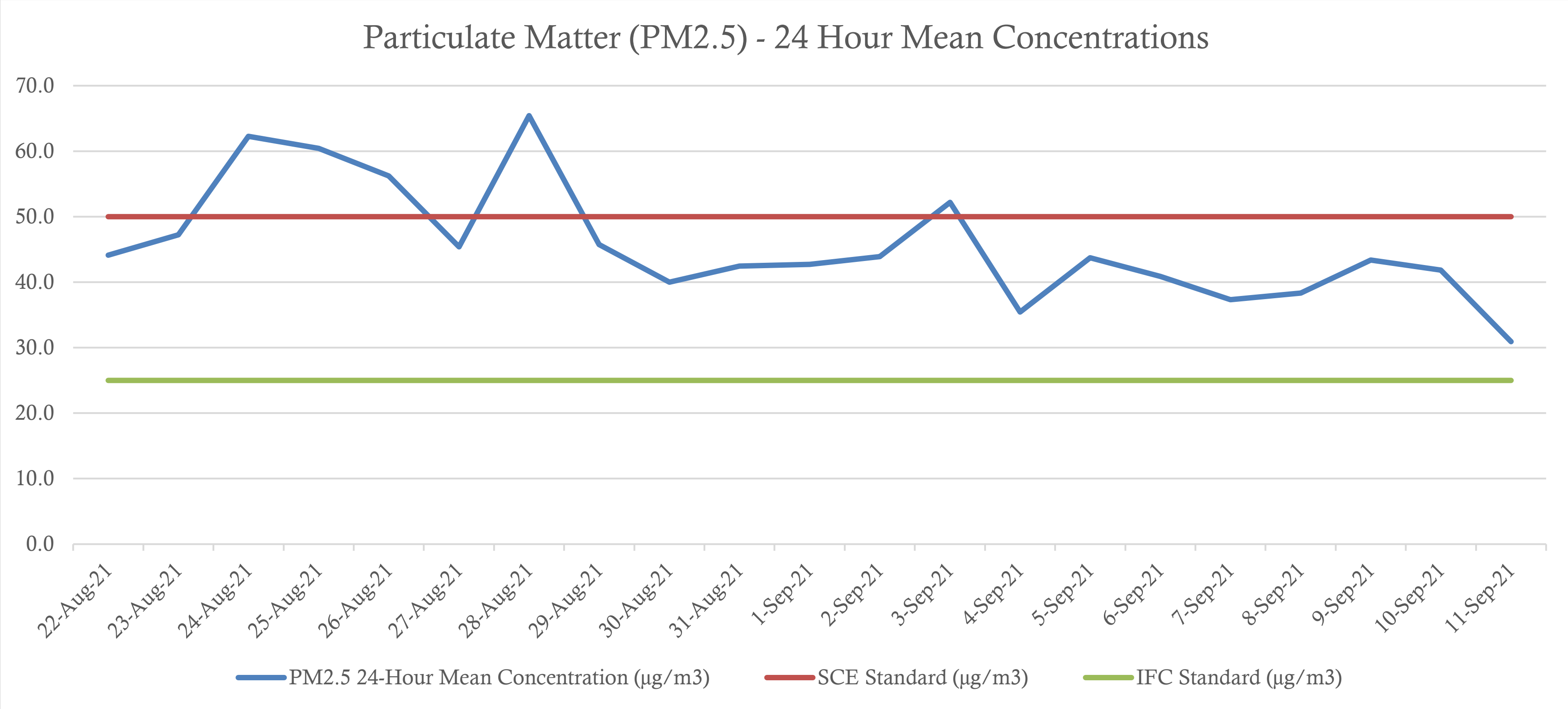

Figure 9-11 Particulate Matter (PM2.5) Concentrations – Daily Average

- Hourly average concentration of Carbon Monoxide was 0.43 ppm and 8-hours average concentration of Carbon Monoxide was 0.44 ppm Maximum hourly concentration was 2.5 ppm and the maximum 8-hours average concentration was 1.38 ppm. In comparison with SCE Standard of 17 ppm (1-hour average) and 9 ppb (8-hours average), no exceedances were recorded.
- Daily average concentration of particulate matter (PM_{10}) was 48.43 µg/m^3. Maximum daily concentration observed was 68.16.71 µg/m^3. In comparison with SCE standard of 340 µg/m^3 (daily average), no exceedances were recorded and with IFC standard of 50 µg/m^3 (daily average), 6 exceedances were recorded.
- Daily average concentration of particulate matter ($PM_{2.5}$) was 45.71 µg/m^3. Maximum daily concentration observed was 65.43.91 µg/m^3. When compared with SCE standard of 50 µg/m^3 (daily average), 5 exceedances were recorded and with IFC standard of 25 µg/m^3 (daily average), 21 exceedances were recorded.

9.3.2.7.1 Local Emission Influences

Nearest point sources of emissions are the stacks of adjacent PS 5 Block 1 to Block 3. PS 4 is located approximately 520 meters and PS 3 is located approximately 650 meters in the North East quadrant of Block 5. Alba Potlines 1 to 6 are in the East, South-East, and Southern Quadrants of the proposed plot. Industrial facilities such as Bahrain Atomisers, West point Home, and Middle East Recycling Co. are falling in the North-West and West Quadrant. Bapco refinery is located at approximately 3 Kms and Riffa Power Station is located at 3.5 Kms away from the proposed plot in the North East.

Emissions due to the combustions processes in these facilities will result in increased ambient air concentrations of Nitrogen Dioxide (NO_2), Sulphur Dioxide (SO_2), Carbon Monoxide (CO), etc. It is expected that the emissions from these sources are well mixed in the local air shed.

9.4 Impact Assessment

9.4.1 Construction Phase

9.4.1.1 Construction Phase Dust

During construction phase of the PS 5 Block 4, it is anticipated that air quality impacts may arise from:

- Dust generation from construction activities (including site clearance, leveling, stockpiling, and excavation etc.);
- Generation of exhaust emissions from construction vehicles, equipment, and machinery.

The magnitude of impact for the construction works provided above has been estimated without mitigation measures in place. Appropriate mitigation measure are provided in Section 9.5.1.

Primary source of emissions from construction works are expected to be fugitive dust generation and release arising during site clearance, excavation, leveling, stockpiling and the construction works itself. The proposed construction phase access routes will generate vehicle movement during the transport of construction materials and site personnel. Construction phase traffic will include light and heavy vehicle movements and other construction plant and machinery. The excavation process includes the temporary stockpiling of materials. During the construction phase, the potential for dust arisings will be heavily influenced by the nature of the activities taking place and it is recommended that EPC contractor and sub-contractors comply with the dust prevention measures provided in Section 9.5.1.

The magnitude of impact resulting from elevated dust emissions depends on the potential for dust to become and remain airborne prior to returning to the surface as a deposit. Unlike other atmospheric pollutants, the presence of dust and its deposition is particularly dependent upon distance to the receptor locations and prevailing weather conditions, with areas most consistently affected being located close to and downwind of emission sources.

It is possible that the receptors located within 500m of a construction site may experience slightly elevated dust levels during the construction-phase. Construction dust impacts can be considered to be temporary, reversible, and short term in nature. Although temporary, an elevation in local dust levels is possible during the construction works, particularly under dry and windy conditions. Therefore, it is considered that the implementation of suitable mitigation measures, as outlined in Section 9.5.1, should effectively restrict potential dust nuisance episodes and associated impacts. Therefore, with the use of appropriate mitigation measures, the magnitude of dust impact upon the identified receptors (within 500m of the site) is predicted to be **negligible**.

9.4.1.2 Construction Phase Traffic

During construction phase it is expected that the proposed Project will generate, light and heavy vehicles, construction machinery and equipment movements. Considering the number of vehicle trips required to ferry construction staff and construction machinery requirements, the impact of the construction activities in terms of the impact of traffic generated on general air quality will be greater during the construction phase of the Project than when operational. Typical construction practices for the proposed Block 4 CCP will include associated internal construction site traffic, comprising of contractor’s vehicles, excavators, cranes, generators, and other diesel-powered vehicles. This will result in emissions of oxides of nitrogen, fine particles, carbon monoxide and other combustion related pollutants. However, emissions of combustion related pollutants from the construction phase activities and traffic are expected to be **negligible** in terms of effect on local air quality due to the low vehicle numbers and are therefore not considered further within this assessment.

9.4.2 Operational Phase

The operational impact of Block 4 has been assessed under the following scenarios:

Table 9-19 Scenarios for Operational Air Quality Impacts

Power Stations	Operational Units (In-Service)
Scenario 1 – Existing Conditions	
Scenario 1A: Winter Base Case (3 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, and ST 82
PS 4	GT 51, GT 52, ST 53, GT 61, GT 62, and ST 63
PS 3	1GT and 1ST
PS 2	No Units Operational
Scenario 1B: Summer Base Case (3 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, and ST 82
PS 4	GT 51, GT 52, ST 53, GT 61, GT 62, and ST 63
PS 3	2 GTs and 1 ST
PS 2	No Units Operational
Scenario 2 – Future Conditions	
Scenario 2A: Winter Base Case (4 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83, and ST 84
PS 4	2 GTs and 1 ST
PS 3	No Units Operational
PS 2	No Units Operational
Scenario 2B: Summer Base Case (4 PS 5 Units Operational)	
PS 5	GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83, and ST 84
PS 4	GT 51, GT 52, ST 53, GT 61, GT 62, and ST 63
PS 3	No Units Operational
PS 2	No Units Operational

The scenarios encompass worst-case scenario for the Block 4 and current operational scenario for PS 3, PS4 and 3 Blocks of PS 5 in terms of emissions to atmosphere.

The details of the operation of the proposed Block 4 is outlined in Section 4; Project Description.

In combined cycle mode, HRSG integral exhaust stacks are the main emission points. No emissions are anticipated through the bypass stacks during normal operation of the Plant.

The assessment of potential impacts of the emissions from the power plant are in accordance with the relevant limit values outlined in the Resolution No. (2) of the Year 2021 with respect to Environmental Standards (Air Quality) and IFC Environmental, Health and Safety Guidelines for Thermal Power Plants (December 10, 2008).

9.4.2.1 Dispersion Modeling Inputs

AERMOD has been used to model the emissions from the stacks at the Alba Power Stations. The modeling scenarios are presented in Table 9-19. To model the emissions data is required in relation to the emission:

- Stack Height and Diameter,
- Exit Velocity or Volume Flow Rate,
- Temperature, and
- Mass Emission Rates of:
  - Oxides of Nitrogen (NOx),
  - Sulphur Dioxide (SO_2), and
  - Carbon Monoxide (CO).

Table 9-20 illustrates the emission rates, stack height, diameter, exit flow rate, exit velocity, and coordinates of the stack used as input data in the AERMOD modeling. The operational stacks are selected as per the operational scenarios provided in Table 9-19.

The locations of the proposed stacks are extracted from the CAD drawings provided by the Project team.

Table 9-20 Point Sources Details with Emission Rates at Power Stations

Pollutant	Stack Reference	Stack Coordinates	Stack Height (m)	Stack Diameter (m)	Temperature (^{0}C)	Stack Exit Velocity (m/s)	Volumetric Flow Rate (m^3/hr)	Emission Concentration (mg/Nm^3)	Mass Emission Rate (g/s)
CO	PS3 GT 31	460116.00	35	4.87	176	16.61	1,113,800	2	0.4108
		2886178.00							
	PS3 GT 32	460102.00						2	0.4108
		2886175.00							
	PS3 GT 33	460084.00						2	0.4108
		2886171.00							
	PS3 GT 41	460071.00						2	0.4108
		2886169.00							
	PS3 GT 42	460053.00						2	0.4108
		2886165.00							
	PS3 GT 43	460039.00						2	0.4108
		2886163.00							
	PS4 GT 51	459951.00	40	6.1	150	13.04	1,371,500	2	0.5369
		2886151.00							
	PS4 GT 52	459919.00						2	0.5369
		2886145.00							
	PS4 GT 61	459885.00						2	0.5369
		2886138.00							

Pollutant	Stack Reference	Stack Coordinates	Stack Height (m)	Stack Diameter (m)	Temperature (^{0}C)	Stack Exit Velocity (m/s)	Volumetric Flow Rate (m^3/hr)	Emission Concentration (mg/Nm^3)	Mass Emission Rate (g/s)
	PS4 GT 62	459852.00						2	0.5369
		2886131.00							
	PS5 GT 71	459406.00	60	7.4	120	15.84	2,453,500	1	0.5168
		2885935.00							
	PS5 GT 73	459424.00						1	0.5168
		2885848.00							
	PS5 GT 81	459443.00						1	0.5168
		2885760.00							
	PS5 GT 83	459514.00	60	7.8	139	11.98	2,062,000	100	41.43
		2885650.00							
NOx as NO_2	PS3 GT 31	460116.00	35	4.87	176	16.61	1,113,800	41	8.420
		2886178.00							
	PS3 GT 32	460102.00						48	9.858
		2886175.00							
	PS3 GT 33	460084.00						52	10.680
		2886171.00							
	PS3 GT 41	460071.00						53	10.885
		2886169.00							
	PS3 GT 42	460053.00						47	9.653

Pollutant	Stack Reference	Stack Coordinates	Stack Height (m)	Stack Diameter (m)	Temperature (^{0}C)	Stack Exit Velocity (m/s)	Volumetric Flow Rate (m^3/hr)	Emission Concentration (mg/Nm^3)	Mass Emission Rate (g/s)
		2886165.00							
	PS3 GT 43	460039.00						34	6.983
		2886163.00							
	PS4 GT 51	459951.00	40	6.1	150	13.04	1,371,500	47	12.62
		2886151.00							
	PS4 GT 52	459919.00						15	4.026
		2886145.00							
	PS4 GT 61	459885.00						36	9.664
		2886138.00							
	PS4 GT 62	459852.00						40	10.74
		2886131.00							
	PS5 GT 71	459406.00	60	7.4	120	15.84	2,453,500	27	13.95
		2885935.00							
	PS5 GT 73	459424.00						31	16.02
		2885848.00							
	PS5 GT 81	459443.00						26	13.44
		2885760.00							
	PS5 GT 83	459514.00	60	7.8	139	11.98	2,062,000	50	20.72
		2885650.00							

Pollutant	Stack Reference	Stack Coordinates	Stack Height (m)	Stack Diameter (m)	Temperature (^0C)	Stack Exit Velocity (m/s)	Volumetric Flow Rate (m^3/hr)	Emission Concentration (mg/Nm^3)	Mass Emission Rate (g/s)
SO_2	PS3 GT 31	460116.00	35	4.87	176	16.61	1,113,800	16	3.286
		2886178.00							
	PS3 GT 32	460102.00						11	2.259
		2886175.00							
	PS3 GT 33	460084.00						1	0.2054
		2886171.00							
	PS3 GT 41	460071.00						14	2.875
		2886169.00							
	PS3 GT 42	460053.00						12	2.465
		2886165.00							
	PS3 GT 43	460039.00						15	3.081
		2886163.00							
	PS4 GT 51	459951.00	40	6.1	150	13.04	1,371,500	2	0.5369
		2886151.00							
	PS4 GT 52	459919.00						1	0.2684
		2886145.00							
	PS4 GT 61	459885.00						2	0.5369
		2886138.00							
	PS4 GT 62	459852.00						5	1.342

Pollutant	Stack Reference	Stack Coordinates	Stack Height (m)	Stack Diameter (m)	Temperature (^{0}C)	Stack Exit Velocity (m/s)	Volumetric Flow Rate (m^3/hr)	Emission Concentration (mg/Nm^3)	Mass Emission Rate (g/s)
		2886131.00							
	PS5 GT 71	459406.00	60	7.4	120	15.84	2,453,500	34	17.57
		2885935.00							
	PS5 GT 73	459424.00						25	12.92
		2885848.00							
	PS5 GT 81	459443.00						21	10.85
		2885760.00							
	PS5 GT 83	459514.00	60	7.8	139	11.98	2,062,000	102.9	42.63
		2885650.00							

9.4.2.2 Meteorological Data

Site-specific dispersion models require a sequential hourly record of dispersion meteorology representative of the region within which the source is located. In the absence of site-specific measurements, the data set generated with MM5, a meteorological prognostic model that provides the most probable surface and upper atmosphere conditions recorded during 01st January 2016 to 31st December 2020 (supplied by Lakes Environmental, Canada) are used.

Regulatory air dispersion modeling using AERMOD requires five years of quality-assured meteorological data that includes hourly records of the following parameters:

- Wind speed;
- Wind direction;
- Air temperature;
- Micrometeorological Parameters (e.g., Monin-Obukhov length, friction velocity);
- Mechanical mixing height; and
- Convective mixing height

Table 9-21 Met Data Information

Description	
Start-End Date	Jan 01, 2016 hour 00 - Dec 31, 2020 hour 23
Met Data Type	AERMET-Ready WRF-MMIF (Onsite & Upper Air Met Data) AERMOD-Ready WRF-MMIF (SFC & PFL Met Data)
Latitude	26.08941 N
Longitude	50.59513 E
Datum	WGS 84
Site Time Zone	UTC/GMT UTC + 3 hour(s)
UTM Zone	39
Anemometer Height	15 m
Station Base Elevation	22.24 m
WRF Grid Cell	4 km x 4 km

The key metrological parameters that were used by the model in hourly sequences include total cloud cover, opaque cloud cover, dry bulb temperature, dew point temperature, relative humidity, station pressure, wind direction, wind speed, ceiling height and hourly precipitation amount. The wind rose based on the above data is presented in Figure 9-12.

9.4.2.3 Building Downwash

Buildings located close to point sources may significantly affect the dispersion of the pollutants from the source. In order to avoid excessive downwind concentrations due to building downwash effects, the height of the stack must be tall enough to allow the emissions plume to escape the cavity region that is created on the downwind side of a building complex. This height of the stack is referred to as good engineering practice (GEP) stack height.

Environmental Protection Agency developed a preprocessing tool referred to as the Building Profile Input Program (BPIP) with Plume Rise Model Enhancements (PRIME) for a consistent method for applying downwash calculations for use in the air quality model.

9.4.2.4 BPIP PRIME

The current version of the AERMOD dispersion model treats the trajectory of the plume near the building and uses the position of the plume relative to the building to calculate interactions with the building wake. AERMOD calculates fields of turbulence intensity, wind speed, and slopes of the mean streamlines as a function of the projected building dimensions.

The direction-specific building dimensions used as input to the AERMOD model were calculated using BPIP- PRIME. BPIP-PRIME is sanctioned by the U.S. EPA and is designed to incorporate the concepts and procedures expressed in the "Good Engineering Practice" (GEP) of Section 123 of the Clean Air Act and 40 CFR 51.1.

A detailed stack height assessment has carried out using BPIP-PRIME to determine safe stack height, using air dispersion modeling for a range of stack heights and gas exit velocities.

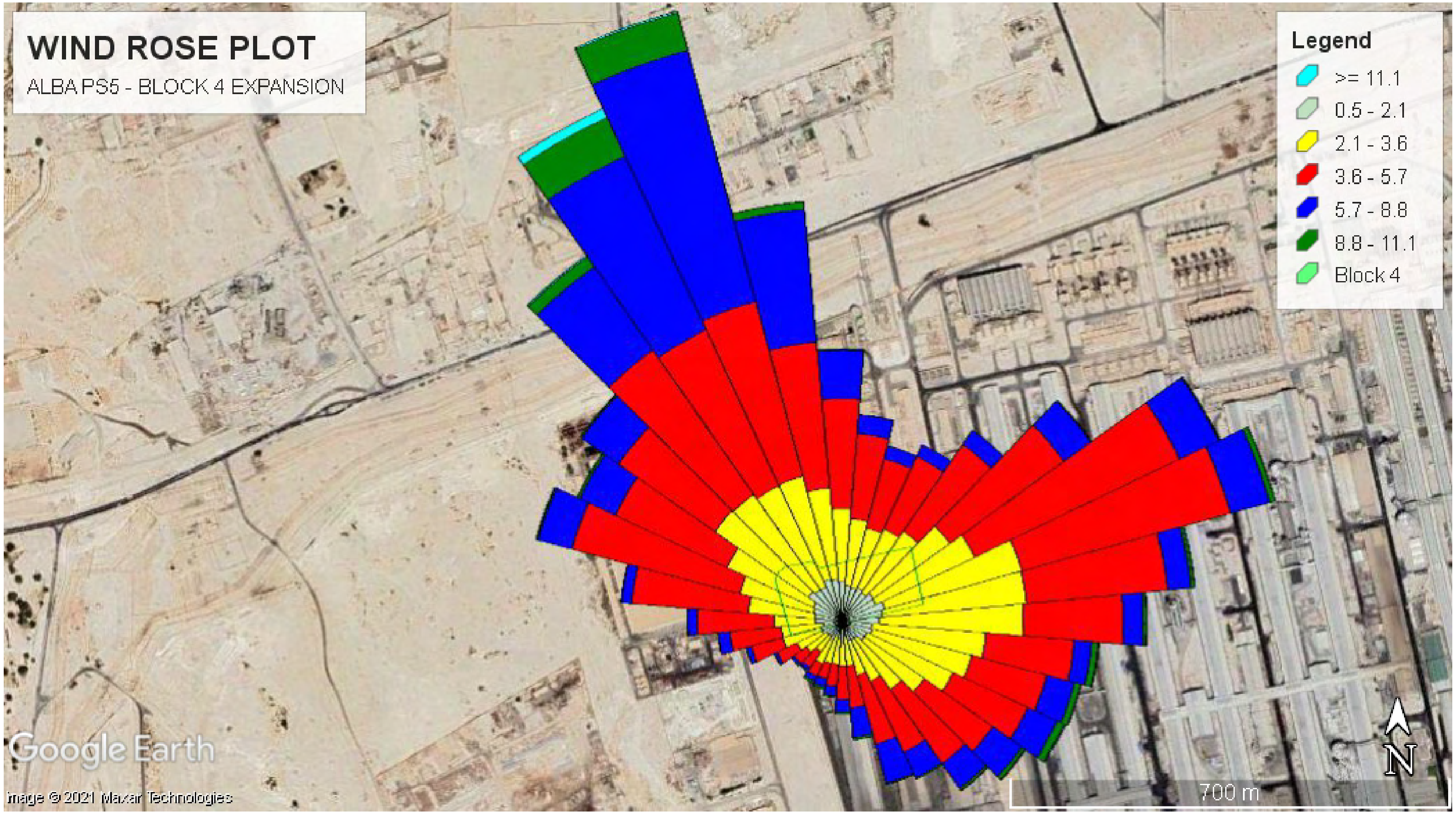

Figure 9-12 Wind Rose Plot on PS5 Block 4 Site

9.4.2.5 Terrain Data

Proposed project is in an Industrial area, where within 5 kms radius the terrain sectors observed are flat and elevated, covered by around 55% of desert shrub land, 35% of residential and industrial area and 10% of marine. A 30m DEM downloaded from SRTM was used as terrain input for present study. Terrain contours generated from AERMOD is presented in Figure 9-13.

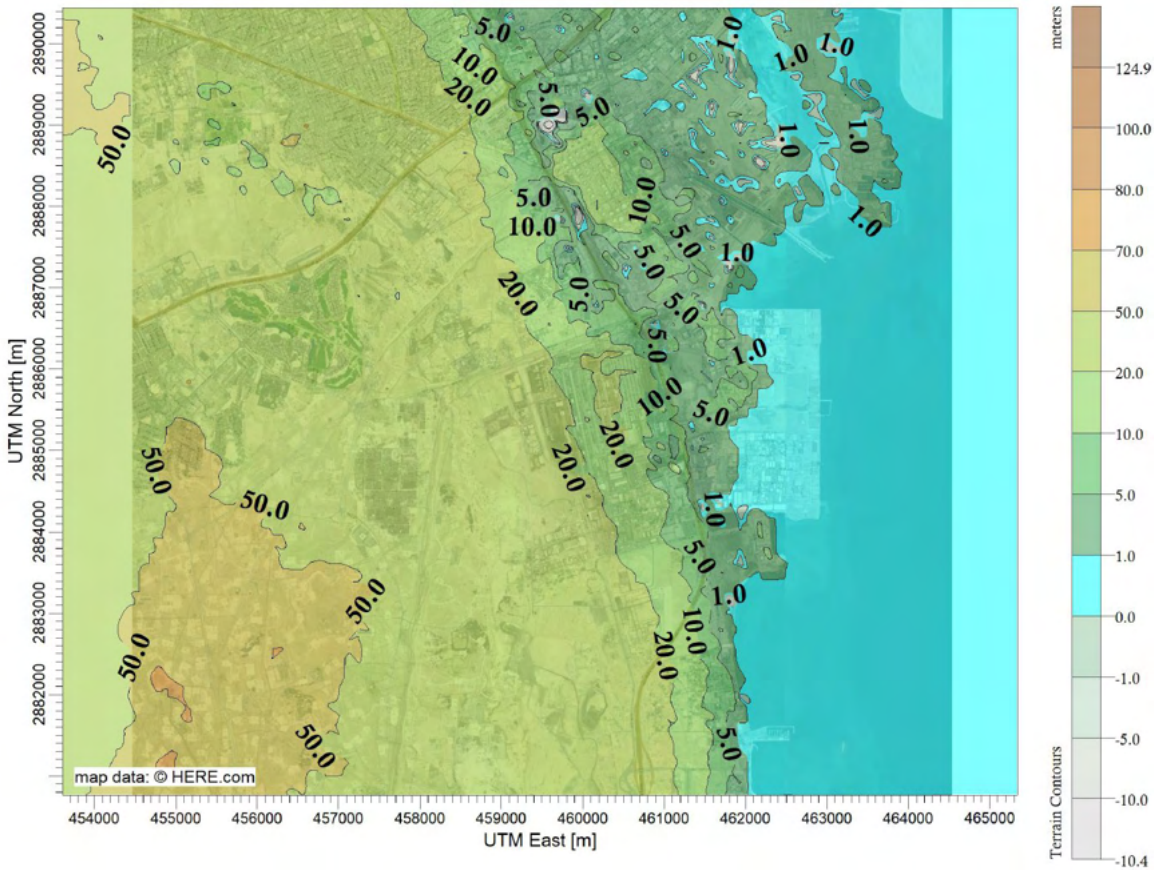

Figure 9-13 Terrain Contours

9.4.2.6 Surface Roughness

The surface roughness conditions in the vicinity of the site have adjusted for rural surroundings.

9.4.2.7 Time Averaging

The time averaging and percentiles have been calculated in terms of the pollutant concentration limit values criteria detailed in the air quality standards. The averaging times for NO_2, SO_2 and CO were selected in terms of the relevant air quality standards.

9.4.2.8 Dispersion Modeling Results

The proposed Block 4 will emit combustion gases through the burning of natural gas, which will give rise to emissions of Nitrogen Oxides (NOx), Carbon Monoxide (CO), and Sulphur Dioxide (SO_2).

For the purpose of this air quality impact assessment, all of the emissions from the existing power plants have been assessed based on the maximum recorded emissions and that for the Block 4 have been assessed based on the maximum expected emissions provided by the OEM. Therefore, this is a worst-case assessment as it unlikely that the emission stacks will emit pollutants at or above the values specified.

Operation of the Block 4 will also result in Carbon Dioxide (CO_2) emissions. However, CO_2 does not affect human health except in extremely high concentrations and therefore, emissions of CO_2 are not relevant for local air quality impact assessment and are not considered further through dispersion modelling. CO_2 emissions from the Block 4 are dealt with in further details in Section 8.2.2.

The assessment of potential impact of emissions on ambient air quality from the Power Stations has been completed in accordance with the Scenarios detailed in Table 9-19.

9.4.2.8.1 Scenario 1A: Winter Base Case (3 PS5 Units, 4 PS4 Units and 1 PS3 Unit Operational)

The predicted maximum ground level concentrations of Scenario 1A air dispersion modeling assessment is presented in Table 9-22 and concentration isopleths are presented in Figure 9-14 to Figure 9-21.

9.4.2.8.1.1 Carbon Monoxide

Maximum predicted ground level concentrations of CO due to process emissions are predicted to be approximately 0.1% of 1 – hour and 0.05% of 8 – hours averaging periods. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 3% of the maximum ambient 1 – hour limit value and 5% of the 8 – hour limit value (refer Table 9-22). Concentration isopleths are presented in Figure 9-14 and Figure 9-15.

Maximum predicted ground level CO concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-23.

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Table 9-22 Scenario 1A Air Dispersion Modeling – Maximum Ground Level Concentrations

Pollutant	Averaging Period	Predicted Maximum Ground Level Concentration (µg/m³) - A	% of Guideline Values		Mean Ambient Concentration (µg/m³) – B	Predicted Environmental Concentration (A + B) (µg/m³)	% of Guideline Values		Guideline Values (µg/m³)	
			SCE	IFC			SCE	IFC	SCE	IFC
CO	1 – Hour	11.4	0.1%	-	493.0	504.4	3%	-	20,000.00	-
	8 – Hours	5.2	0.05%	-	504.0	509.2	5%	-	10,000.00	-
NO_2	1 – Hour	197.9	99%	99%	100.3	298.2	149%	149%	200	200
	24 – Hours	64.0	43%	-	102.4	166.4	111%	-	150	-
	Annual	11.3	28%	28%		11.3	28%	28%	40	40
SO_2	1 – Hour	142.5	48%	-	153.7	296.2	99%	-	300	-
	24 – Hours	82.6	66%	66%	155.9	238.5	191%	191%	125	125 IT- 1
	Annual	13.1	26%	-		13.1	26%	-	50	-

Note 1: Ambient concentration is the mean recorded during the ambient air quality monitoring at site.

Note 2: Assumed NOx / NO_2 Conversion Rate is 0.63 to 0.65 based on ARM2 (AERMOD Feature) - Ambient Ratio Method

Note 3: IT-1 (Interim Target 1): Interim Targets are proposed as incremental steps in a progressive reduction of air pollution and are intended for use in areas where pollution is high. These targets aim to promote a shift from high air pollutant concentrations, which have acute and serious health consequences, to lower air pollutant concentrations. If these targets were to be achieved, one could expect significant reductions in risks for acute and chronic health effects from air pollution.

Table 9-23 Scenario 1A: Maximum Predicted Short Term (1 – Hour and 8 – Hour) CO Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	SCE Standard
1 – Hour			
Camp Areas	4.9	0.02%	20,000
Camp Areas	6.8	0.03%	
Riffa View	4.5	0.02%	
Princess Sabeeka Oasis	3.6	0.02%	
BSPCA	2.8	0.01%	
Camp Areas	3.4	0.02%	
Askar Village	3.7	0.02%	
Camp Areas	2.3	0.01%	
Camp Areas	2.1	0.01%	
Camp Areas	3.6	0.02%	
Mameer Village	2.2	0.01%	
Riffa City	3.1	0.02%	
Tatweer Petroleum	5.3	0.03%	
BDF Muaskar Camp	3.9	0.02%	
8 – Hours			
Camp Areas	2.9	0.03%	10,000
Camp Areas	2.8	0.03%	
Riffa View	1.6	0.02%	
Princess Sabeeka Oasis	1.0	0.01%	
BSPCA	1.6	0.02%	
Camp Areas	1.0	0.01%	
Askar Village	0.8	0.01%	
Camp Areas	0.7	0.01%	

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	SCE Standard
Camp Areas	0.9	0.01%	
Camp Areas	1.7	0.02%	
Mameer Village	1.0	0.01%	
Riffa City	1.3	0.01%	
Tatweer Petroleum	2.4	0.02%	
BDF Muaskar Camp	2.0	0.02%	

The short term (1-hour and 8 – hour) CO process contributions are <10% of the limit values at all receptor locations. Thus, the impacts of Carbon Monoxide emissions due to the existing operation (Scenario 1A – Winter Base Case) of Alba Power Stations are assessed to be **insignificant**.

9.4.2.8.1.2 Nitrogen Dioxide (NO_2)

The NO_2 modeling results indicate that the maximum 1 – hour, 24 – hours, and annual ground level concentrations are well below the ambient air quality standards. NO_2 emissions equate to a process contribution of ambient NO_2 concentrations 99% of the maximum 1 – hour limit value. The process contribution of ambient 24 – hour NO_2 concentrations, is 43% of the limit value and that for annual mean NO_2 concentrations is 28% of the limit value. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 149% of the maximum ambient 1 – hour limit value and 111% of the 24 – hour limit value (refer Table 9-22). Plot Files are presented in Figure 9-16 to Figure 9-18.

Maximum predicted ground level NO_2 concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-24 and Table 9-25.

Table 9-24 Scenario 1A: Maximum Predicted Long Term (Annual) NO_2 Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	2.7	6.63%	40	40
Camp Areas	3.2	8.00%		
Riffa View	1.2	3.05%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Princess Sabeeka Oasis	1.7	4.30%		
BSPCA	2.4	6.00%		
Camp Areas	1.42	3.55%		
Askar Village	1.52	3.80%		
Camp Areas	0.66	1.65%		
Camp Areas	0.49	1.23%		
Camp Areas	0.98	2.45%		
Mameer Village	0.45	1.13%		
Riffa City	0.71	1.78%		
Tatweer Petroleum	1.37	3.43%		
BDF Muaskar Camp	2.13	5.33%		

The annual mean NO_2 process contributions are well within the guideline values. Modeling results indicate that the process contribution of ambient annual NO_2 concentrations is >1% at all receptor locations.

Table 9-25 Scenario 1A: Maximum Predicted Short Term (1 – Hour and 24 – Hour) NO_2 Concentrations at Sensitive Receptors (µg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
1 – Hour				
Camp Areas	95.2	47.60%	200	200
Camp Areas	140.8	70.42%		
Riffa View	114.0	56.99%		
Princess Sabeeka Oasis	71.3	35.63%		
BSPCA	70.5	35.26%		
Camp Areas	92.8	46.40%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Askar Village	76.1	38.07%		
Camp Areas	50.8	25.38%		
Camp Areas	53.8	26.91%		
Camp Areas	74.2	37.08%		
Mameer Village	48.9	24.47%		
Riffa City	77.3	38.67%		
Tatweer Petroleum	123.3	61.66%		
BDF Muaskar Camp	108.2	54.10%		
24 - Hours				
Camp Areas	44.8	29.89%	150	-
Camp Areas	40.1	26.71%		
Riffa View	15.2	10.15%		
Princess Sabeeka Oasis	14.5	9.63%		
BSPCA	21.0	14.01%		
Camp Areas	14.7	9.77%		
Askar Village	15.2	10.12%		
Camp Areas	6.8	4.53%		
Camp Areas	10.1	6.73%		
Camp Areas	15.4	10.28%		
Mameer Village	9.6	6.41%		
Riffa City	11.0	7.33%		
Tatweer Petroleum	22.9	15.25%		
BDF Muaskar Camp	30.7	20.46%		

From the modeling study it is evident that the short-term NO_2 process contributions are well within the guideline values. The process contributions of ambient 1 – hour concentrations are >10% at all receptor locations.

The process contributions of ambient 24 – hour NO_2 concentrations is >10% at all receptor locations except camp areas located at approximately 2 km away from the Block 4 location towards South and South-East, Princess Sabeeka Oasis, Mameer Village and Riffa City.

Thus, in accordance with the significance criteria (refer section 9.2.2.1), the impacts due to the process contributions of Nitrogen Dioxide emissions during Scenario 1A Winter Base Case Operations are **significant** and assessed to be of **moderate adverse**.

9.4.2.8.1.3 Sulphur Dioxide (SO_2)

The SO_2 modeling results indicate that the maximum 1 – hour, 24 – hours, and annual ground level concentrations are well below the ambient air quality standards. SO_2 emissions equate to a process contribution of ambient SO_2 concentrations 48% of the maximum 1 – hour limit value. The process contribution of ambient 24 – hour SO_2 concentrations, is 66% of the limit value and that for annual mean SO_2 concentrations is 26% of the limit value. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 99% of the maximum ambient 1 – hour limit value and 191% of the 24 – hour limit value (refer Table 9-22). Plot Files are presented in Figure 9-19 to Figure 9-21.

Maximum predicted ground level SO_2 concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-26 and Table 9-27.

Table 9-26 Scenario 1A: Maximum Predicted Long Term (Annual) SO_2 Concentrations at Sensitive Receptors (µg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	1.3	2.64%	50	-
Camp Areas	2.2	4.38%		
Riffa View	0.8	1.52%		
Princess Sabeeka Oasis	0.9	1.74%		
BSPCA	1.6	3.26%		
Camp Areas	0.9	1.82%		
Askar Village	0.9	1.86%		
Camp Areas	0.4	0.72%		
Camp Areas	0.3	0.50%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	0.4	0.84%		
Mameer Village	0.2	0.46%		
Riffa City	0.4	0.82%		
Tatweer Petroleum	0.8	1.52%		
BDF Muaskar Camp	1.3	2.56%		

The annual mean SO_2 process contributions are well within the guideline values. Modeling results indicate that the process contribution of ambient annual SO_2 concentrations is >1% at all receptor locations except camp areas located ~2kms away from the Block 4 Plot towards South-East, Mameer Village and Riffa City.

Table 9-27 Scenario 1A: Maximum Predicted Short Term (1 – Hour and 24 – Hour) SO_2 Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
1 - Hours				
Camp Areas	76.0	25.34%	300	-
Camp Areas	116.7	38.91%		
Riffa View	104.2	34.72%		
Princess Sabeeka Oasis	67.1	22.38%		
BSPCA	72.3	24.08%		
Camp Areas	94.0	31.34%		
Askar Village	58.8	19.61%		
Camp Areas	51.5	17.16%		
Camp Areas	51.0	16.99%		
Camp Areas	63.9	21.30%		
Mameer Village	43.5	14.50%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Riffa City	56.6	18.86%		
Tatweer Petroleum	80.6	26.85%		
BDF Muaskar Camp	103.4	34.48%		
24 - Hours				
Camp Areas	39.8	31.85%	125	125 IT – 1
Camp Areas	37.7	30.18%		
Riffa View	12.6	10.04%		
Princess Sabeeka Oasis	9.5	7.63%		
BSPCA	19.5	15.56%		
Camp Areas	11.1	8.87%		
Askar Village	13.5	10.80%		
Camp Areas	5.6	4.45%		
Camp Areas	7.5	6.00%		
Camp Areas	10.7	8.54%		
Mameer Village	5.9	4.70%		
Riffa City	9.0	7.18%		
Tatweer Petroleum	16.4	13.08%		
BDF Muaskar Camp	25.6	20.51%		

From the modeling study it is evident that the short-term SO_2 process contributions are well within the guideline values. The process contributions of ambient 1 – hour concentrations are >10% at all receptor locations.

The process contributions of ambient 24 – hour SO_2 concentrations is >10% at all receptor locations except camp areas located at approximately 2 km away from the Block 4 location towards South and South-East, Princess Sabeeka Oasis, Mameer Village and Riffa City.

Thus, in accordance with the significance criteria (refer section 9.2.2.1), the impacts due to the process contributions of Sulphur Dioxide emissions during Scenario 1A Winter Base Case Operations are **significant** and assessed to be of **moderate adverse**.

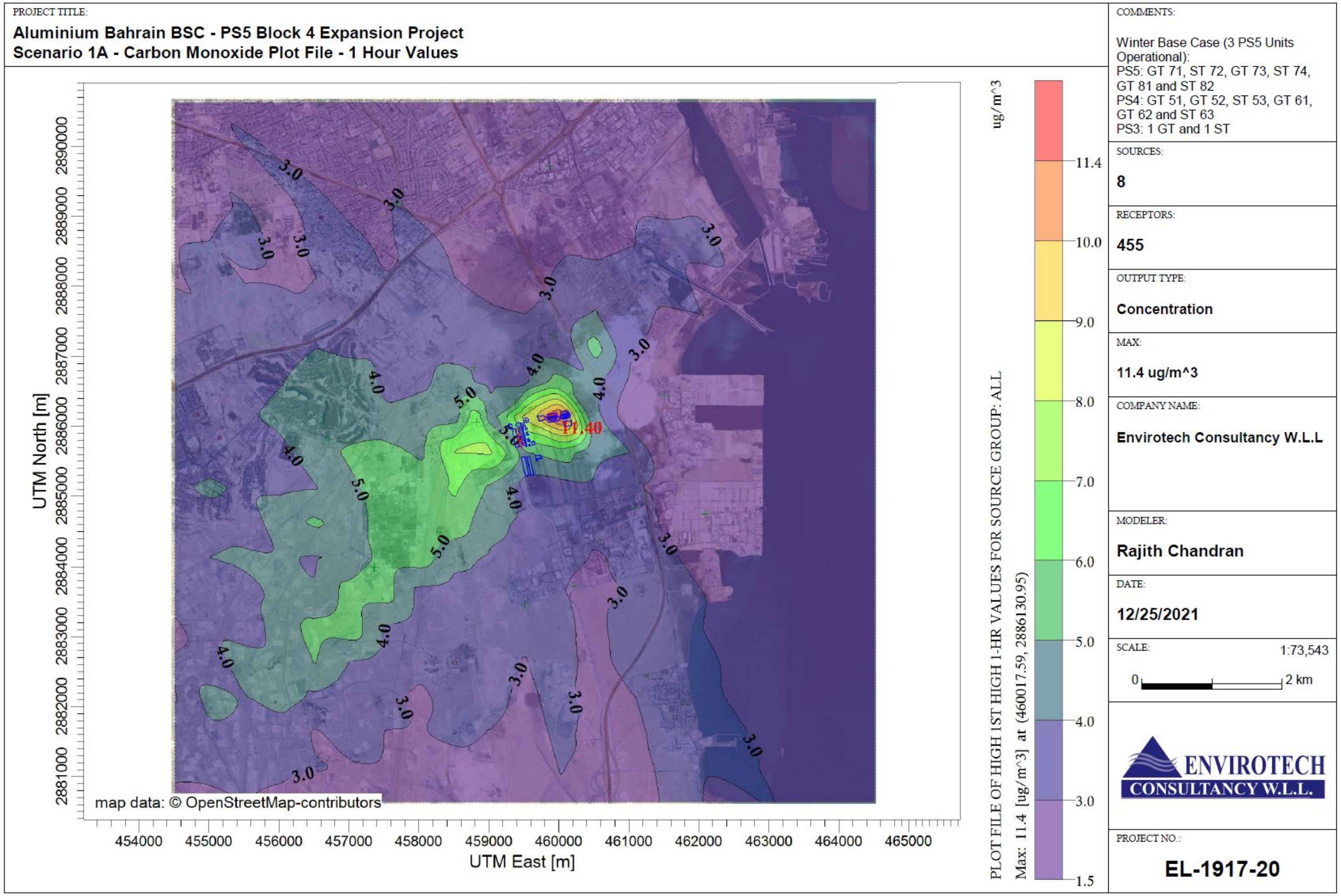

Figure 9-14 Scenario 1A: Carbon Monoxide Concentration Isopleth – Hourly Values

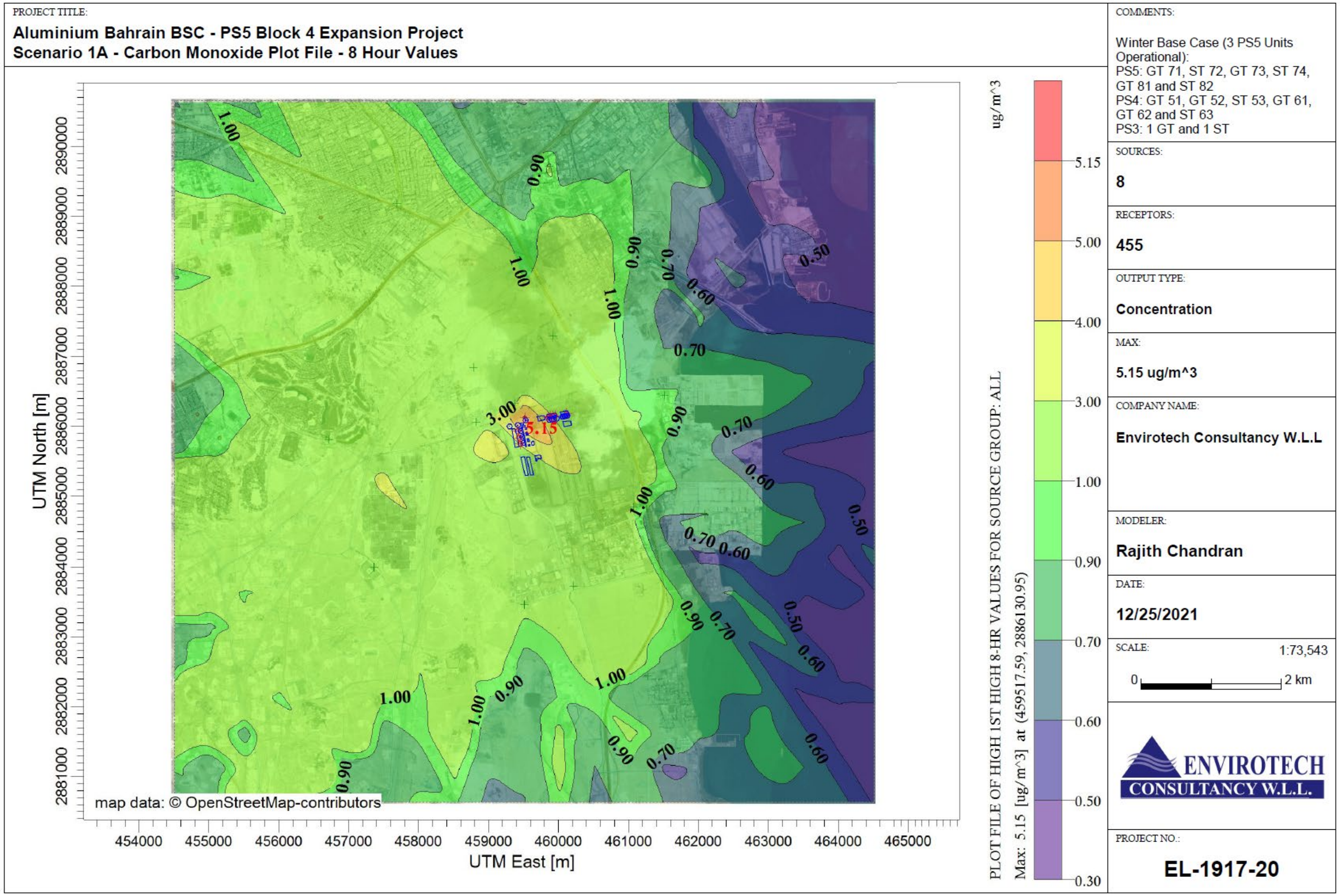

Figure 9-15 Scenario 1A: Carbon Monoxide Concentration Isopleth – 24 Hour Values

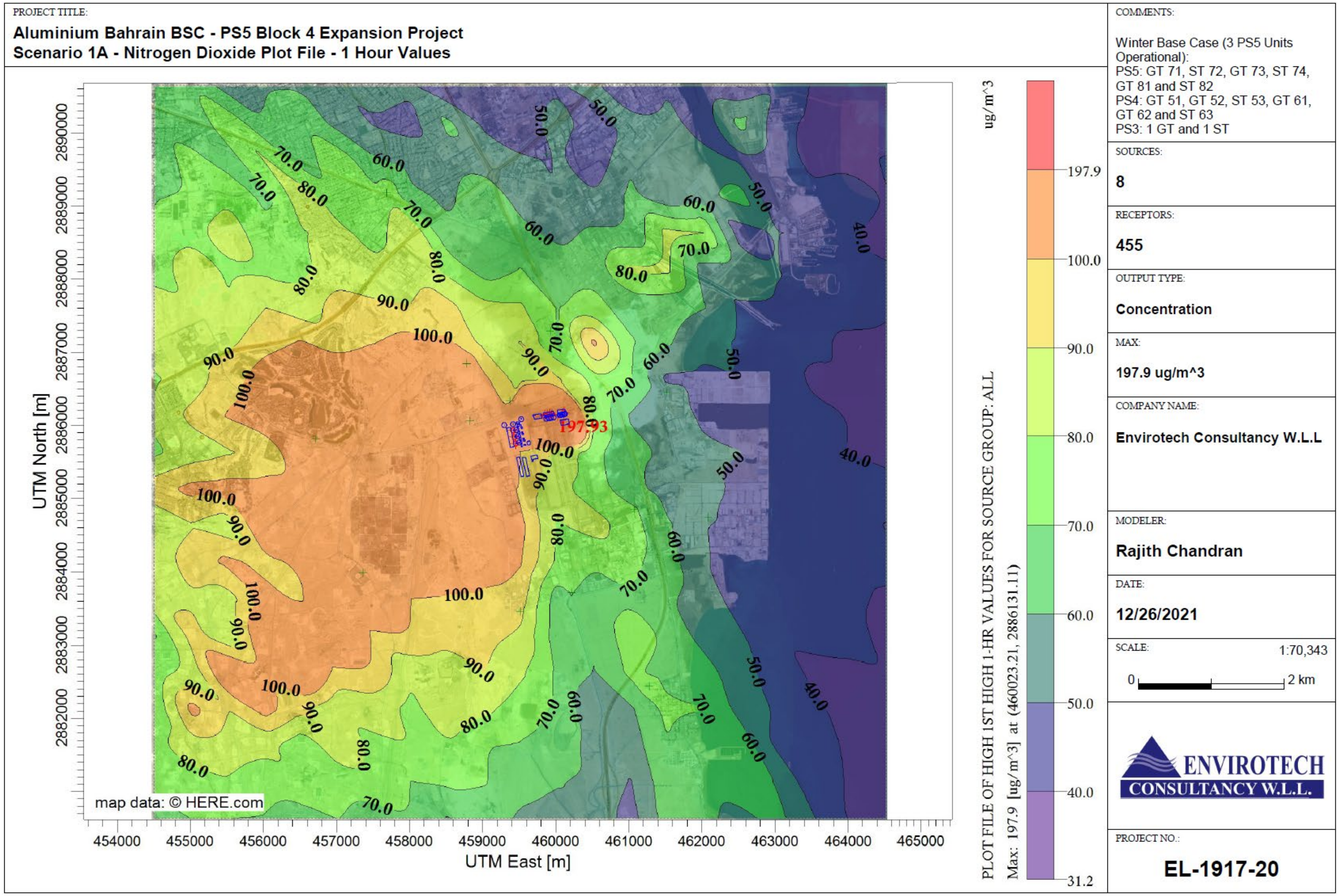

Figure 9-16 Scenario 1A: Nitrogen Dioxide Concentration Isopleth – 1 Hour Values

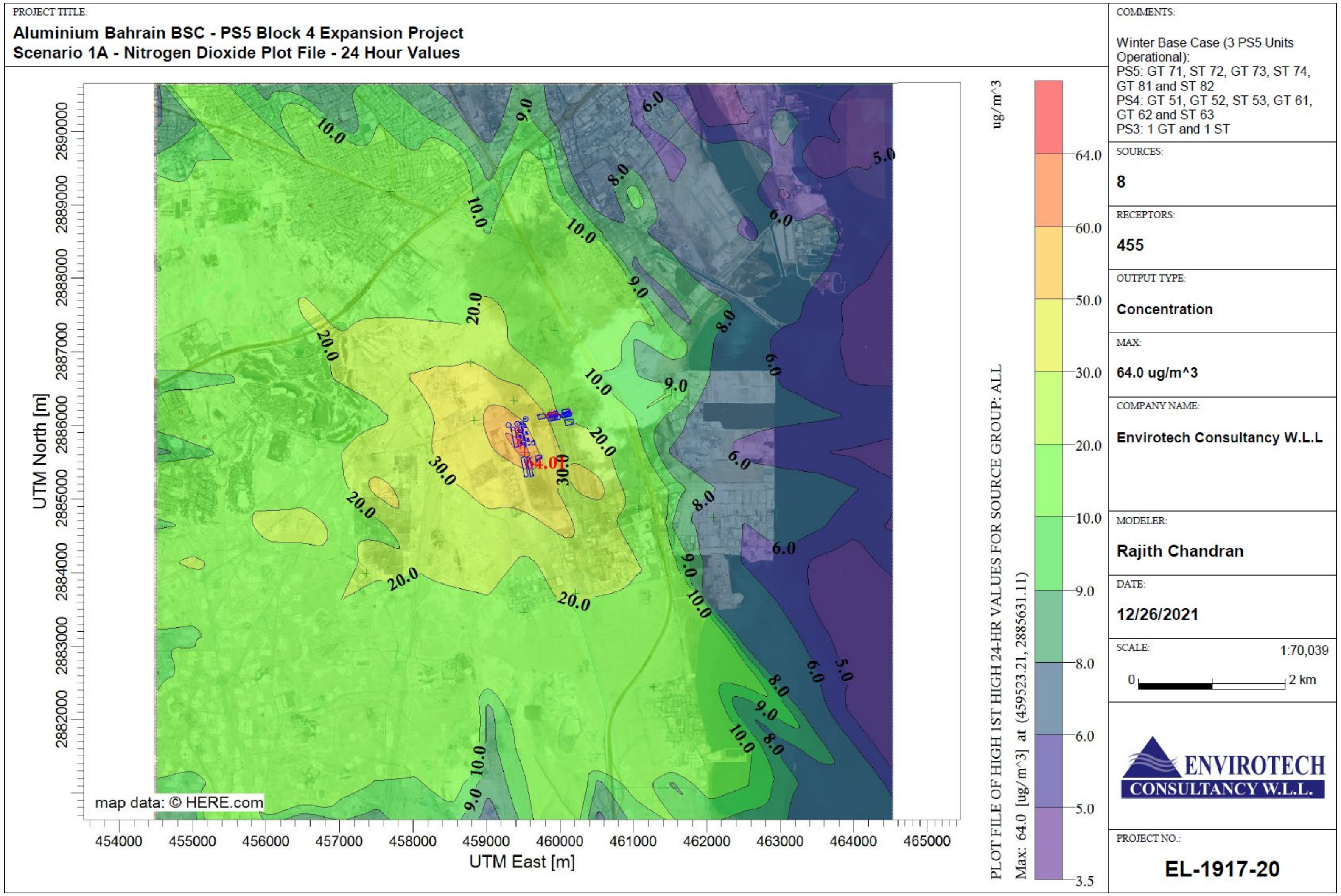

Figure 9-17 Scenario 1A: Nitrogen Dioxide Concentration Isopleth – 24 Hour Values

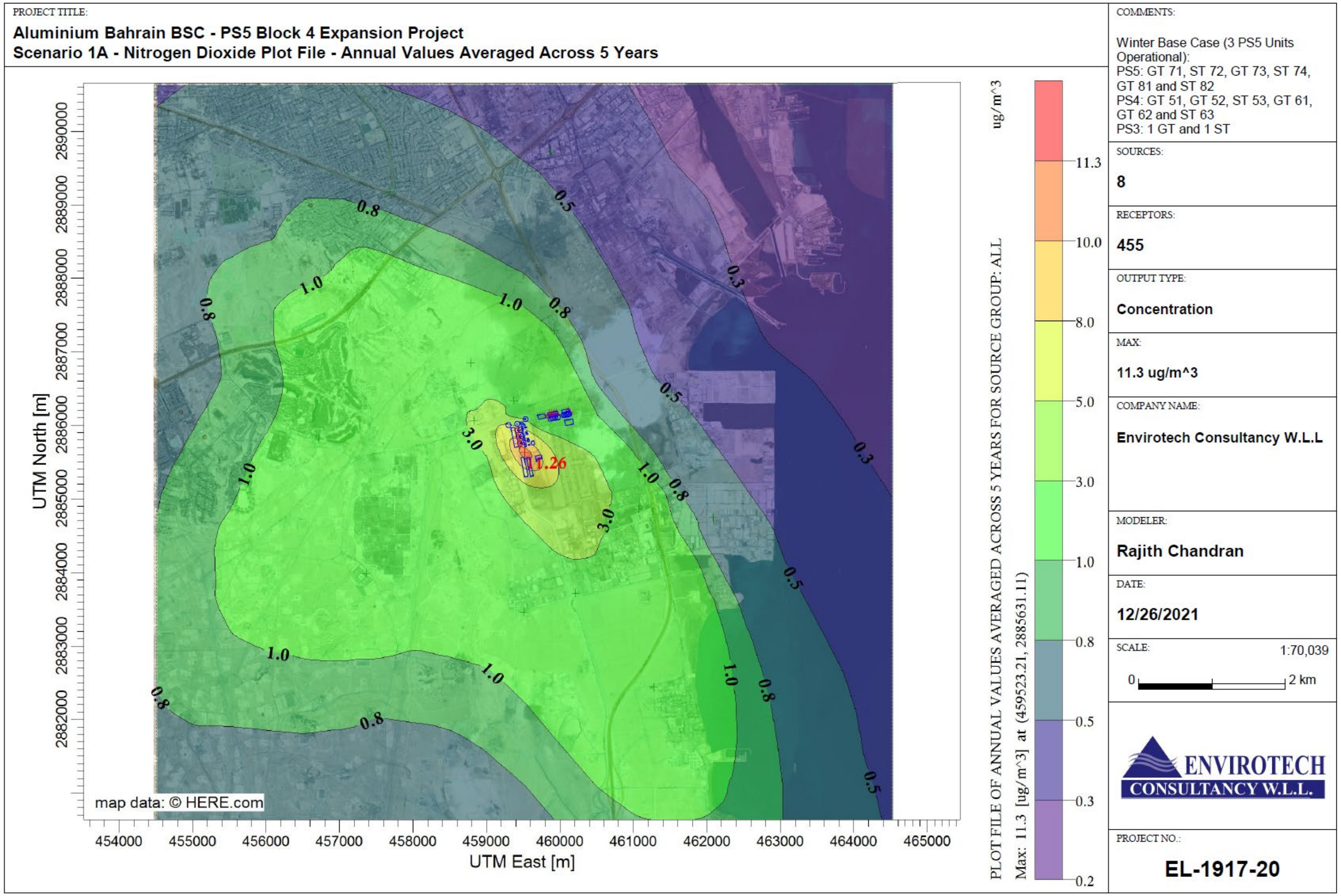

Figure 9-18 Scenario 1A: Nitrogen Dioxide Concentration Isopleth – Annual Values Averaged Across 5 Years

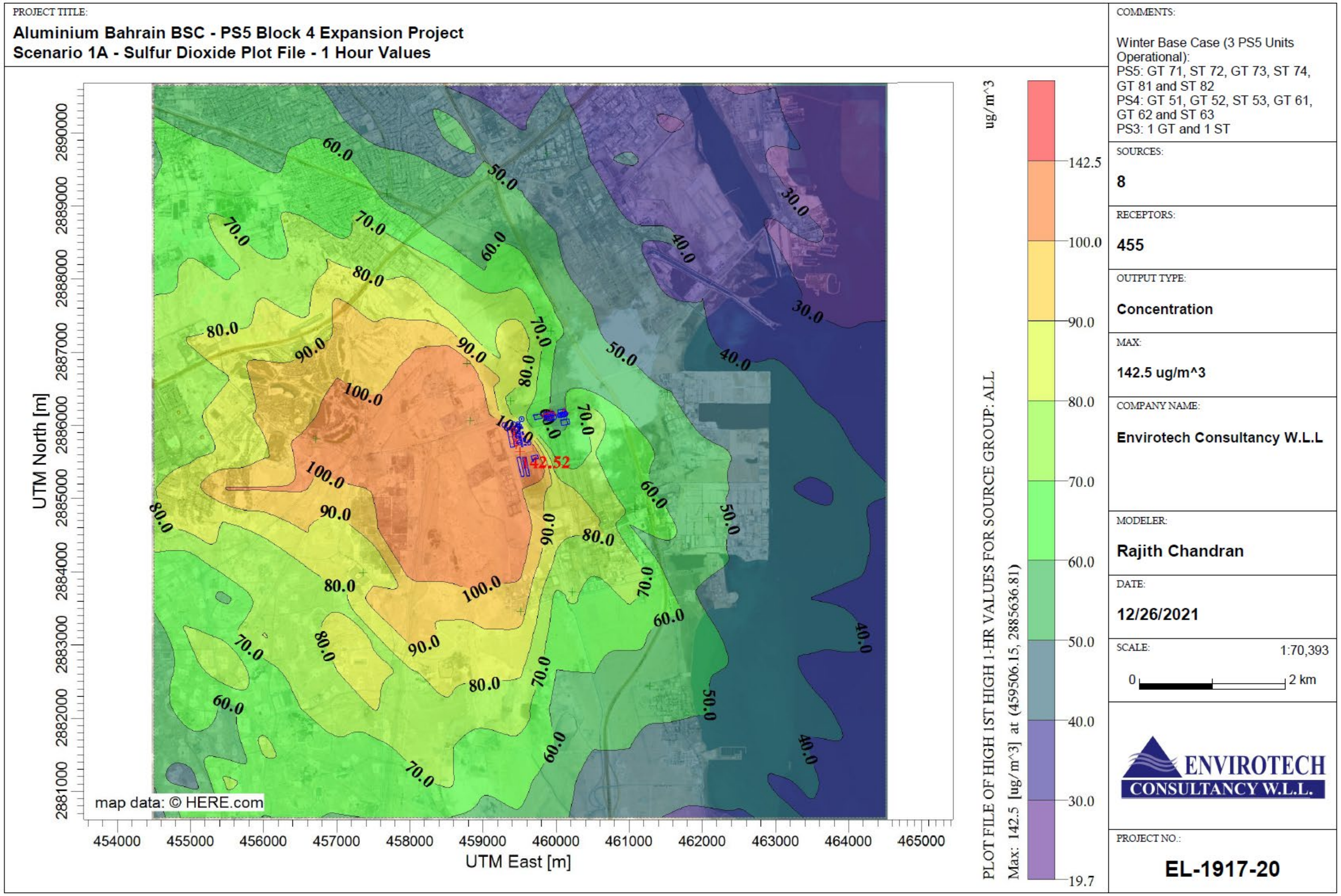

Figure 9-19 Scenario 1A: Sulphur Dioxide Concentration Isopleth – 1 Hour Values

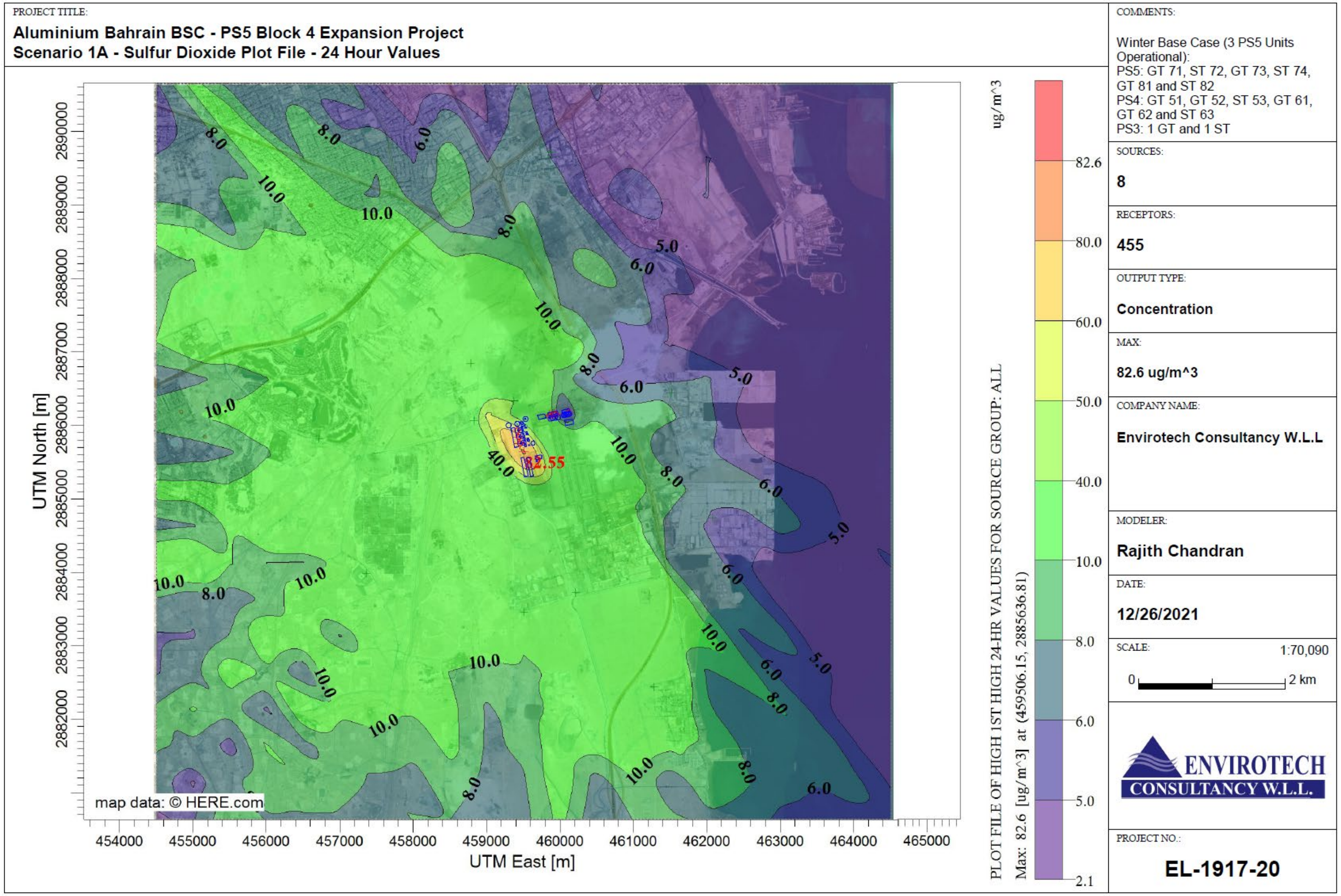

Figure 9-20 Scenario 1A: Sulphur Dioxide Concentration Isopleth – 24 Hour Values

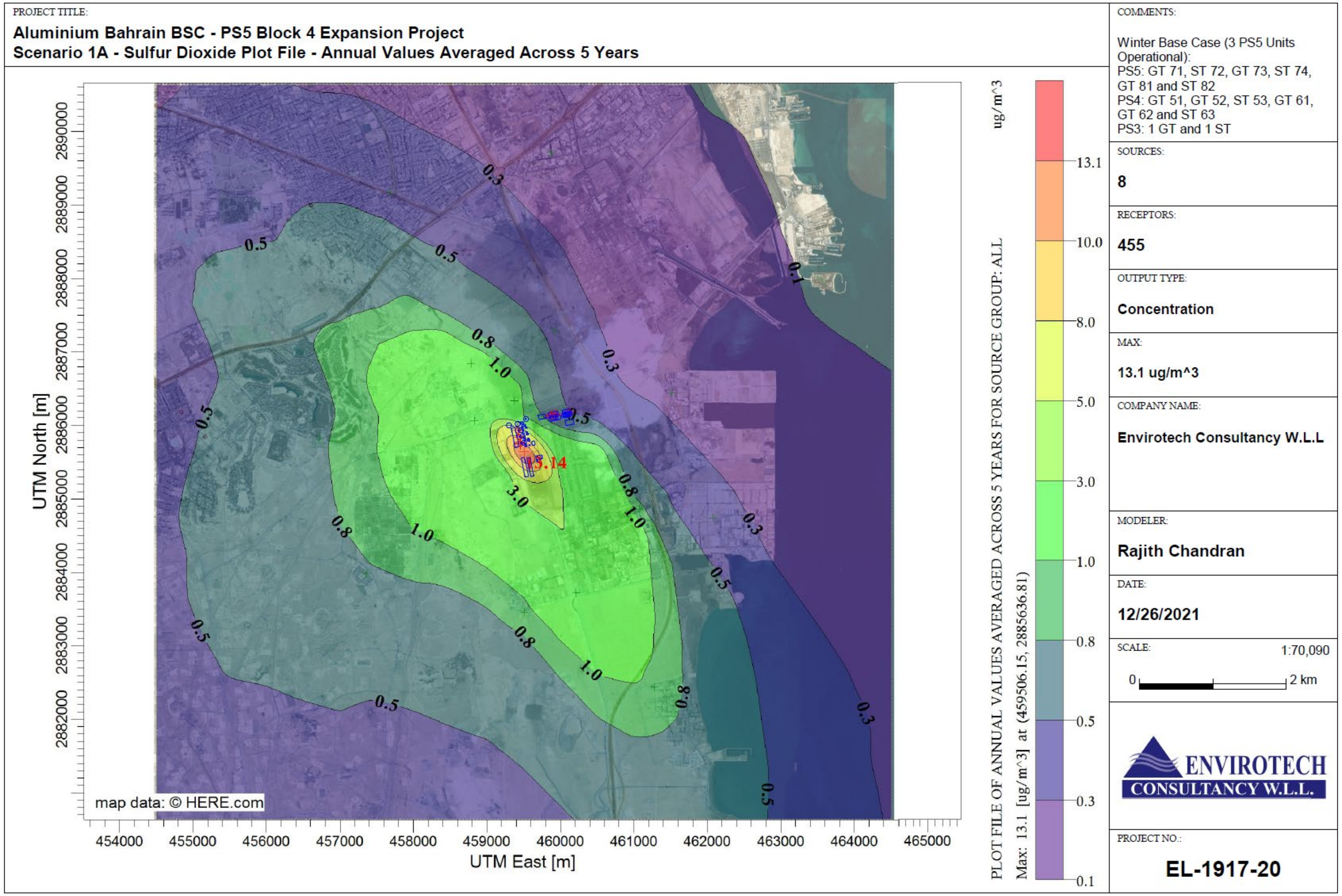

Figure 9-21 Scenario 1A: Sulphur Dioxide Concentration Isopleth – Annual Values Averaged Across 5 Years

9.4.2.8.2 Scenario 1B: Summer Base Case (3 PS5 Units, 4 PS4 Units and 2 PS3 Units Operational)

The predicted maximum ground level concentrations of Scenario 1B air dispersion modeling assessment is presented in Table 9-28 and concentration isopleths are presented in Figure 9-22 to Figure 9-29.

9.4.2.8.2.1 Carbon Monoxide

Maximum predicted ground level concentrations of CO due to process emissions are predicted to be approximately 0.1% of 1 – hour and 8 – hours averaging periods. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 3% of the maximum ambient 1 – hour limit value and 5% of the 8 – hour limit value (refer Table 9-28). Concentration isopleths are presented in Figure 9-22 and Figure 9-23.

Maximum predicted ground level CO concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-29.

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Table 9-28 Scenario 1B Air Dispersion Modeling – Maximum Ground Level Concentrations

Pollutant	Averaging Period	Predicted Maximum Ground Level Concentration (µg/m³) - A	% of Guideline Values		Ambient Concentration (µg/m³) – B	Predicted Environmental Concentration (A + B) (µg/m³)	% of Guideline Values		Guideline Values (µg/m³)	
			SCE	IFC			SCE	IFC	SCE	IFC
CO	1 – Hour	13.7	0.1%	-	493.0	506.7	3%	-	20,000.00	-
	8 – Hours	5.9	0.1%	-	504.0	509.9	5%	-	10,000.00	-
NO_2	1 – Hour	240.7	120%	120%	100.3	341.0	170%	170%	200	200
	24 – Hours	64.0	43%	-	102.4	166.4	111%	-	150	-
	Annual	11.5	29%	29%		11.5	29%	29%	40	40
SO_2	1 – Hour	142.5	48%	-	153.7	296.2	99%	-	300	-
	24 – Hours	82.6	66%	66%	155.9	238.5	191%	191%	125	125 IT- 1
	Annual	13.2	26%	-		13.2	26%	-	50	-

Note 1: Ambient concentration is the mean recorded during the ambient air quality monitoring at site.

Note 2: Assumed NOx / NO_2 Conversion Rate is 0.63 to 0.65 based on ARM2 (AERMOD Feature) - Ambient Ratio Method

Note 3: IT-1 (Interim Target 1): Interim Targets are proposed as incremental steps in a progressive reduction of air pollution and are intended for use in areas where pollution is high. These targets aim to promote a shift from high air pollutant concentrations, which have acute and serious health consequences, to lower air pollutant concentrations. If these targets were to be achieved, one could expect significant reductions in risks for acute and chronic health effects from air pollution.

Table 9-29 Scenario 1B: Maximum Predicted Short Term (1 – Hour and 8 – Hour) CO Concentrations at Sensitive Receptors (μg/m³)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	SCE Standard
1 – Hour			
Camp Areas	6.6	0.03%	20,000
Camp Areas	6.9	0.03%	
Riffa View	4.5	0.02%	
Princess Sabeeka Oasis	4.1	0.02%	
BSPCA	3.1	0.02%	
Camp Areas	3.4	0.02%	
Askar Village	4.2	0.02%	
Camp Areas	2.6	0.01%	
Camp Areas	2.3	0.01%	
Camp Areas	4.0	0.02%	
Mameer Village	2.5	0.01%	
Riffa City	3.2	0.02%	
Tatweer Petroleum	5.7	0.03%	
BDF Muaskar Camp	4.0	0.02%	
8 – Hour			
Camp Areas	3.6	0.04%	10,000
Camp Areas	2.8	0.03%	
Riffa View	1.6	0.02%	
Princess Sabeeka Oasis	1.3	0.01%	
BSPCA	1.6	0.02%	
Camp Areas	1.1	0.01%	
Askar Village	0.9	0.01%	
Camp Areas	0.7	0.01%	
Camp Areas	1.0	0.01%	
Camp Areas	1.8	0.02%	
Mameer Village	1.1	0.01%	

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	SCE Standard
Riffa City	1.4	0.01%	
Tatweer Petroleum	2.4	0.02%	
BDF Muaskar Camp	2.0	0.02%	

The short term (1-hour and 8 – hour) CO process contributions are <10% of the limit values at all receptor locations. Thus, the impacts of Carbon Monoxide emissions due to the existing operation (Scenario 1B – Summer Base Case) of Alba Power Stations are assessed to be **insignificant**.

9.4.2.8.2.2 Nitrogen Dioxide (NO_2)

The NO_2 modeling results indicate that the maximum 1 – hour, 24 – hours, and annual ground level concentrations are well below the ambient air quality standards. NO_2 emissions equate to a process contribution of ambient NO_2 concentrations 120% of the maximum 1 – hour limit value. The process contribution of ambient 24 – hour NO_2 concentrations, is 43% of the limit value and that for annual mean NO_2 concentrations is 29% of the limit value. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 170% of the maximum ambient 1 – hour limit value and 111% of the 24 – hour limit value (refer Table 9-28). Plot Files are presented in Figure 9-24 to Figure 9-26.

Maximum predicted ground level NO_2 concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-30 and Table 9-31.

Table 9-30 Scenario 1B: Maximum Predicted Long Term (Annual) NO_2 Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	2.9	7.13%	40	40
Camp Areas	3.3	8.35%		
Riffa View	1.3	3.25%		
Princess Sabeeka Oasis	2.1	5.25%		
BSPCA	2.5	6.33%		
Camp Areas	1.5	3.83%		
Askar Village	1.7	4.15%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	0.7	1.83%		
Camp Areas	0.6	1.38%		
Camp Areas	1.1	2.75%		
Mameer Village	0.5	1.23%		
Riffa City	0.8	1.95%		
Tatweer Petroleum	1.5	3.70%		
BDF Muaskar Camp	2.3	5.65%		

The annual mean NO_2 process contributions are well within the guideline values. Modeling results indicate that the process contribution of ambient annual NO_2 concentrations is >1% at all receptor locations.

Table 9-31 Scenario 1B: Maximum Predicted Short Term (1 – Hour and 24 – Hour) NO_2 Concentrations at Sensitive Receptors ($\mu g/m^3$)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
1 - Hour				
Camp Areas	133.2	66.60%	200	200
Camp Areas	142.7	71.36%		
Riffa View	114.0	57.00%		
Princess Sabeeka Oasis	80.2	40.09%		
BSPCA	70.5	35.26%		
Camp Areas	92.8	46.40%		
Askar Village	84.1	42.06%		
Camp Areas	50.8	25.38%		
Camp Areas	53.8	26.90%		
Camp Areas	81.3	40.65%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Mameer Village	50.0	24.99%		
Riffa City	77.4	38.70%		
Tatweer Petroleum	130.3	65.15%		
BDF Muaskar Camp	108.2	54.10%		
24 - Hours				
Camp Areas	44.8	29.89%	150	-
Camp Areas	40.1	26.73%		
Riffa View	15.5	10.31%		
Princess Sabeeka Oasis	18.9	12.58%		
BSPCA	21.2	14.13%		
Camp Areas	15.1	10.07%		
Askar Village	15.6	10.39%		
Camp Areas	7.1	4.75%		
Camp Areas	10.6	7.05%		
Camp Areas	16.9	11.25%		
Mameer Village	9.9	6.63%		
Riffa City	11.7	7.77%		
Tatweer Petroleum	23.3	15.53%		
BDF Muaskar Camp	33.0	21.99%		

From the modeling study it is evident that the short-term NO_2 process contributions are well within the guideline values. The process contributions of ambient 1 – hour concentrations are >10% at all receptor locations.

The process contributions of ambient 24 – hour NO_2 concentrations is >10% at all receptor locations except camp areas located at approximately 2 km away from the Block 4 location towards South-East, Mameer Village and Riffa City.

Thus, in accordance with the significance criteria (refer section 9.2.2.1), the impacts due to the process contributions of Nitrogen Dioxide emissions during Scenario 1B Summer Base Case Operations are **significant** and assessed to be of **moderate adverse**.

9.4.2.8.2.3 Sulphur Dioxide (SO_2)

The SO_2 modeling results indicate that the maximum 1 – hour, 24 – hours, and annual ground level concentrations are well below the ambient air quality standards. SO_2 emissions equate to a process contribution of ambient SO_2 concentrations 48% of the maximum 1 – hour limit value. The process contribution of ambient 24 – hour SO_2 concentrations, is 66% of the limit value and that for annual mean SO_2 concentrations is 26% of the limit value. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 99% of the maximum ambient 1 – hour limit value and 191% of the 24 – hour limit value (refer Table 9-28). Plot Files are presented in Figure 9-27 to Figure 9-29.

Maximum predicted ground level SO_2 concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-32 and Table 9-33.

Table 9-32 Scenario 1B: Maximum Predicted Long Term (Annual) SO_2 Concentrations at Sensitive Receptors ($\mu g/m^3$)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	1.3	2.66%	50	-
Camp Areas	2.2	4.46%		
Riffa View	0.8	1.58%		
Princess Sabeeka Oasis	1.0	1.96%		
BSPCA	1.7	3.34%		
Camp Areas	0.9	1.89%		
Askar Village	1.0	1.94%		
Camp Areas	0.4	0.76%		
Camp Areas	0.3	0.52%		
Camp Areas	0.5	0.92%		
Mameer Village	0.2	0.49%		
Riffa City	0.4	0.86%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values SCE	Guideline Values IFC
Tatweer Petroleum	0.8	1.60%		
BDF Muaskar Camp	1.3	2.64%		

The annual mean SO_2 process contributions are well within the guideline values. Modeling results indicate that the process contribution of ambient annual SO_2 concentrations is >1% at all receptor locations except camp areas located ~2kms away from the Block 4 Plot towards South-East, Mameer Village and Riffa City.

Table 9-33 Scenario 1B: Maximum Predicted Short Term (1 – Hour and 24 – Hour) SO_2 Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values SCE	Guideline Values IFC
1 - Hour				
Camp Areas	76.0	25.34%	300	-
Camp Areas	116.7	38.91%		
Riffa View	104.2	34.72%		
Princess Sabeeka Oasis	67.1	22.38%		
BSPCA	72.3	24.08%		
Camp Areas	94.0	31.34%		
Askar Village	58.8	19.61%		
Camp Areas	51.5	17.16%		
Camp Areas	51.0	16.99%		
Camp Areas	63.9	21.30%		
Mameer Village	43.5	14.50%		
Riffa City	56.6	18.87%		
Tatweer Petroleum	82.7	27.55%		
BDF Muaskar Camp	103.4	34.48%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values SCE	Guideline Values IFC
24 - Hours				
Camp Areas	39.8	31.85%	125	125 IT – 1
Camp Areas	37.7	30.16%		
Riffa View	12.6	10.10%		
Princess Sabeeka Oasis	10.0	8.03%		
BSPCA	19.5	15.61%		
Camp Areas	11.2	8.98%		
Askar Village	13.6	10.90%		
Camp Areas	5.6	4.48%		
Camp Areas	7.7	6.13%		
Camp Areas	10.7	8.57%		
Mameer Village	6.0	4.78%		
Riffa City	9.1	7.27%		
Tatweer Petroleum	16.5	13.18%		
BDF Muaskar Camp	26.3	21.06%		

From the modeling study it is evident that the short-term SO_2 process contributions are well within the guideline values. The process contributions of ambient 1 – hour concentrations are >10% at all receptor locations.

The process contributions of ambient 24 – hour SO_2 concentrations is >10% at all receptor locations except camp areas located at approximately 2 km away from the Block 4 location towards South and South-East, Princess Sabeeka Oasis, Mameer Village and Riffa City.

Thus, in accordance with the significance criteria (refer section 9.2.2.1), the impacts due to the process contributions of Sulphur Dioxide emissions during Scenario 1B Summer Base Case Operations are **significant** and assessed to be of **moderate adverse**.

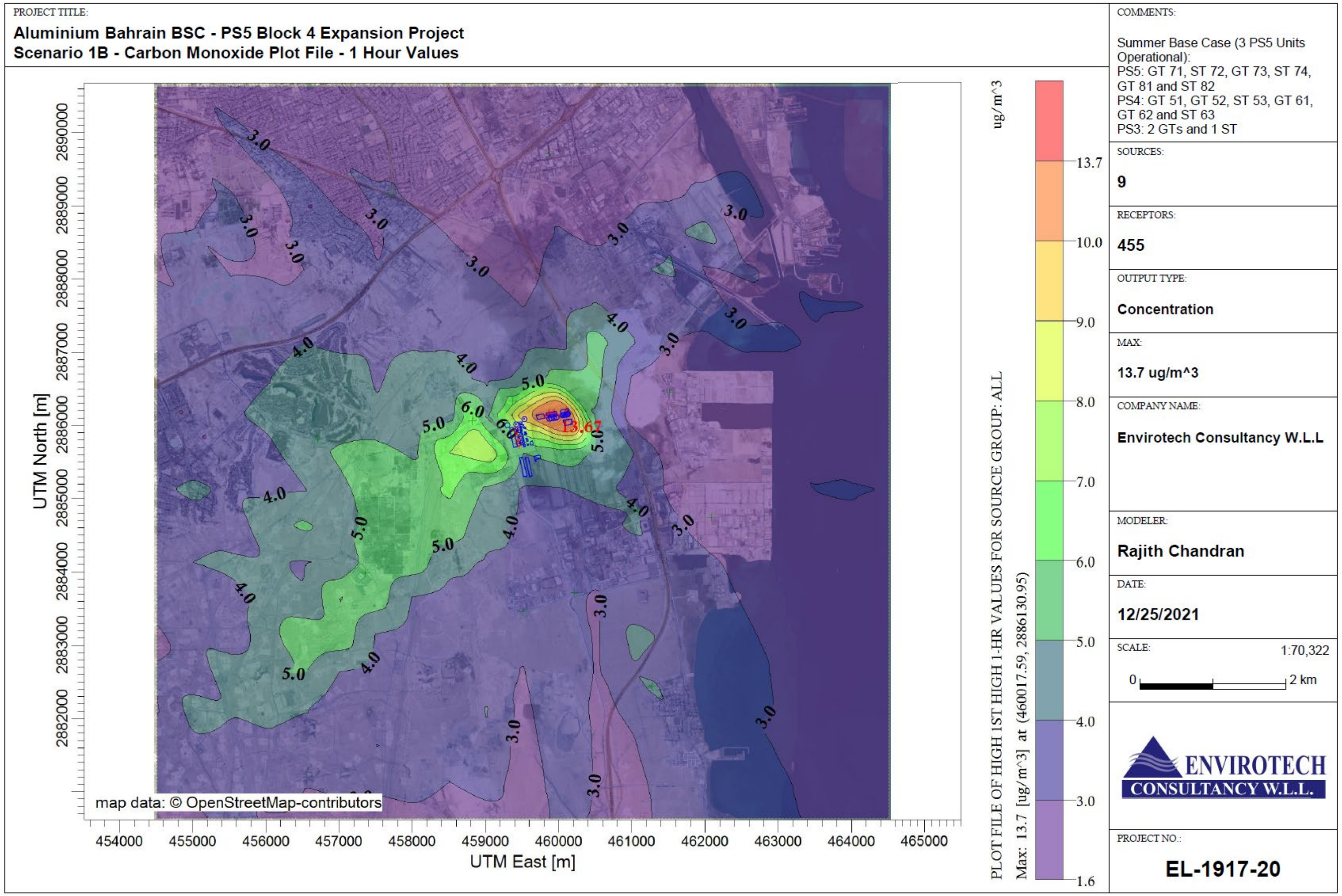

Figure 9-22 Scenario 1B: Carbon Monoxide Concentration Isopleth – 1 Hour Values

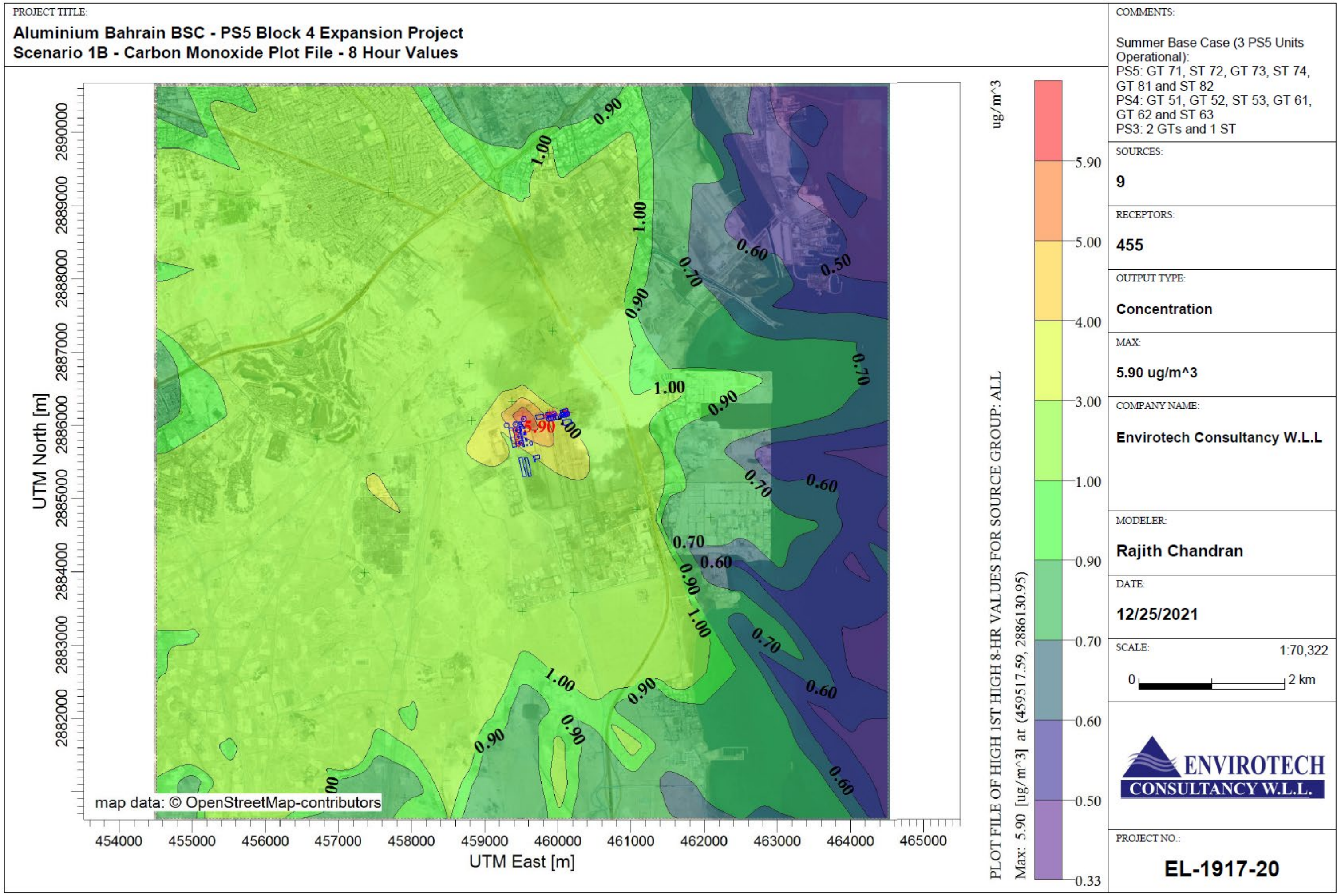

Figure 9-23 Scenario 1B: Carbon Monoxide Concentration Isopleth – 8 Hour Values

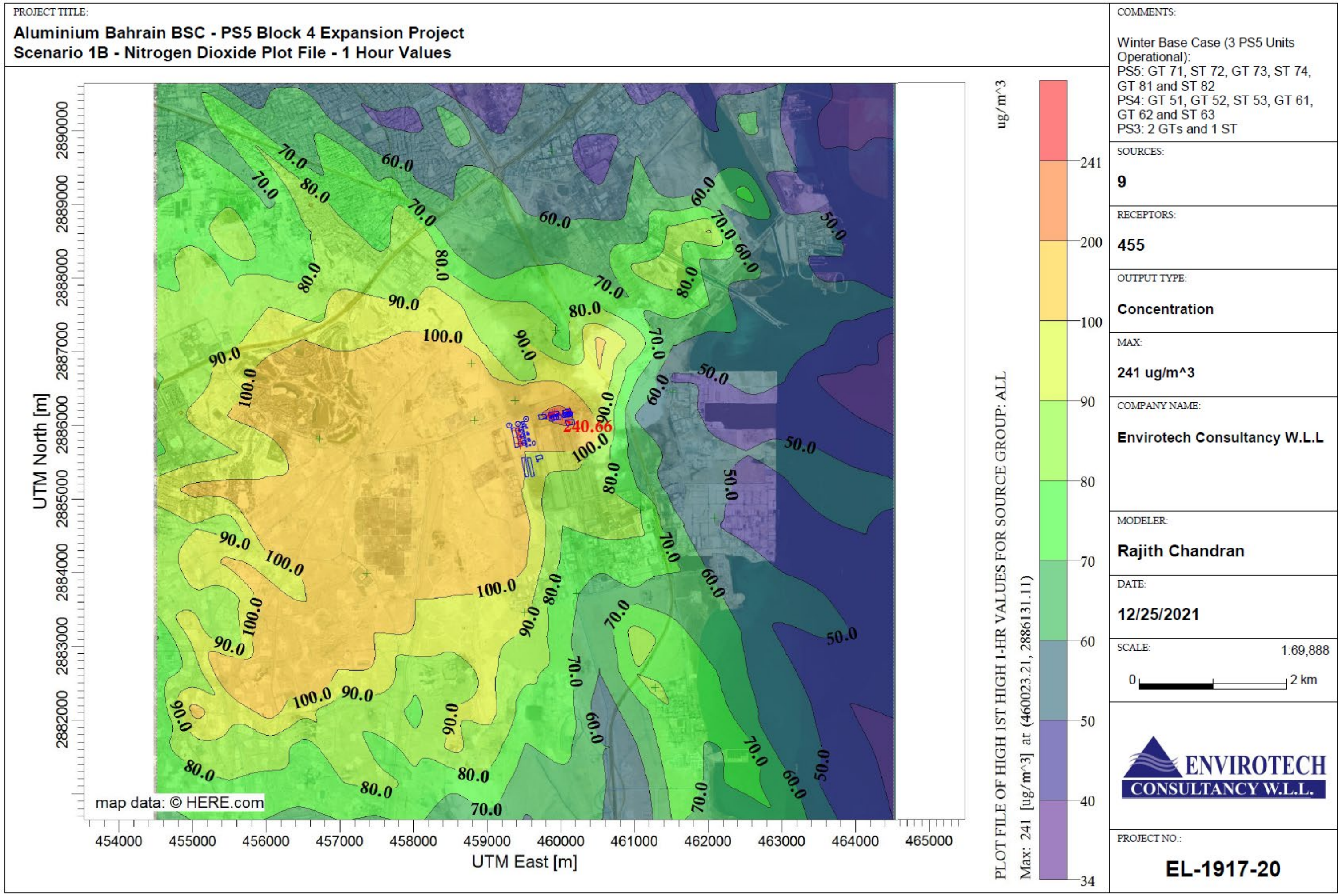

Figure 9-24 Scenario 1B: Nitrogen Dioxide Concentration Isopleth – 1 Hour Values

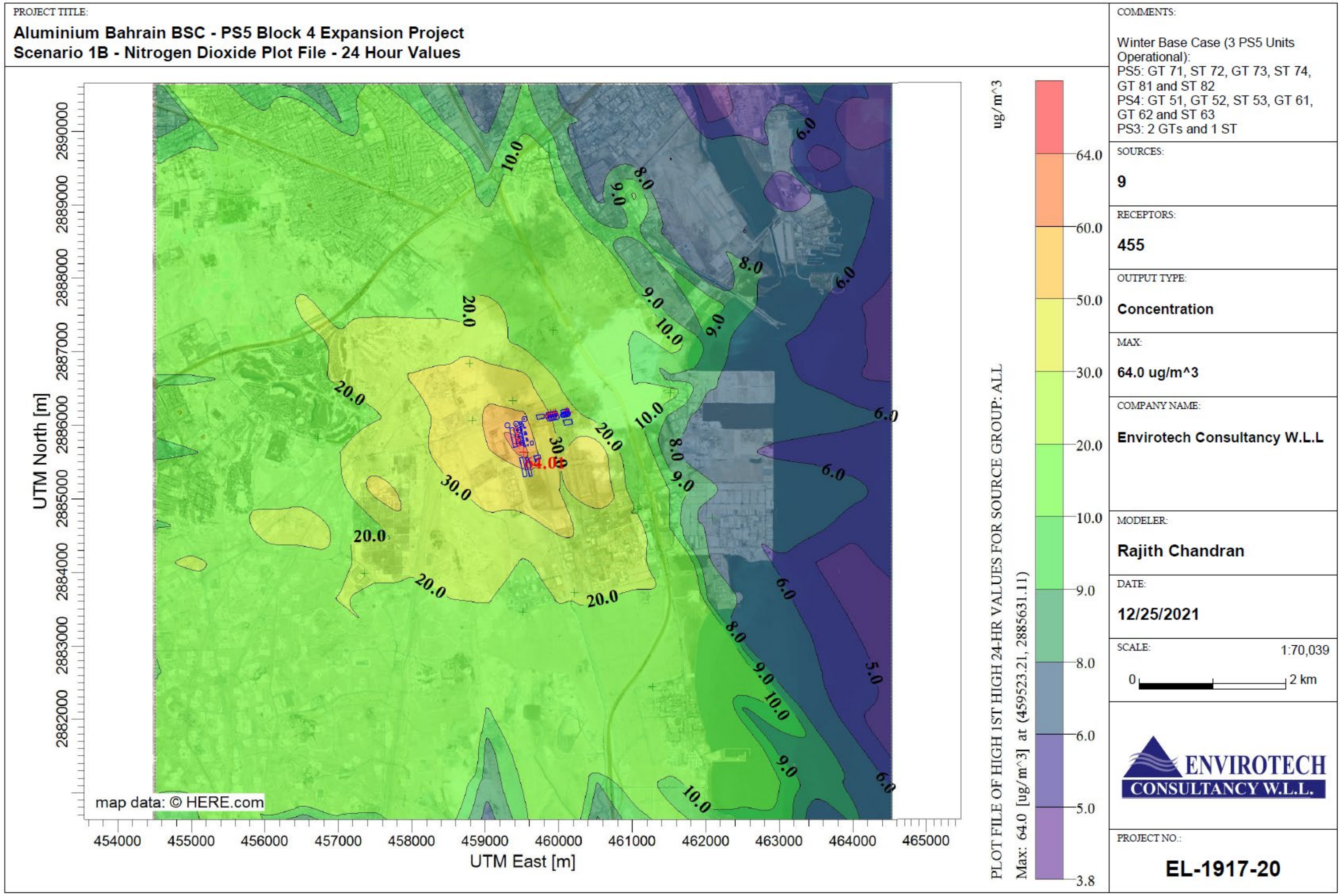

Figure 9-25 Scenario 1B: Nitrogen Dioxide Concentration Isopleth – 24 Hour Values

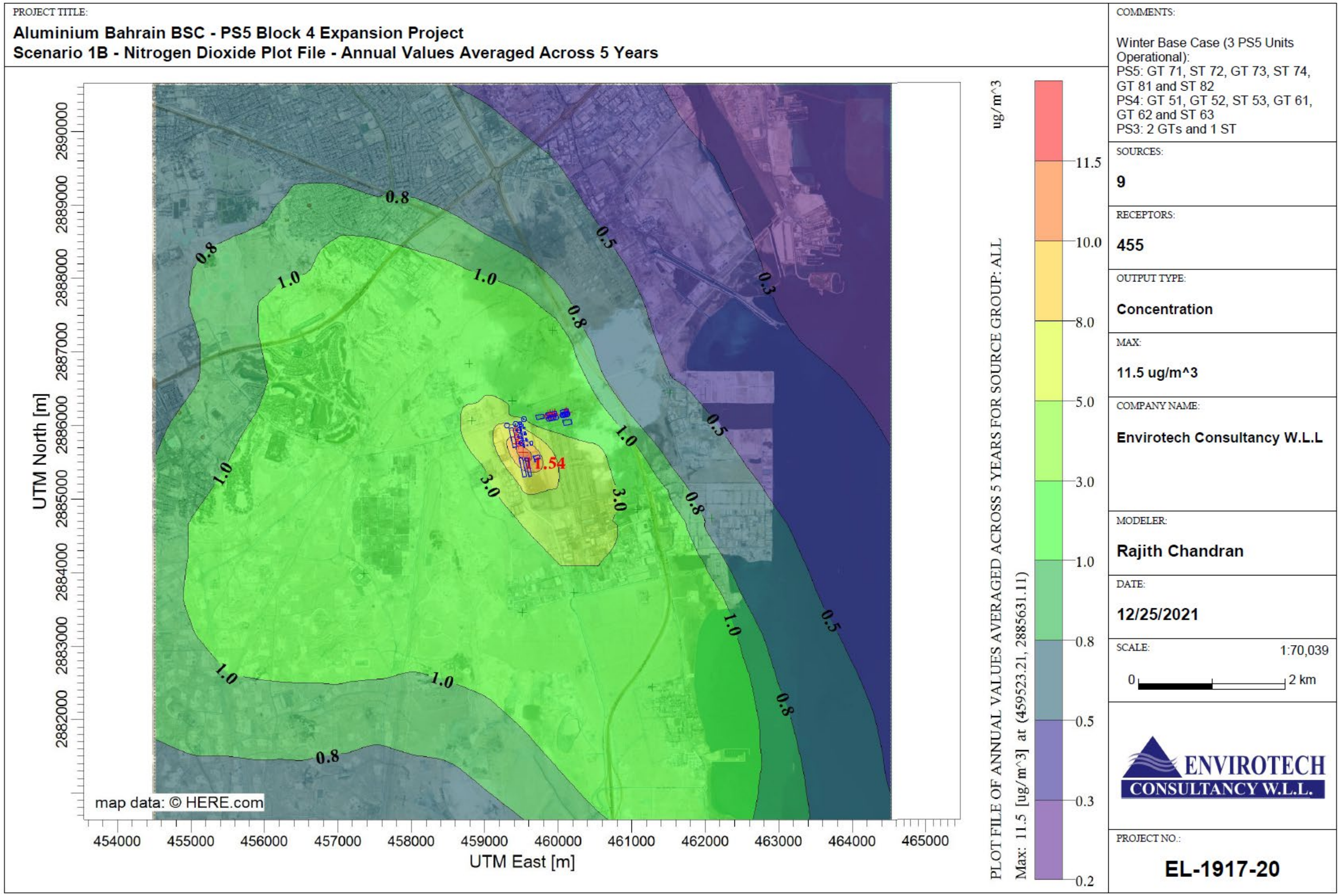

Figure 9-26 Scenario 1B: Nitrogen Dioxide Concentration Isopleth – Annual Values Averaged Across 5 Years

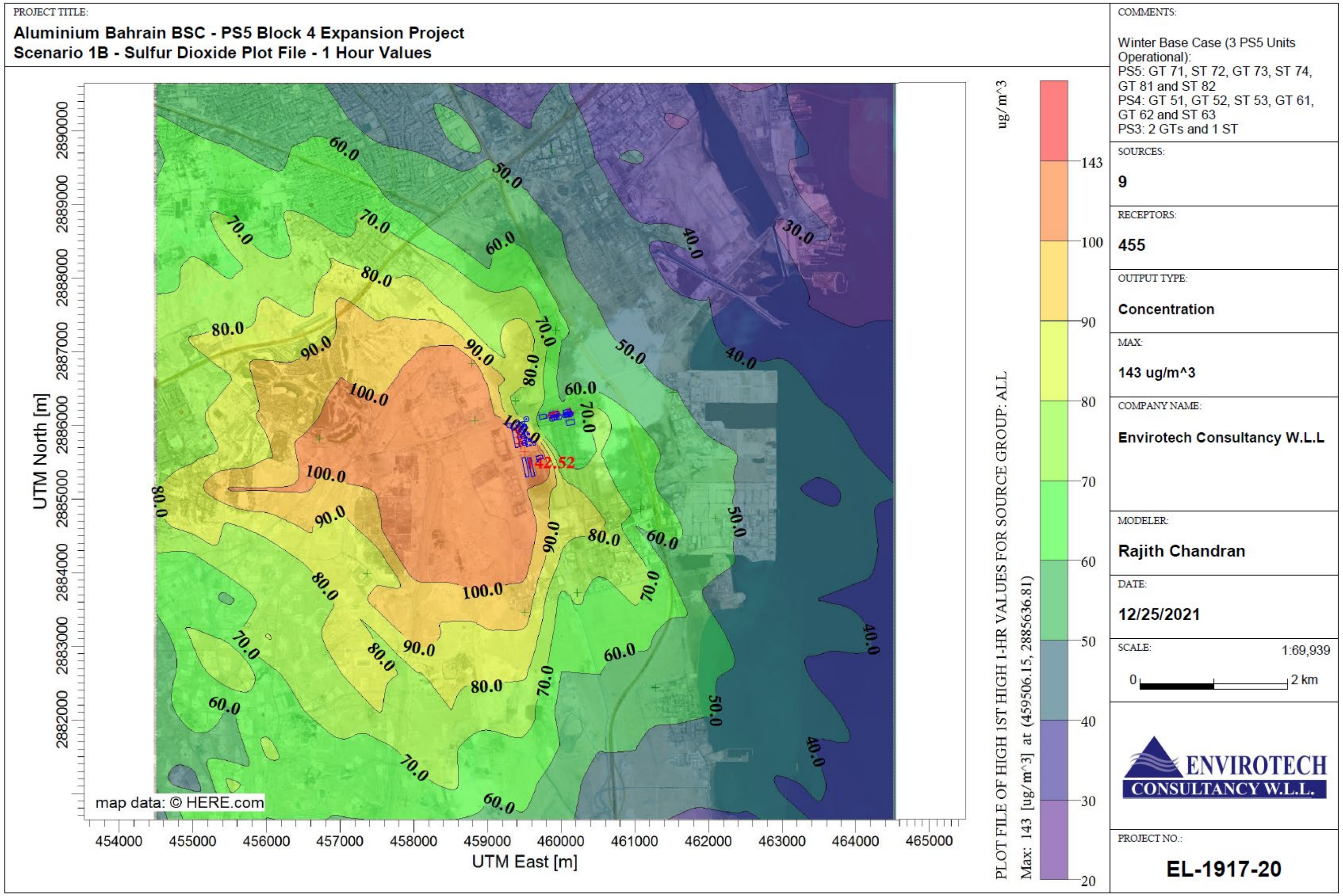

Figure 9-27 Scenario 1B: Sulphur Dioxide Concentration Isopleth – 1 Hour Values

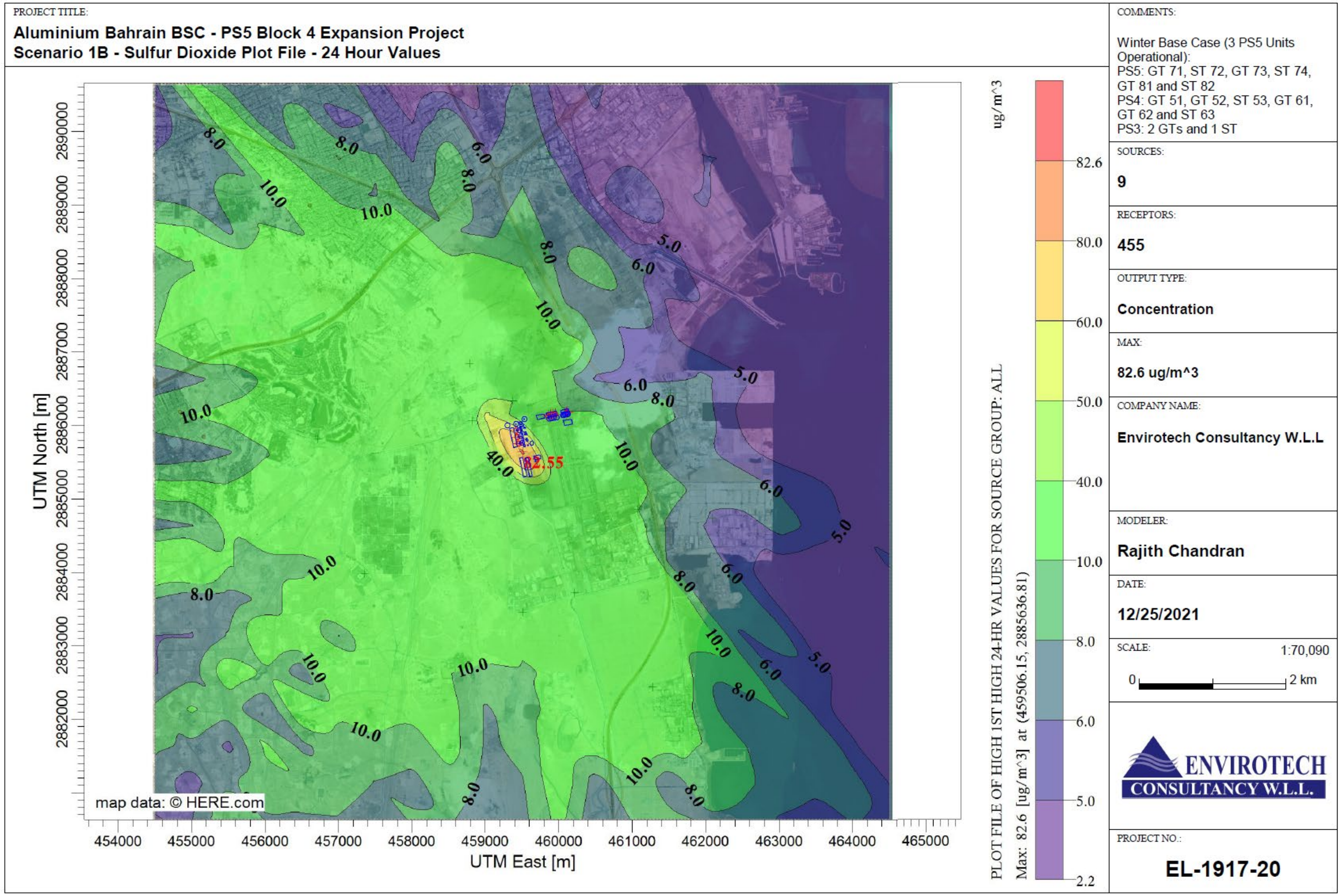

Figure 9-28 Scenario 1B: Sulphur Dioxide Concentration Isopleth – 24 Hour Values

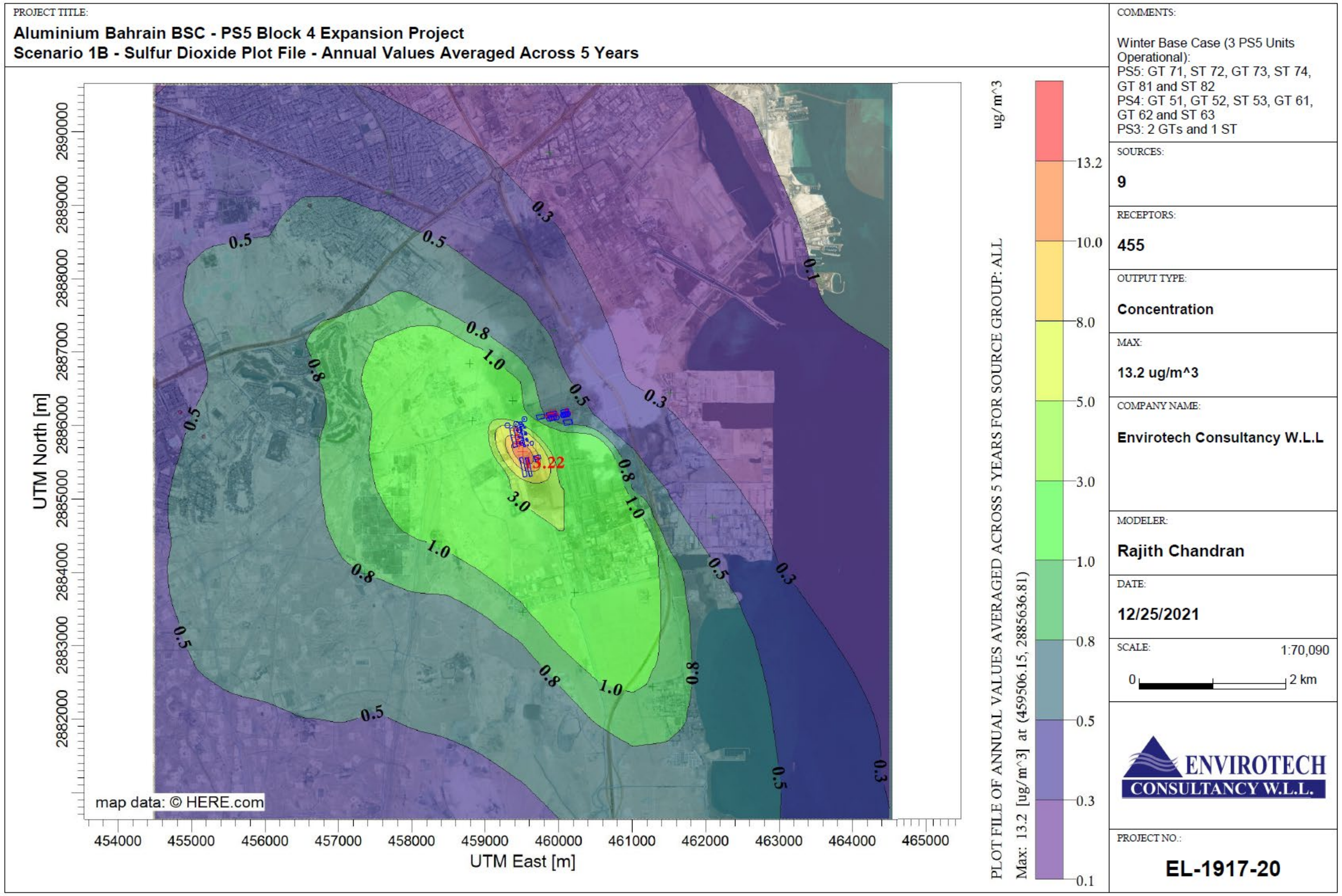

Figure 9-29 Scenario 1B: Sulphur Dioxide Concentration Isopleth – Annual Values Averaged Across 5 Years

9.4.2.8.3 Scenario 2A: Winter Base Case (4 PS5 Units and 2 PS4 Units Operational)

The predicted maximum ground level concentrations of Scenario 2A air dispersion modeling assessment is presented in Table 9-34 and concentration isopleths are presented in Figure 9-30 to Figure 9-36.

9.4.2.8.3.1 Carbon Monoxide

Maximum predicted ground level concentrations of CO due to process emissions are predicted to be approximately 0.9% of 1 – hour and 0.6% of 8 – hours averaging periods. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 3% of the maximum ambient 1 – hour limit value and 6% of the 8 – hour limit value (refer Table 9-34). Concentration isopleths are presented in Figure 9-30 and Figure 9-31.

Maximum predicted ground level CO concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-35.

Table 9-34 Scenario 2A Air Dispersion Modeling – Maximum Ground Level Concentrations

Pollutant	Averaging Period	Predicted Maximum Ground Level Concentration (µg/m³) - A	% of Guideline Values		Ambient Concentration (µg/m³) – B	Predicted Environmental Concentration (A + B) (µg/m³)	% of Guideline Values		Guideline Values (µg/m³)	
			SCE	IFC			SCE	IFC	SCE	IFC
CO	1 – Hour	175.8	0.9%	-	493.0	668.8	3%	-	20,000.00	-
	8 – Hours	60.6	0.6%	-	504.0	564.6	6%	-	10,000.00	-
NO_2	1 – Hour	135.5	68%	68%	100.3	235.8	118%	118%	200	200
	24 – Hours	83.4	56%	-	102.4	185.8	124%	-	150	-
	Annual	15.8	40%	40%		15.8	40%	40%	40	40
SO_2	1 – Hour	176.6	59%	-	153.7	330.3	110%	-	300	-
	24 – Hours	95.8	77%	77%	155.9	251.7	201%	201%	125	125 IT- 1
	Annual	16.4	33%	-		16.4	33%	-	50	-

Note 1: Ambient concentration is the mean recorded during the ambient air quality monitoring at site.

Note 2: Assumed NOx / NO_2 Conversion Rate is 0.63 to 0.65 based on ARM2 (AERMOD Feature) - Ambient Ratio Method

Note 3: IT-1 (Interim Target 1): Interim Targets are proposed as incremental steps in a progressive reduction of air pollution and are intended for use in areas where pollution is high. These targets aim to promote a shift from high air pollutant concentrations, which have acute and serious health consequences, to lower air pollutant concentrations. If these targets were to be achieved, one could expect significant reductions in risks for acute and chronic health effects from air pollution.

Table 9-35 Scenario 2A: Maximum Predicted Short Term (1 – Hour and 8 – Hour) CO Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	SCE Standard
1 – Hour			
Camp Areas	83.5	0.42%	20,000
Camp Areas	75.1	0.38%	
Riffa View	39.2	0.20%	
Princess Sabeeka Oasis	37.7	0.19%	
BSPCA	47.5	0.24%	
Camp Areas	26.8	0.13%	
Askar Village	26.6	0.13%	
Camp Areas	22.2	0.11%	
Camp Areas	23.4	0.12%	
Camp Areas	22.2	0.11%	
Mameer Village	27.4	0.14%	
Riffa City	31.6	0.16%	
Tatweer Petroleum	31.5	0.16%	
BDF Muaskar Camp	66.9	0.33%	
8 – Hour			
Camp Areas	33.5	0.33%	10,000
Camp Areas	59.0	0.59%	
Riffa View	10.1	0.10%	
Princess Sabeeka Oasis	9.0	0.09%	
BSPCA	18.0	0.18%	
Camp Areas	9.0	0.09%	
Askar Village	11.9	0.12%	
Camp Areas	7.0	0.07%	
Camp Areas	8.9	0.09%	
Camp Areas	7.6	0.08%	
Mameer Village	5.5	0.05%	

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	SCE Standard
Riffa City	7.8	0.08%	
Tatweer Petroleum	10.3	0.10%	
BDF Muaskar Camp	21.1	0.21%	

The short term (1-hour and 8 – hour) CO process contributions are <10% of the limit values at all receptor locations. Thus, the impacts of Carbon Monoxide emissions due to the future operations (Scenario 2A – Winter Base Case) of Alba Power Stations are assessed to be **insignificant**.

9.4.2.8.3.2 Nitrogen Dioxide (NO_2)

The NO_2 modeling results indicate that the maximum 1 – hour, 24 – hours, and annual ground level concentrations are well below the ambient air quality standards. NO_2 emissions equate to a process contribution of ambient NO_2 concentrations 68% of the maximum 1 – hour limit value. The process contribution of ambient 24 – hour NO_2 concentrations, is 56% of the limit value and that for annual mean NO_2 concentrations is 40% of the limit value. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 118% of the maximum ambient 1 – hour limit value and 124% of the 24 – hour limit value (refer Table 9-34). Plot Files are presented in Figure 9-32 to Figure 9-34.

Maximum predicted ground level NO_2 concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-36 and Table 9-37.

Table 9-36 Scenario 2A: Maximum Predicted Long Term (Annual) NO_2 Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	1.1	2.73%	40	40
Camp Areas	2.8	6.98%		
Riffa View	1.1	2.63%		
Princess Sabeeka Oasis	1.2	2.90%		
BSPCA	2.2	5.60%		
Camp Areas	1.3	3.25%		
Askar Village	1.3	3.33%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	0.6	1.40%		
Camp Areas	0.4	0.93%		
Camp Areas	0.6	1.40%		
Mameer Village	0.3	0.75%		
Riffa City	0.5	1.33%		
Tatweer Petroleum	1.1	2.65%		
BDF Muaskar Camp	1.4	3.55%		

The annual mean NO_2 process contributions are well within the guideline values. Modeling results indicate that the process contribution of ambient annual NO_2 concentrations is >1% at all receptor locations except camp areas located ~2km away from the Block 4 Plot towards South-East and Mameer Village.

Table 9-37 Scenario 2A: Maximum Predicted Short Term (1 – Hour and 24 – Hour) NO_2 Concentrations at Sensitive Receptors ($\mu g/m^3$)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
1 - Hours				
Camp Areas	74.1	37.07%		
Camp Areas	116.7	58.34%		
Riffa View	109.4	54.71%		
Princess Sabeeka Oasis	74.9	37.46%		
BSPCA	68.6	34.28%	200	200
Camp Areas	76.3	38.13%		
Askar Village	52.9	26.43%		
Camp Areas	70.9	35.47%		
Camp Areas	54.9	27.44%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	53.5	26.75%		
Mameer Village	27.7	13.85%		
Riffa City	43.5	21.76%		
Tatweer Petroleum	75.1	37.57%		
BDF Muaskar Camp	89.9	44.95%		
24 - Hours				
Camp Areas	13.0	8.67%	150	-
Camp Areas	42.3	28.20%		
Riffa View	15.7	10.49%		
Princess Sabeeka Oasis	12.5	8.32%		
BSPCA	20.4	13.61%		
Camp Areas	13.6	9.08%		
Askar Village	14.6	9.70%		
Camp Areas	7.3	4.83%		
Camp Areas	8.7	5.80%		
Camp Areas	5.7	3.81%		
Mameer Village	4.7	3.13%		
Riffa City	9.9	6.58%		
Tatweer Petroleum	16.0	10.69%		
BDF Muaskar Camp	18.6	12.40%		

From the modeling study it is evident that the short-term NO_2 process contributions are well within the guideline values. The process contributions of ambient 1 – hour concentrations are >10% at all receptor locations.

The process contributions of ambient 24 – hour NO_2 concentrations is <10% at all receptor locations except camp areas located at ~ 750 m away from the Block 4 location towards North, Riffa Views, BSPCA, Tatweer Petroleum and BDF Muaskar Camp.

Thus, in accordance with the significance criteria (refer section 9.2.2.1), the impacts due to the process contributions of Nitrogen Dioxide emissions during Scenario 2A Winter Base Case Operations are **significant** and assessed to be of **moderate adverse**. However, it should be noted that the predicted ground level concentrations represent the worst-case emissions in different meteorological conditions experienced over five (5) years.

9.4.2.8.3.3 Sulphur Dioxide (SO_2)

The SO_2 modeling results indicate that the maximum 1 – hour, 24 – hours, and annual ground level concentrations are well below the ambient air quality standards. SO_2 emissions equate to a process contribution of ambient SO_2 concentrations 59% of the maximum 1 – hour limit value. The process contribution of ambient 24 – hour SO_2 concentrations, is 77% of the limit value and that for annual mean SO_2 concentrations is 33% of the limit value. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 110% of the maximum ambient 1 – hour limit value and 201% of the 24 – hour limit value (refer Table 9-34). Plot Files are presented in Figure 9-35 to Figure 9-37.

Maximum predicted ground level SO_2 concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-38 and Table 9-39.

Table 9-38 Scenario 2A: Maximum Predicted Long Term (Annual) SO_2 Concentrations at Sensitive Receptors ($\mu g/m^3$)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	1.0	1.94%	50	-
Camp Areas	2.6	5.24%		
Riffa View	1.0	2.00%		
Princess Sabeeka Oasis	1.0	2.02%		
BSPCA	2.4	4.86%		
Camp Areas	1.4	2.82%		
Askar Village	1.4	2.72%		
Camp Areas	0.5	1.04%		
Camp Areas	0.4	0.71%		
Camp Areas	0.5	0.96%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Mameer Village	0.3	0.62%		
Riffa City	0.5	1.06%		
Tatweer Petroleum	1.0	2.08%		
BDF Muaskar Camp	1.4	2.82%		

The annual mean SO_2 process contributions are well within the guideline values. Modeling results indicate that the process contribution of ambient annual SO_2 concentrations is >1% at all receptor locations except camp areas located ~2kms away from the Block 4 Plot towards South-East, and Mameer Village.

Table 9-39 Scenario 2A: Maximum Predicted Short Term (1 – Hour and 24 – Hour) SO_2 Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
1 - Hours				
Camp Areas	102.3	34.11%	300	-
Camp Areas	123.4	41.14%		
Riffa View	105.2	35.05%		
Princess Sabeeka Oasis	74.1	24.69%		
BSPCA	97.0	32.32%		
Camp Areas	82.4	27.47%		
Askar Village	60.4	20.13%		
Camp Areas	69.4	23.14%		
Camp Areas	58.9	19.65%		
Camp Areas	48.5	16.16%		
Mameer Village	34.5	11.50%		
Riffa City	58.0	19.33%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values SCE	Guideline Values IFC
Tatweer Petroleum	78.1	26.04%		
BDF Muaskar Camp	109.3	36.42%		
24 - Hours				
Camp Areas	22.3	17.87%	125	125 IT – 1
Camp Areas	55.9	44.73%		
Riffa View	14.5	11.62%		
Princess Sabeeka Oasis	14.0	11.21%		
BSPCA	25.5	20.37%		
Camp Areas	13.7	10.98%		
Askar Village	17.4	13.94%		
Camp Areas	6.8	5.45%		
Camp Areas	8.0	6.37%		
Camp Areas	6.2	4.94%		
Mameer Village	4.2	3.36%		
Riffa City	10.4	8.35%		
Tatweer Petroleum	16.4	13.14%		
BDF Muaskar Camp	20.4	16.28%		

From the modeling study it is evident that the short-term SO_2 process contributions are well within the guideline values. The process contributions of ambient 1 – hour concentrations are >10% at all receptor locations.

The process contributions of ambient 24 – hour SO_2 concentrations is >10% at all receptor locations except camp areas located at approximately 2 km away from the Block 4 location towards South and South-East, Mameer Village and Riffa City. Thus, in accordance with the significance criteria (refer section 9.2.2.1), the impacts due to the process contributions of Sulphur Dioxide emissions during Scenario 2A Summer Base Case Operations are **significant** and assessed to be of **moderate adverse**. However, it should be noted that the predicted ground level concentrations represent the worst-case emissions in different meteorological conditions experienced over five (5) years.

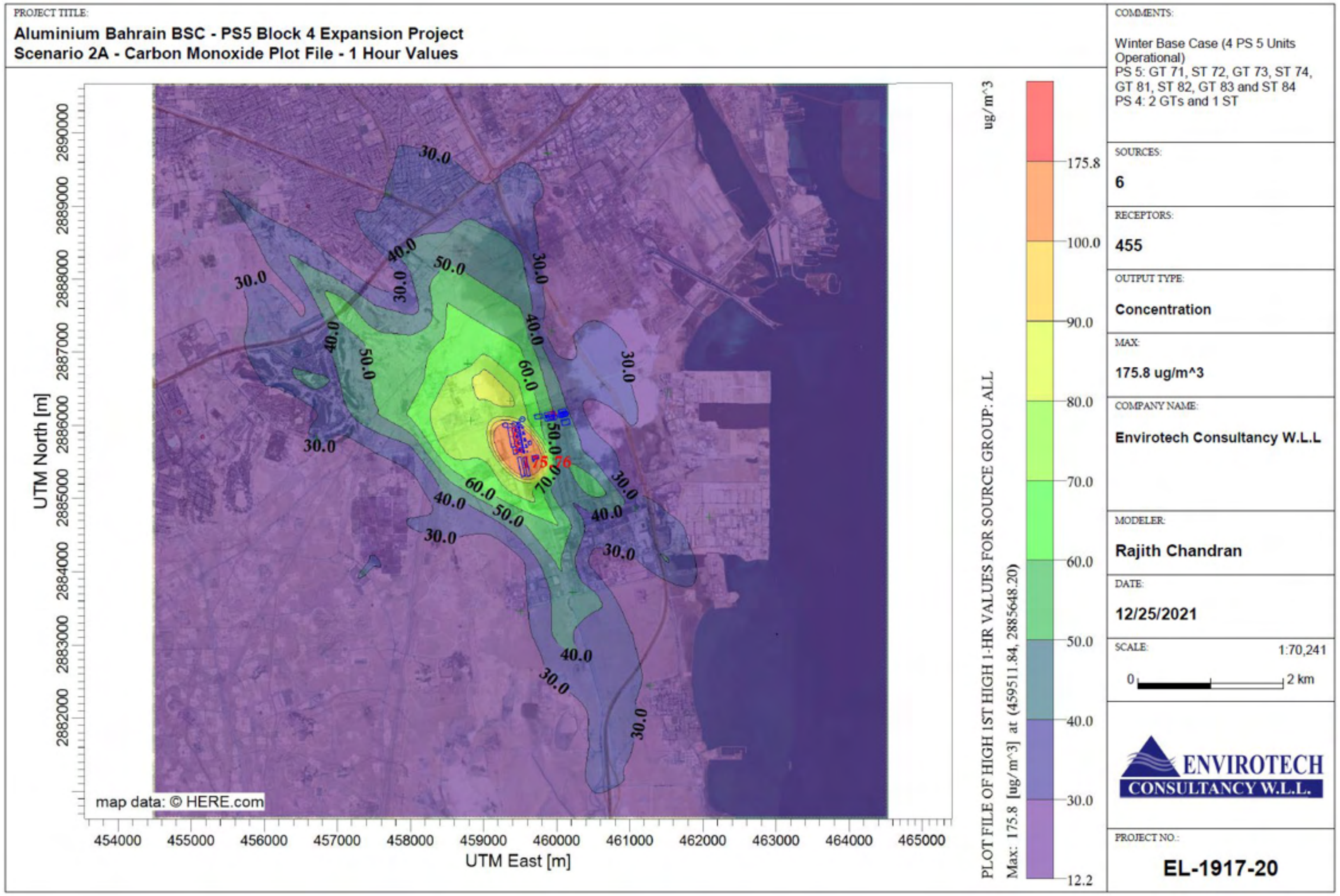

Figure 9-30 Scenario 2A: Carbon Monoxide Concentration Isopleth – 1 Hour Values

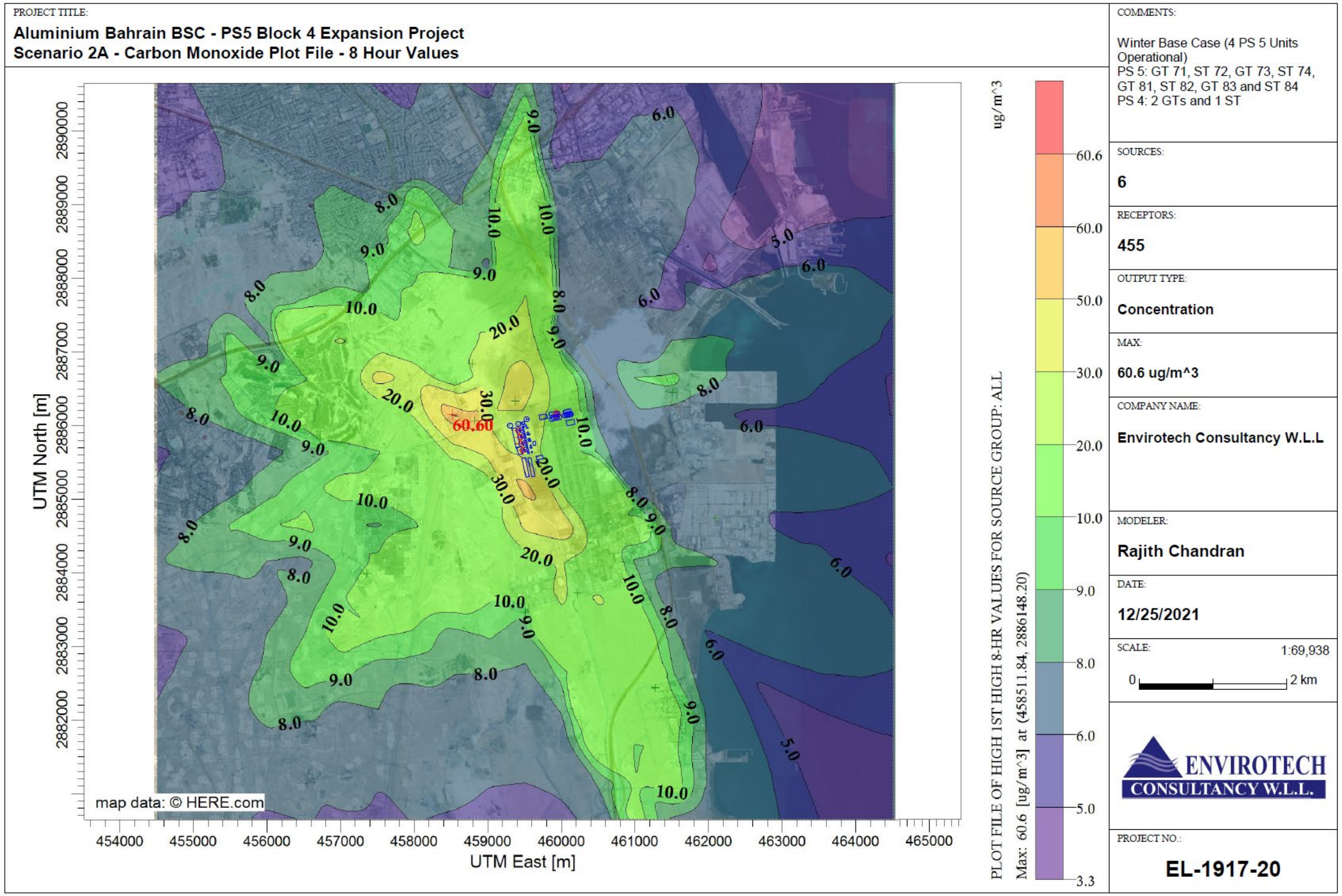

Figure 9-31 Scenario 2A: Carbon Monoxide Concentration Isopleth – 8 Hour Values

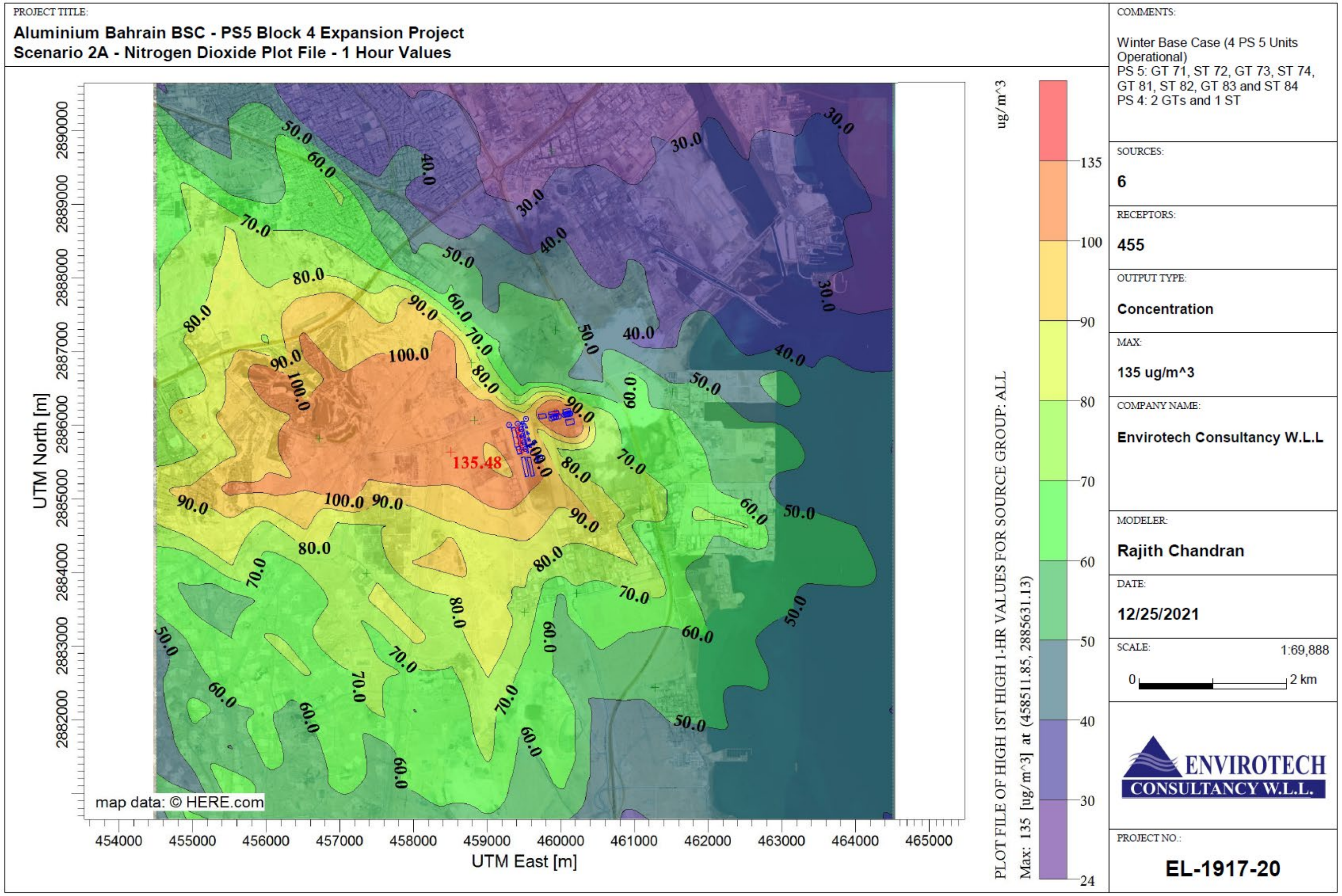

Figure 9-32 Scenario 2A: Nitrogen Dioxide Concentration Isopleth – 1 Hour Values

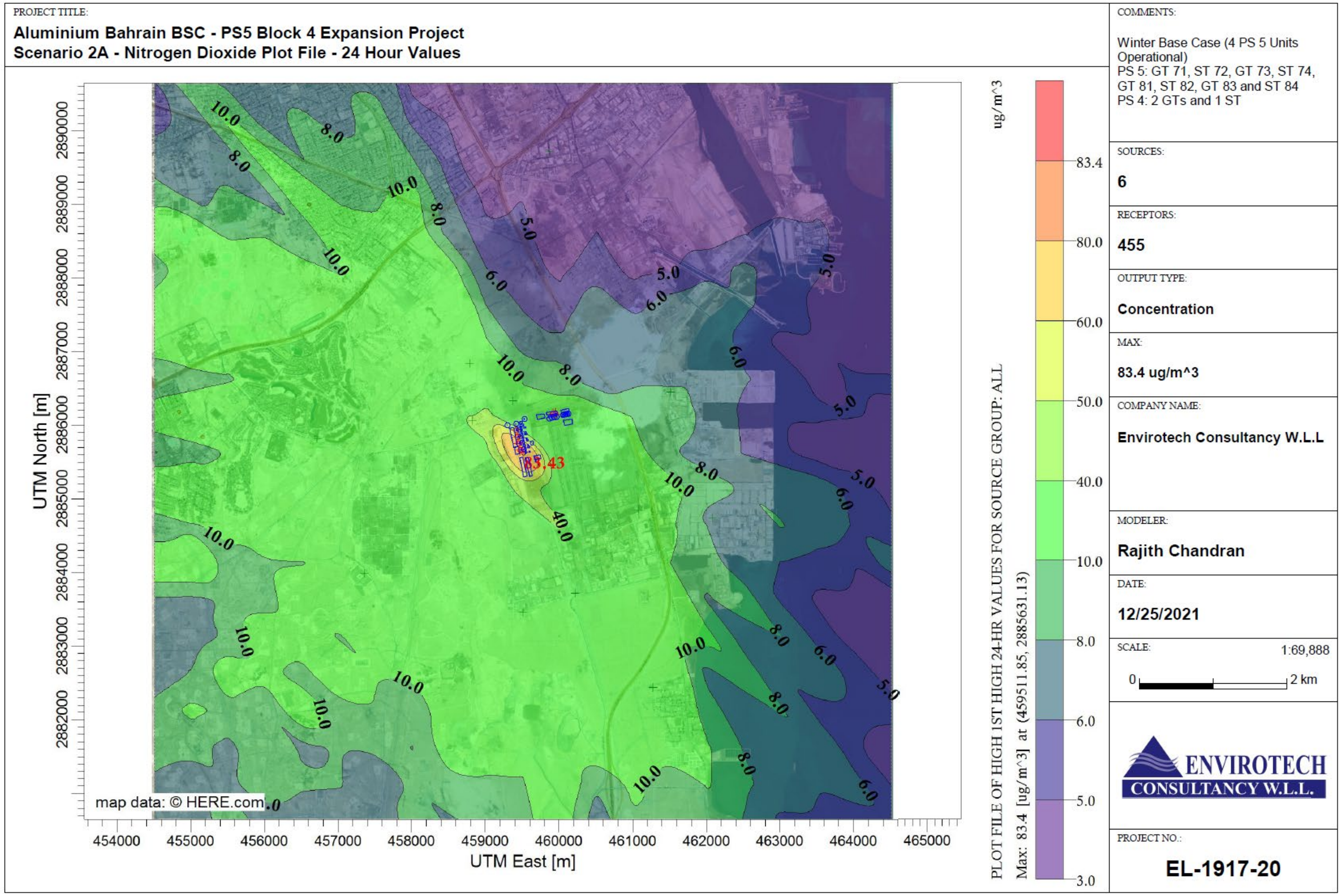

Figure 9-33 Scenario 2A: Nitrogen Dioxide Concentration Isopleth – 24 Hour Values

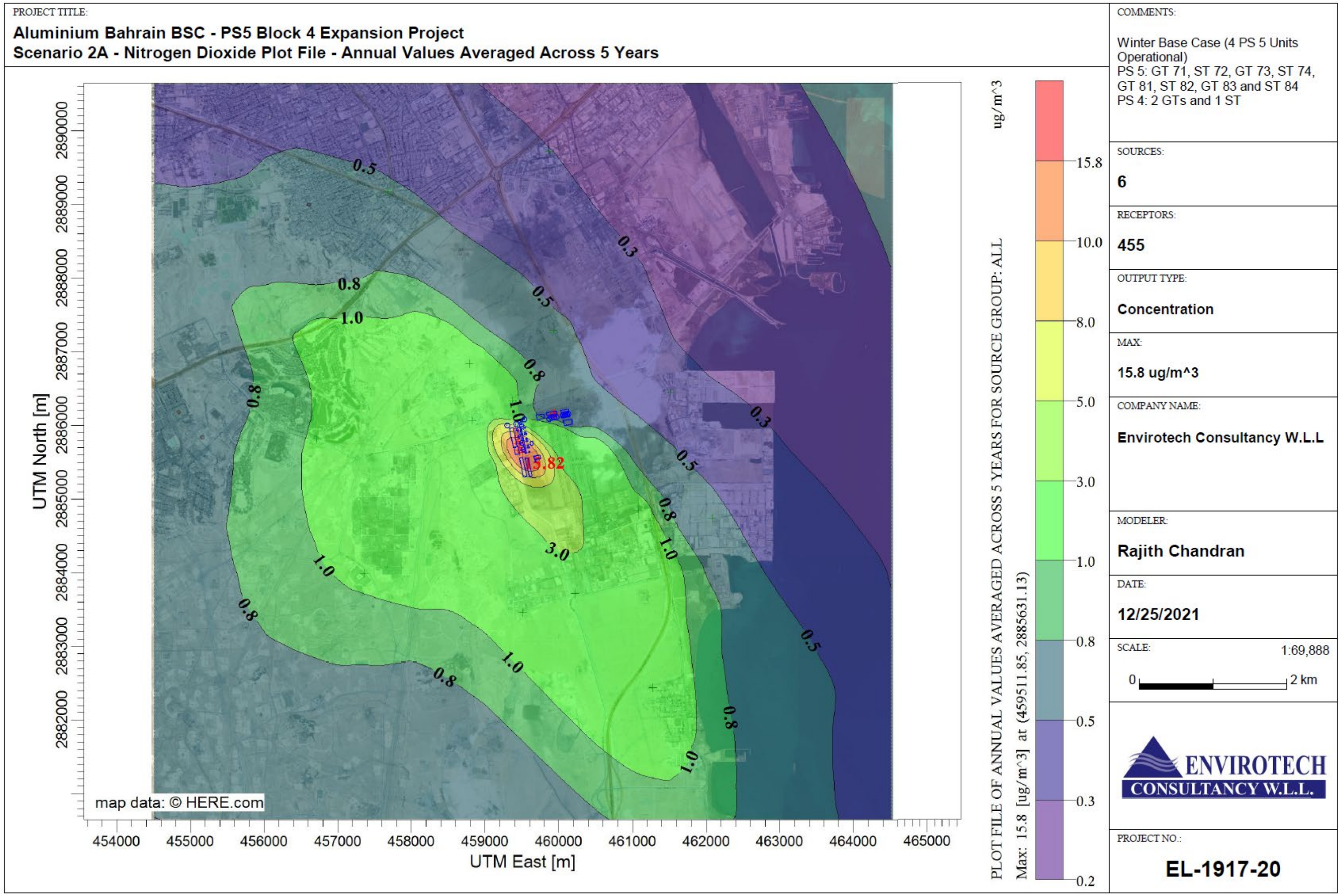

Figure 9-34 Scenario 2A: Nitrogen Dioxide Concentration Isopleth – Annual Values Averaged Across 5 Years

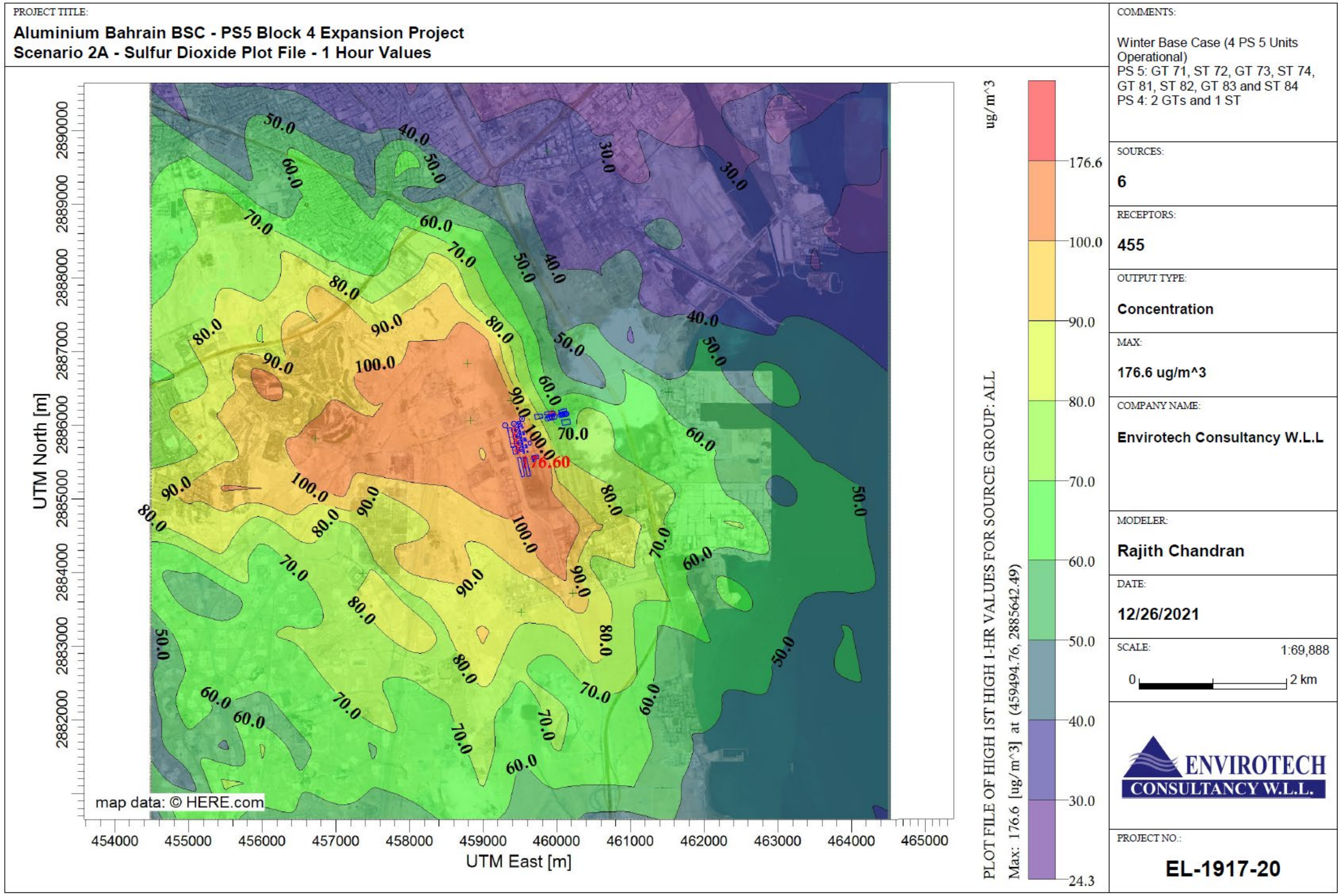

Figure 9-35 Scenario 2A: Sulphur Dioxide Concentration Isopleth – 1 Hour Values

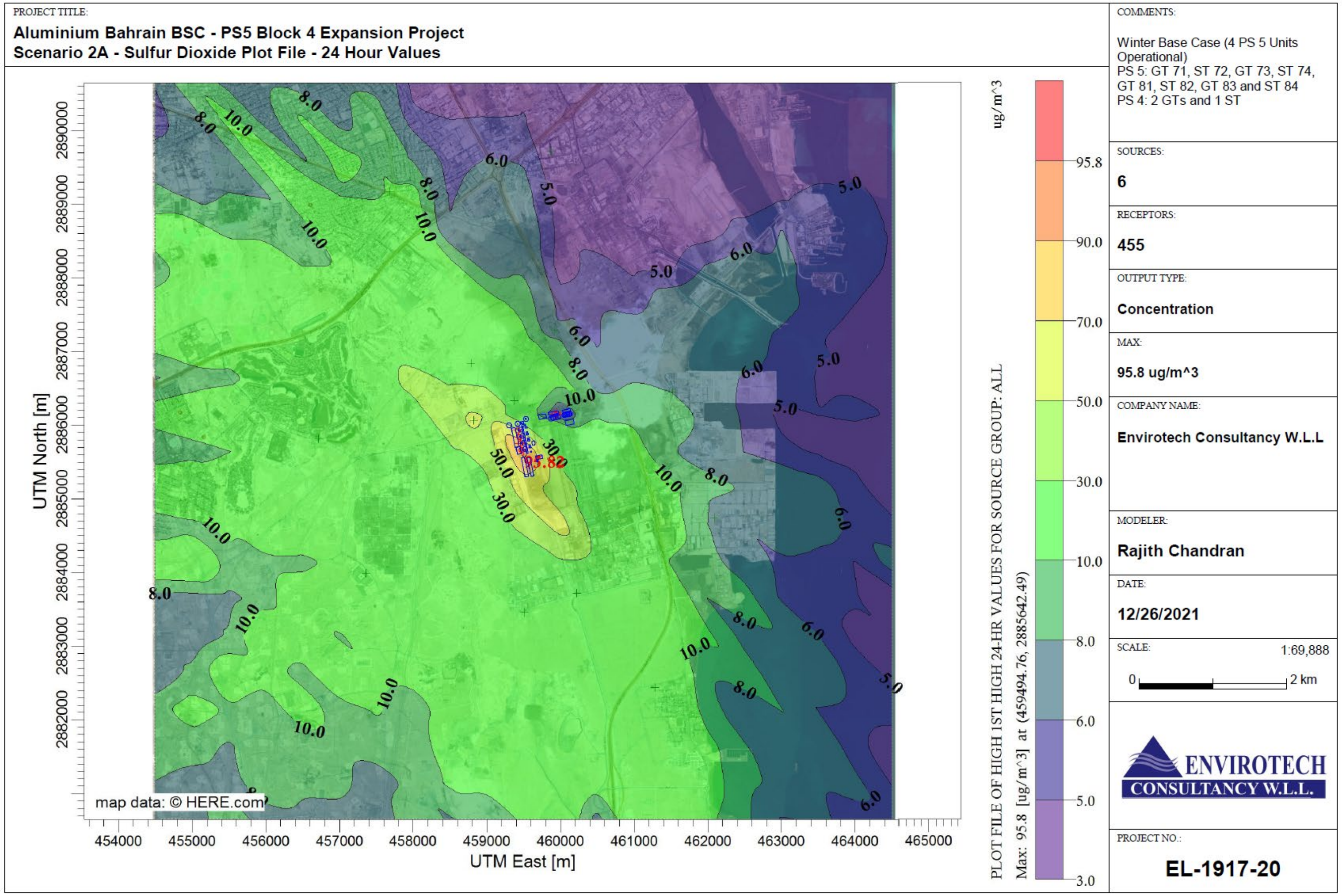

Figure 9-36 Scenario 2A: Sulphur Dioxide Concentration Isopleth – 24 Hour Values

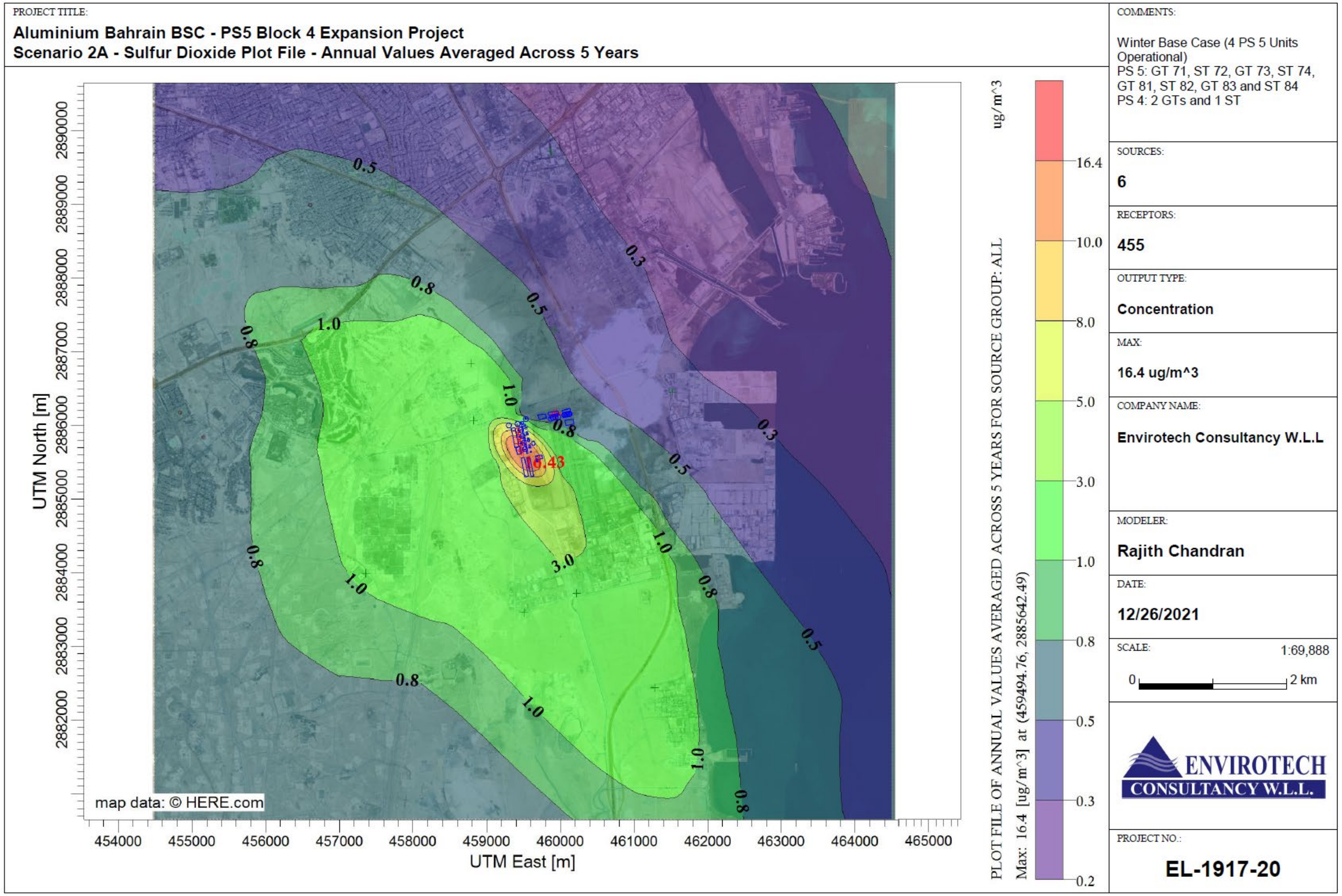

Figure 9-37 Scenario 2A: Sulphur Dioxide Concentration Isopleth – Annual Values Averaged Across 5 Years

9.4.2.8.4 Scenario 2B: Winter Base Case (4 PS5 Units and 4 PS4 Units Operational)

The predicted maximum ground level concentrations of Scenario 2B air dispersion modeling assessment is presented in Table 9-40 and concentration isopleths are presented in Figure 9-38 to Figure 9-45.

9.4.2.8.4.1 Carbon Monoxide

Maximum predicted ground level concentrations of CO due to process emissions are predicted to be approximately 0.6% of 1 – hour and 0.9% of 8 – hours averaging periods. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 3% of the maximum ambient 1 – hour limit value and 6% of the 8 – hour limit value (refer Table 9-40). Concentration isopleths are presented in Figure 9-38 and Figure 9-39.

Maximum predicted ground level CO concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-41.

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Table 9-40 Scenario 2B Air Dispersion Modeling – Maximum Ground Level Concentrations

Pollutant	Averaging Period	Predicted Maximum Ground Level Concentration (µg/m³) - A	% of Guideline Values		Ambient Concentration (µg/m³) – B	Predicted Environmental Concentration (A + B) (µg/m³)	% of Guideline Values		Guideline Values (µg/m³)	
			SCE	IFC			SCE	IFC	SCE	IFC
CO	1 – Hour	173.5	0.9%	-	493.0	666.5	3%	-	20,000.00	-
	8 – Hours	60.1	0.6%	-	504.0	564.1	6%	-	10,000.00	-
NO_2	1 – Hour	177.8	89%	89%	100.3	278.1	139%	139%	200	200
	24 – Hours	81.3	54%	-	102.4	183.7	122%	-	150	-
	Annual	15.7	39%	39%		15.7	39%	39%	40	40
SO_2	1 – Hour	202.5	67%	-	153.7	356.2	119%	-	300	-
	24 – Hours	115.7	93%	93%	155.9	271.6	217%	217%	125	125 IT- 1
	Annual	18.7	37%	-		18.7	37%	-	50	-

Note 1: Ambient concentration is the mean recorded during the ambient air quality monitoring at site.

Note 2: Assumed NOx / NO_2 Conversion Rate is 0.63 to 0.65 based on ARM2 (AERMOD Feature) - Ambient Ratio Method

Note 3: IT-1 (Interim Target 1): Interim Targets are proposed as incremental steps in a progressive reduction of air pollution and are intended for use in areas where pollution is high. These targets aim to promote a shift from high air pollutant concentrations, which have acute and serious health consequences, to lower air pollutant concentrations. If these targets were to be achieved, one could expect significant reductions in risks for acute and chronic health effects from air pollution.

Table 9-41 Scenario 2B: Maximum Predicted Short Term (1 – Hour and 8 – Hour) CO Concentrations at Sensitive Receptors (μg/m³)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	SCE Standard
1 – Hour			
Camp Areas	83.5	0.42%	20,000
Camp Areas	75.1	0.38%	
Riffa View	39.2	0.20%	
Princess Sabeeka Oasis	37.7	0.19%	
BSPCA	47.5	0.24%	
Camp Areas	27.5	0.14%	
Askar Village	26.6	0.13%	
Camp Areas	22.2	0.11%	
Camp Areas	23.4	0.12%	
Camp Areas	22.2	0.11%	
Mameer Village	27.4	0.14%	
Riffa City	31.6	0.16%	
Tatweer Petroleum	32.5	0.16%	
BDF Muaskar Camp	66.9	0.33%	
8 – Hour			
Camp Areas	33.5	0.33%	10,000
Camp Areas	59.0	0.59%	
Riffa View	10.4	0.10%	
Princess Sabeeka Oasis	9.0	0.09%	
BSPCA	18.1	0.18%	
Camp Areas	9.2	0.09%	
Askar Village	11.9	0.12%	
Camp Areas	7.1	0.07%	
Camp Areas	9.1	0.09%	
Camp Areas	7.7	0.08%	
Mameer Village	5.5	0.05%	

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	SCE Standard
Riffa City	8.0	0.08%	
Tatweer Petroleum	10.6	0.11%	
BDF Muaskar Camp	21.1	0.21%	

The short term (1-hour and 8 – hour) CO process contributions are <10% of the limit values at all receptor locations. Thus, the impacts of Carbon Monoxide emissions due to the future operations (Scenario 2B – Summer Base Case) of Alba Power Stations are assessed to be **insignificant**.

9.4.2.8.4.2 Nitrogen Dioxide (NO_2)

The NO_2 modeling results indicate that the maximum 1 – hour, 24 – hours, and annual ground level concentrations are well below the ambient air quality standards. NO_2 emissions equate to a process contribution of ambient NO_2 concentrations 89% of the maximum 1 – hour limit value. The process contribution of ambient 24 – hour NO_2 concentrations, is 54% of the limit value and that for annual mean NO_2 concentrations is 39% of the limit value. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 139% of the maximum ambient 1 – hour limit value and 122% of the 24 – hour limit value (refer Table 9-40). Plot Files are presented in Figure 9-40 to Figure 9-42.

Maximum predicted ground level NO_2 concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-42 and Table 9-43.

Table 9-42 Scenario 2B: Maximum Predicted Long Term (Annual) NO_2 Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	1.9	4.75%	40	40
Camp Areas	3.3	8.30%		
Riffa View	1.3	3.23%		
Princess Sabeeka Oasis	1.5	3.78%		
BSPCA	2.6	6.60%		
Camp Areas	1.5	3.85%		
Askar Village	1.6	4.08%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	0.7	1.75%		
Camp Areas	0.5	1.23%		
Camp Areas	0.8	2.10%		
Mameer Village	0.4	1.03%		
Riffa City	0.7	1.70%		
Tatweer Petroleum	1.4	3.43%		
BDF Muaskar Camp	1.9	4.75%		

The annual mean NO_2 process contributions are well within the guideline values. Modeling results indicate that the process contribution of ambient annual NO_2 concentrations is >1% at all receptor locations.

Table 9-43 Scenario 2B: Maximum Predicted Short Term (1 – Hour and 24 – Hour) NO_2 Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
1 - Hours				
Camp Areas	89.9	44.93%	200	200
Camp Areas	140.0	70.01%		
Riffa View	113.5	56.76%		
Princess Sabeeka Oasis	74.9	37.46%		
BSPCA	68.6	34.28%		
Camp Areas	76.3	38.13%		
Askar Village	72.0	36.00%		
Camp Areas	70.9	35.47%		
Camp Areas	56.7	28.34%		
Camp Areas	72.0	36.00%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Mameer Village	39.4	19.68%		
Riffa City	54.7	27.37%		
Tatweer Petroleum	102.7	51.33%		
BDF Muaskar Camp	89.9	44.97%		
24 - Hours				
Camp Areas	27.0	18.01%	150	-
Camp Areas	42.3	28.20%		
Riffa View	16.9	11.26%		
Princess Sabeeka Oasis	13.2	8.77%		
BSPCA	21.4	14.27%		
Camp Areas	15.0	10.01%		
Askar Village	15.7	10.47%		
Camp Areas	8.0	5.33%		
Camp Areas	9.9	6.59%		
Camp Areas	12.4	8.26%		
Mameer Village	6.5	4.33%		
Riffa City	11.6	7.73%		
Tatweer Petroleum	20.3	13.55%		
BDF Muaskar Camp	20.1	13.37%		

From the modeling study it is evident that the short-term NO_2 process contributions are well within the guideline values. The process contributions of ambient 1 – hour concentrations are >10% at all receptor locations.

The process contributions of ambient 24 – hour NO_2 concentrations is >10% at all receptor locations except camp areas located at ~ 2 km away from the Block 4 location towards South-East, Mameer Village and Riffa City.

Thus, in accordance with the significance criteria (refer section 9.2.2.1), the impacts due to the process contributions of Nitrogen Dioxide emissions during Scenario 2B

Summer Base Case Operations are **significant** and assessed to be of **moderate adverse**. However, it should be noted that the predicted ground level concentrations represent the worst-case emissions in different meteorological conditions experienced over five (5) years.

9.4.2.8.4.3 Sulphur Dioxide (SO_2)

The SO_2 modeling results indicate that the maximum 1 – hour, 24 – hours, and annual ground level concentrations are well below the ambient air quality standards. SO_2 emissions equate to a process contribution of ambient SO_2 concentrations 67% of the maximum 1 – hour limit value. The process contribution of ambient 24 – hour SO_2 concentrations, is 93% of the limit value and that for annual mean SO_2 concentrations is 37% of the limit value. When background concentrations are included as appropriate, the predicted maximum ground level concentration rises to 119% of the maximum ambient 1 – hour limit value and 217% of the 24 – hour limit value (refer Table 9-40). Plot Files are presented in Figure 9-43 to Figure 9-45.

Maximum predicted ground level SO_2 concentrations at the identified sensitive receptors and percentage of ambient air quality standards are presented in Table 9-44 and Table 9-45.

Table 9-44 Scenario 2B: Maximum Predicted Long Term (Annual) SO_2 Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Camp Areas	1.1	2.20%	50	-
Camp Areas	2.7	5.34%		
Riffa View	1.0	2.04%		
Princess Sabeeka Oasis	1.1	2.10%		
BSPCA	2.5	4.94%		
Camp Areas	1.4	2.86%		
Askar Village	1.4	2.78%		
Camp Areas	0.5	1.00%		
Camp Areas	0.4	0.72%		
Camp Areas	0.5	1.00%		
Mameer Village	0.3	0.64%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
Riffa City	0.5	1.08%		
Tatweer Petroleum	1.1	2.14%		
BDF Muaskar Camp	1.4	2.80%		

The annual mean SO_2 process contributions are well within the guideline values. Modeling results indicate that the process contribution of ambient annual SO_2 concentrations is >1% at all receptor locations except camp areas located ~2kms away from the Block 4 Plot towards South-East, and Mameer Village.

Table 9-45 Scenario 2B: Maximum Predicted Short Term (1 – Hour and 24 – Hour) SO_2 Concentrations at Sensitive Receptors (μg/m^3)

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values	
			SCE	IFC
1 - Hours				
Camp Areas	102.3	34.11%	300	-
Camp Areas	123.4	41.13%		
Riffa View	105.7	35.22%		
Princess Sabeeka Oasis	74.1	24.69%		
BSPCA	97.0	32.32%		
Camp Areas	82.4	27.47%		
Askar Village	60.4	20.13%		
Camp Areas	69.4	23.14%		
Camp Areas	59.0	19.66%		
Camp Areas	50.3	16.75%		
Mameer Village	34.6	11.54%		
Riffa City	58.0	19.34%		
Tatweer Petroleum	79.1	26.36%		

Sensitive Receptor	Predicted Maximum GLC	GLC as % of Standard	Guideline Values SCE	Guideline Values IFC
BDF Muaskar Camp	109.3	36.42%		
24 - Hours				
Camp Areas	22.3	17.86%	125	125 IT – 1
Camp Areas	55.9	44.73%		
Riffa View	14.6	11.71%		
Princess Sabeeka Oasis	14.1	11.26%		
BSPCA	25.5	20.38%		
Camp Areas	13.9	11.08%		
Askar Village	17.5	13.98%		
Camp Areas	6.9	5.50%		
Camp Areas	8.1	6.46%		
Camp Areas	6.4	5.11%		
Mameer Village	4.4	3.50%		
Riffa City	10.6	8.48%		
Tatweer Petroleum	16.9	13.50%		
BDF Muaskar Camp	20.4	16.29%		

From the modeling study it is evident that the short-term SO_2 process contributions are well within the guideline values. The process contributions of ambient 1 – hour concentrations are >10% at all receptor locations.

The process contributions of ambient 24 – hour SO_2 concentrations is >10% at all receptor locations except camp areas located at approximately 2 km away from the Block 4 location towards South-East, Mameer Village and Riffa City.

Thus, in accordance with the significance criteria (refer section 9.2.2.1), the impacts due to the process contributions of Sulphur Dioxide emissions during Scenario 2B Summer Base Case Operations are **significant** and assessed to be of **moderate adverse**. However, it should be noted that the predicted ground level concentrations represent the worst-case emissions in different meteorological conditions experienced over five (5) years.

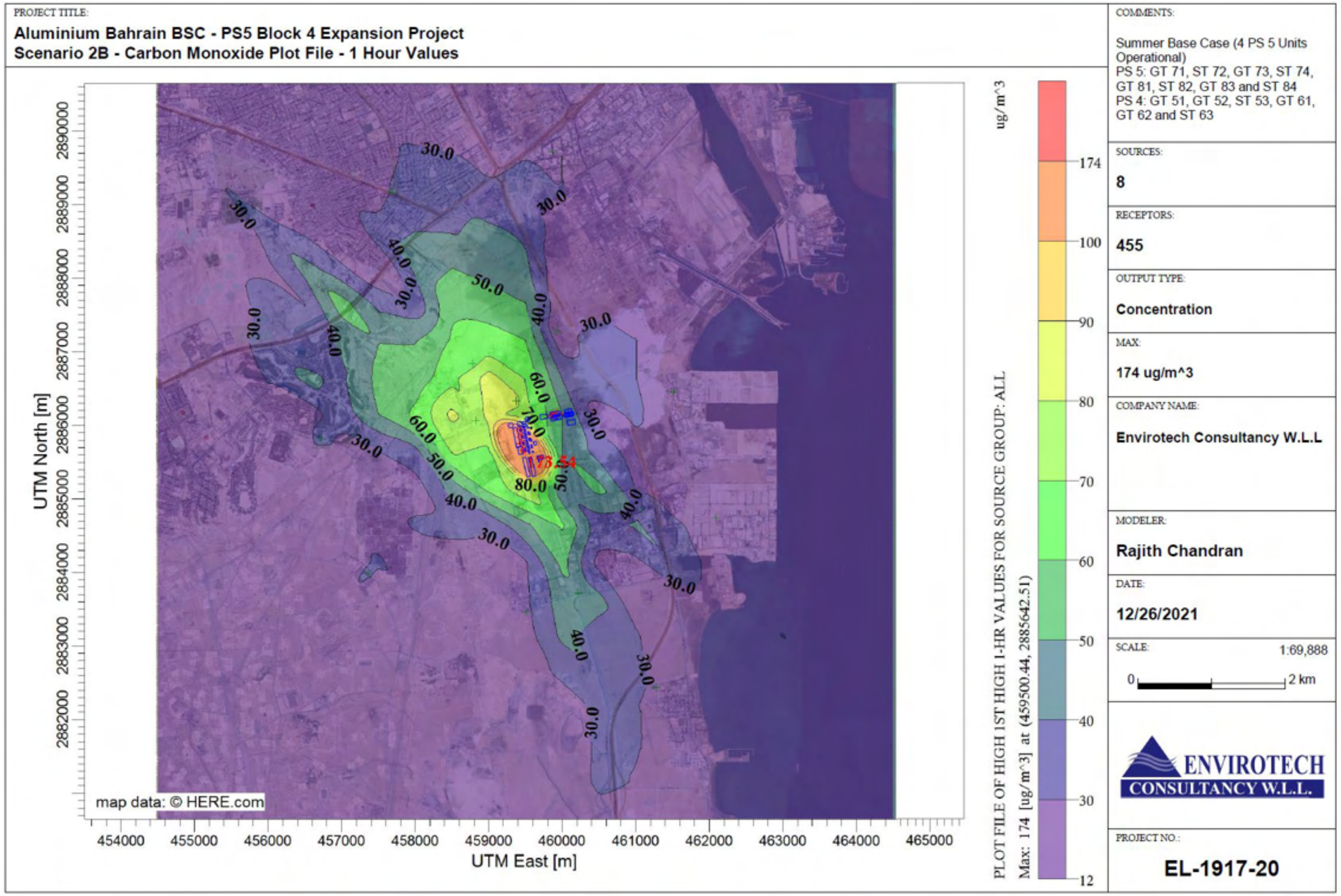


Figure 9-38 Scenario 2B: Carbon Monoxide Concentration Isopleth – 1 Hour Values

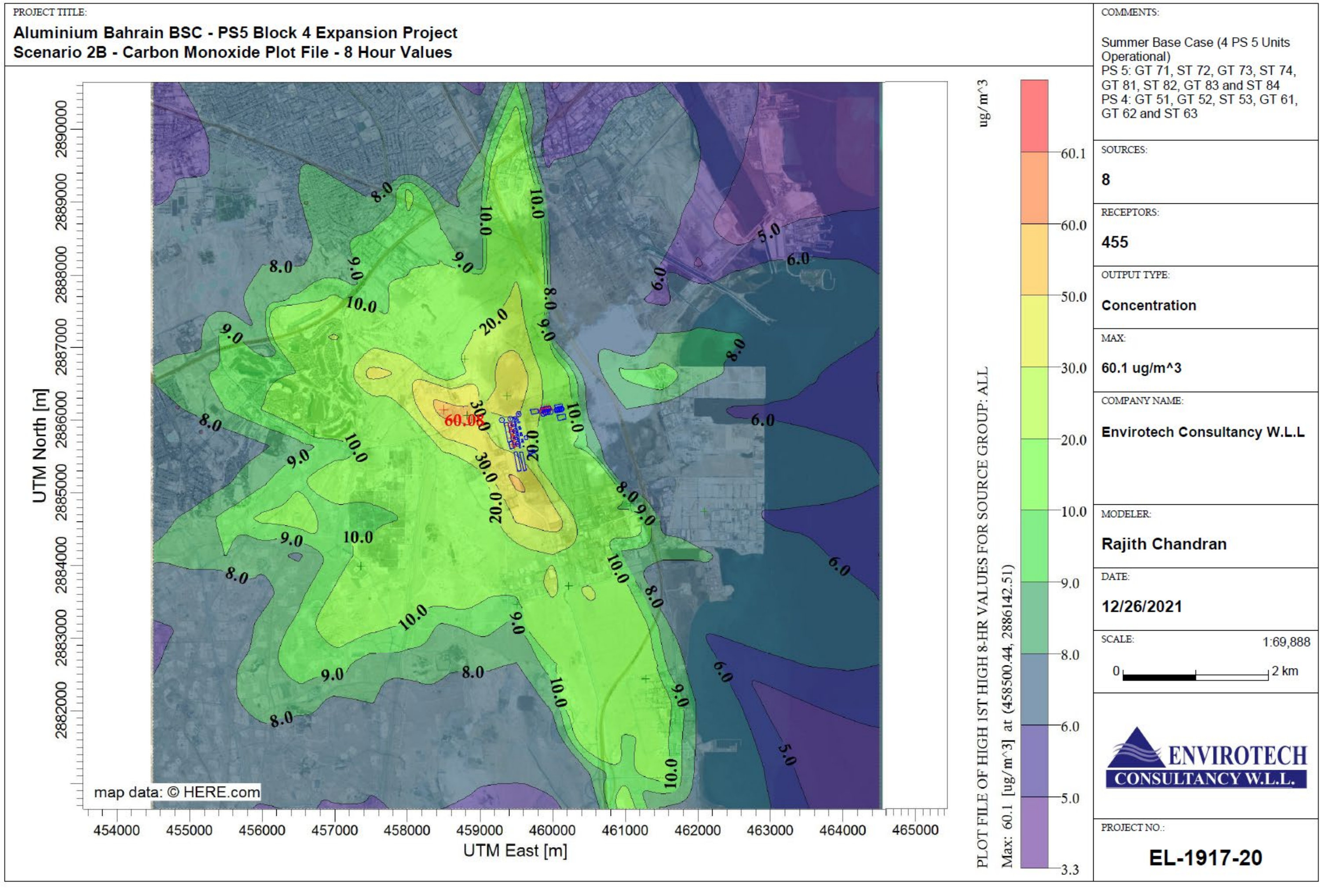


Figure 9-39 Scenario 2B: Carbon Monoxide Concentration Isopleth – 8 Hour Values

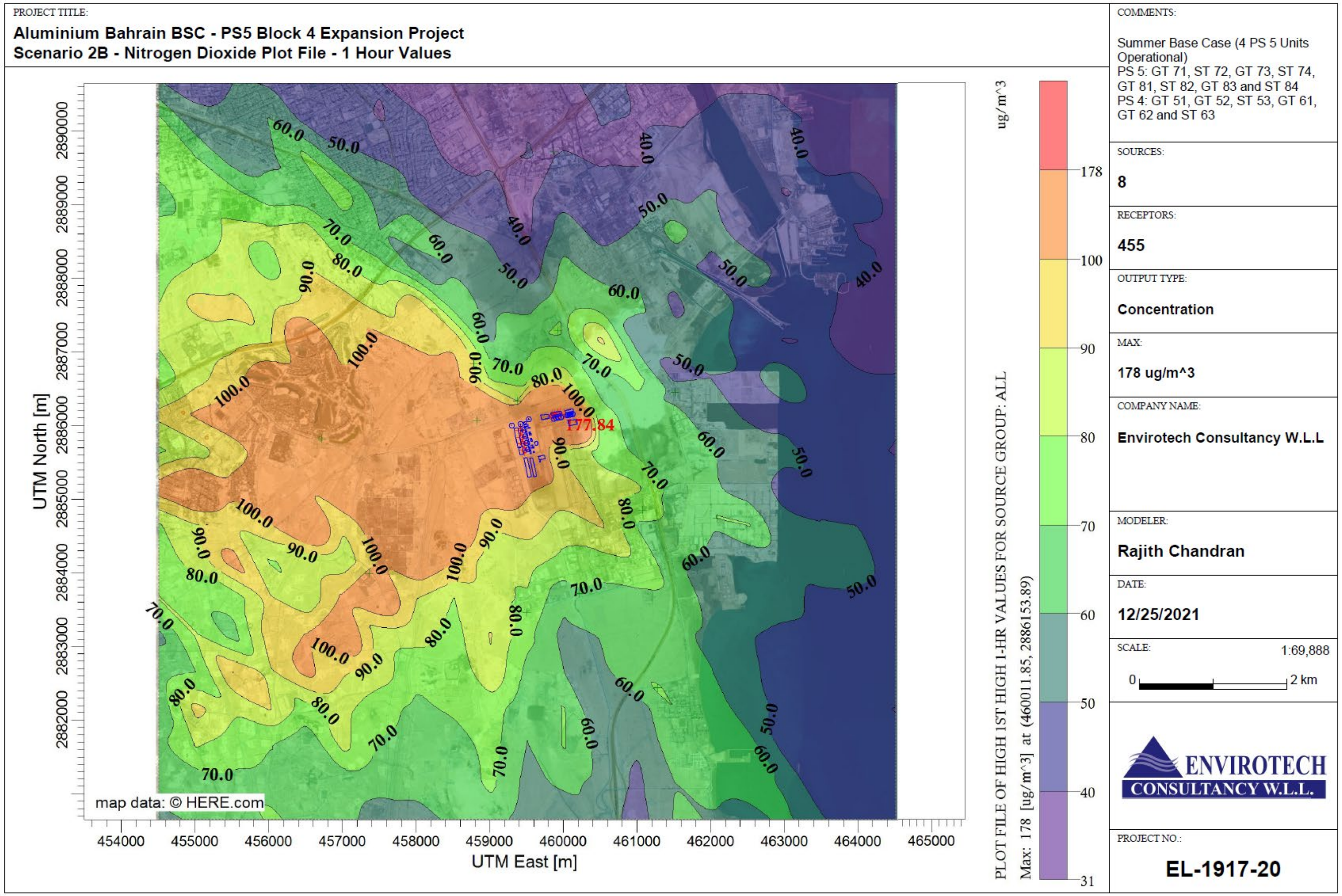


Figure 9-40 Scenario 2B: Nitrogen Dioxide Concentration Isopleth – 1 Hour Values

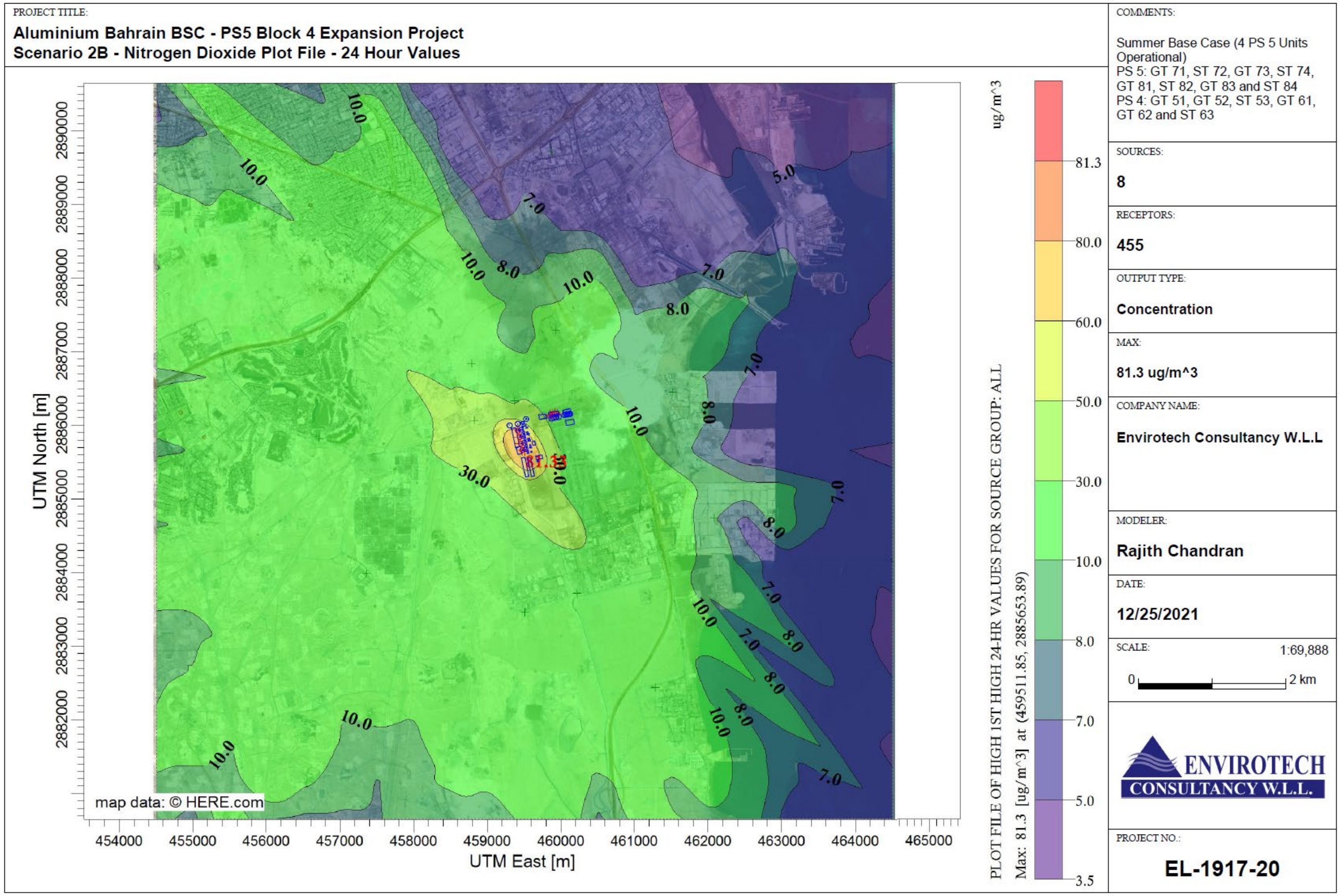


Figure 9-41 Scenario 2B: Nitrogen Dioxide Concentration Isopleth – 24 Hour Values

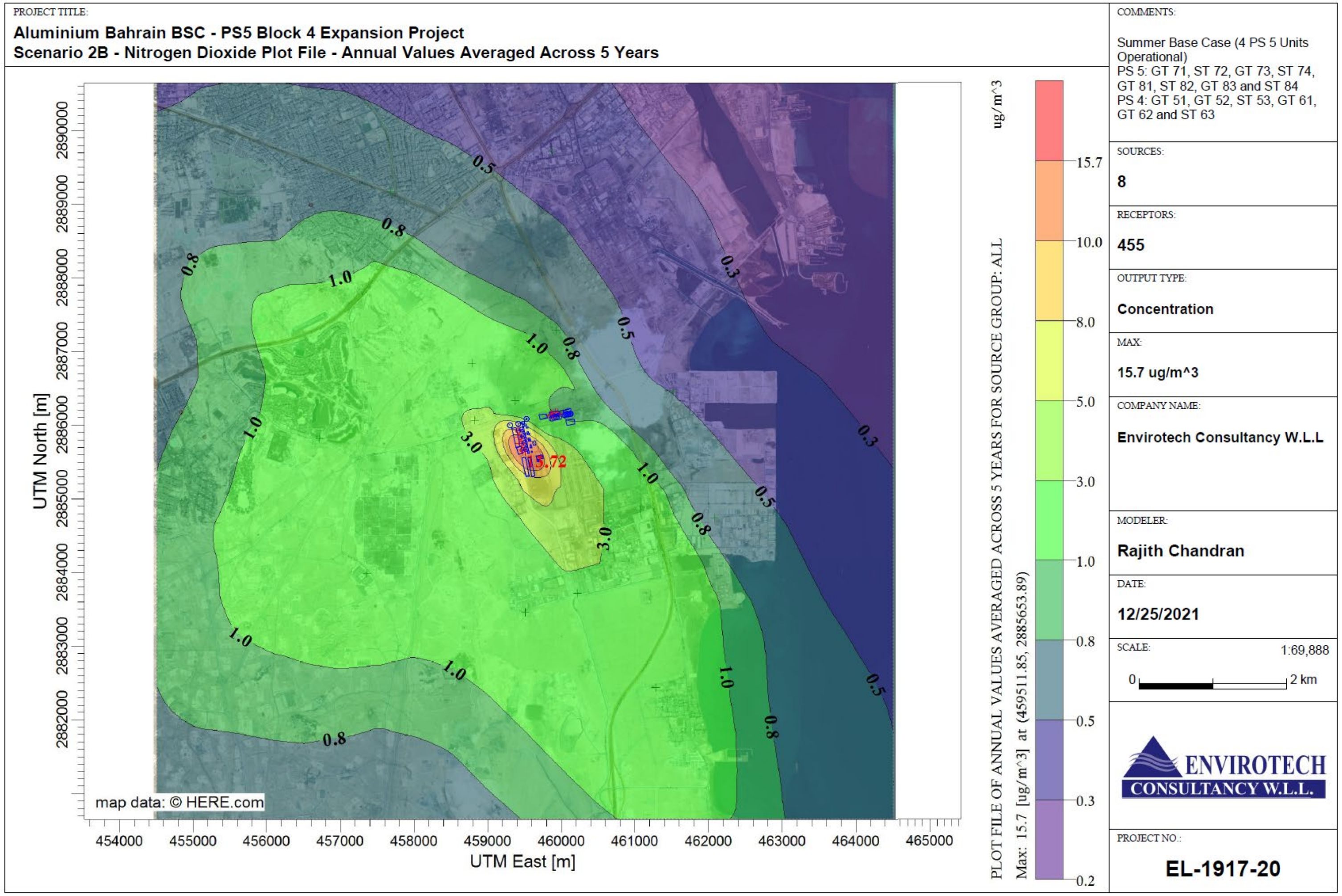


Figure 9-42 Scenario 2B: Nitrogen Dioxide Concentration Isopleth – Annual Values Averaged Across 5 Years

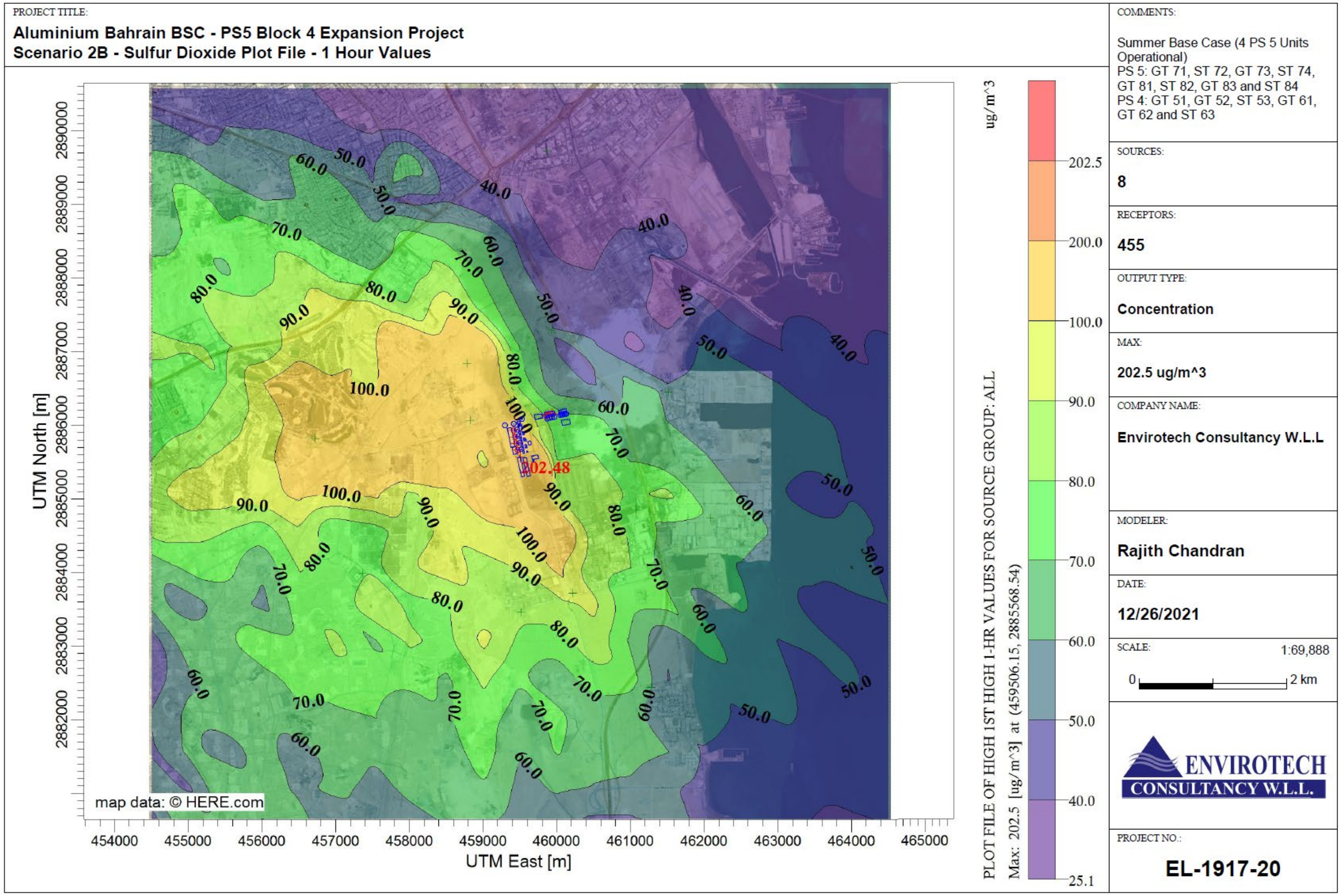


Figure 9-43 Scenario 2B: Sulphur Dioxide Concentration Isopleth – 1 Hour Values

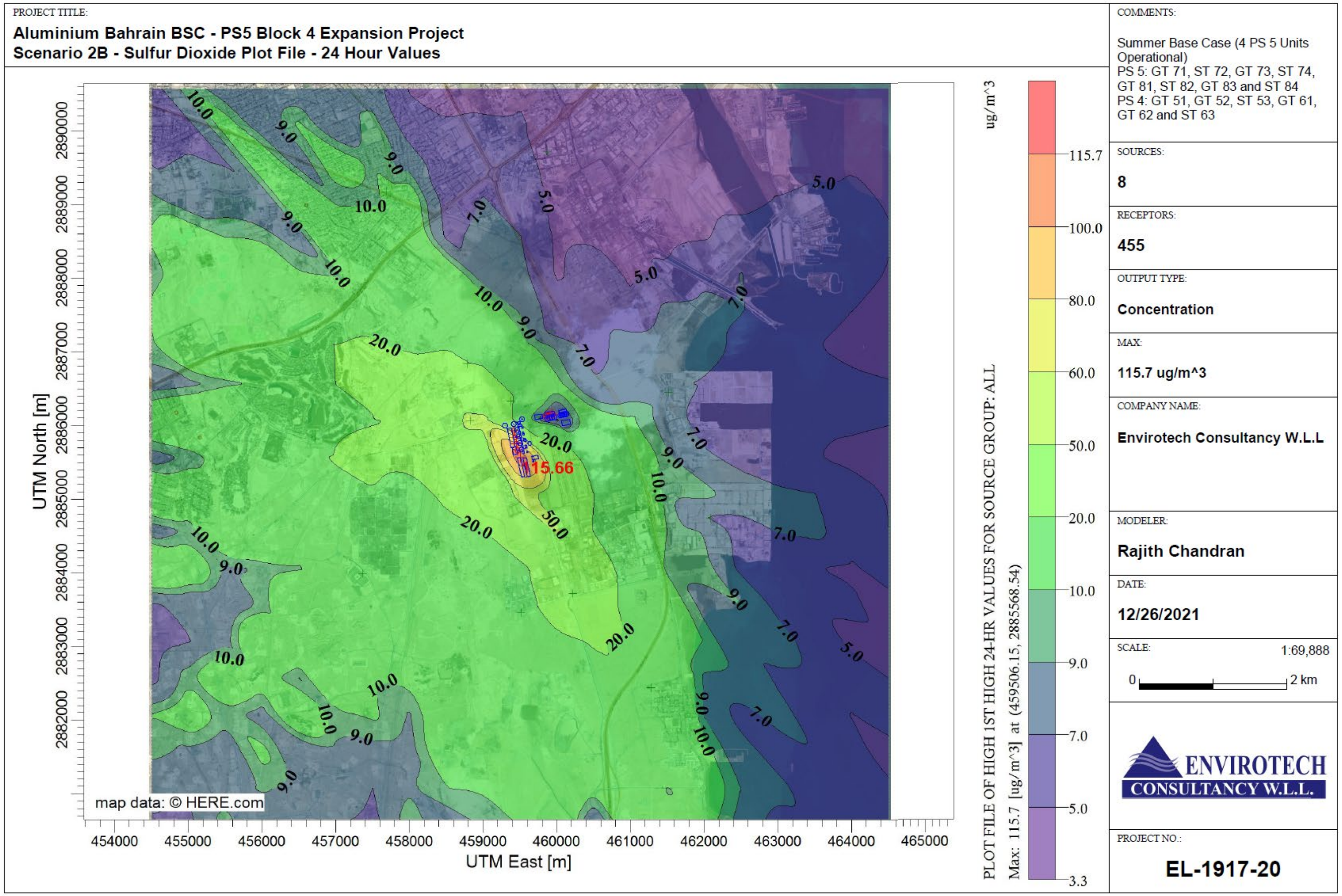


Figure 9-44 Scenario 2B: Sulphur Dioxide Concentration Isopleth – 24 Hour Values

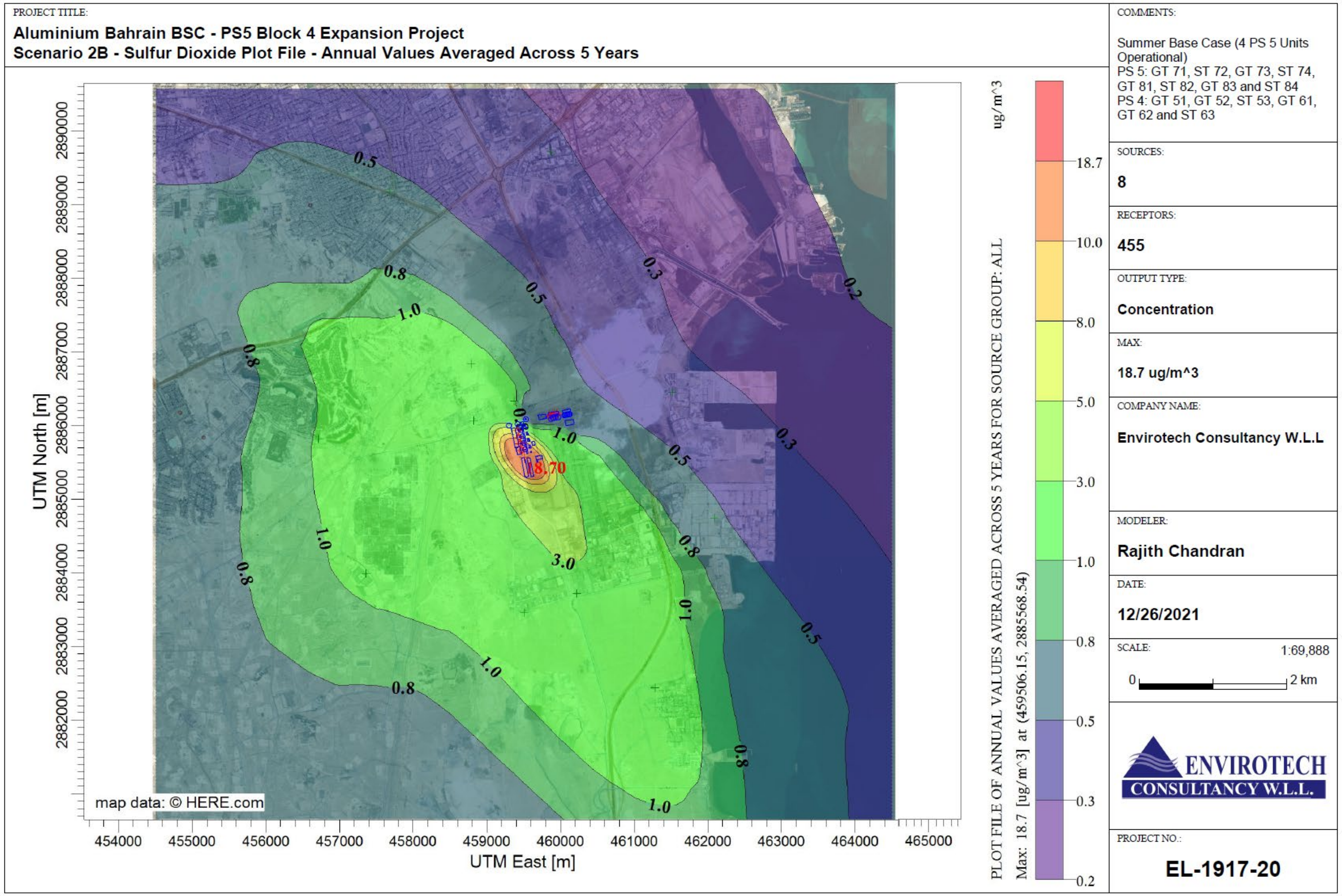


Figure 9-45 Scenario 2B: Sulphur Dioxide Concentration Isopleth – Annual Values Averaged Across 5 Years

9.4.2.9 Emissions from Operational Traffic

The operation of Block 4 will not generate additional traffic as it will be utilizing resources from the existing PS 5 facilities. Further, the existing staff at PS 5 will operate Block 4. Hence, no impacts are anticipated during operational phase.

9.4.3 Summary of Impacts

The summary of impacts associated with air quality during the construction and operation phases of the Project are summarized in the table below:

Table 9-46 Summary of Noise Impacts during Construction and Operational Phases

Potential Impact	Aspect Impacted	Magnitude of Impacts	Duration of Impacts	Extent of Impacts
Construction Phase				
Construction dust	Workers and occupants on site and surrounding facilities	Less significant	Short Term	Local
Vehicular emissions	Workers and occupants on site and surrounding facilities	Less significant	Short Term	Local
Operation Phase				
Stack Emissions	PS 5 Staff and surrounding receptors	Less significant to Moderate Adverse	Long Term	Local

9.5 Mitigation Measures

This section details proposed mitigation measured to be adopted during construction and operation phases.

9.5.1 Construction Phase

During the construction phase of Block 4, the following management measures should be implemented to minimize the impacts:

- A construction dust minimization plan shall be formulated by the EPC Contractor.
- Use of water suppression for control of loose materials on paved or unpaved road surfaces. Oil and oil by-products is not a recommended method to control road dust.

- Site roads should be regularly cleaned and maintained as appropriate.
- Public roads adjacent to the site shall be regularly inspected for cleanliness and cleaned as necessary.
- Site speed limits shall be used to prevent the unnecessary generation of fugitive dust emissions.
- Lorries/trucks shall be properly covered or enclosed during transportation of construction materials to prevent their escape along public roads.
- Adherence to good site engineering practices shall assist in reducing dust generation.
- The storage of fuel and/or the location of re-fueling operations shall not occur in a position that could give rise to nuisance from fugitive VOC emissions.
- Undertake wheel washing at site exits to minimize dust and soil on wheels being transferred off-site.
- Minimize drop heights from conveyors, loading shovels, hoppers, loading or handling equipment and use water sprays on such equipment / work areas where possible.
- Suspend dusty works during periods of high wind speed, where possible.
- Minimize stockpiles onsite (e.g., immediate removal of excavated materials requiring offsite disposal).
- Limit the height and slope of stockpiles and locate away from adjacent facilities.
- Align stockpiles along their main axis in the direction of prevailing winds to ensure minimal cross-section exposure to prevailing winds, whenever possible.
- Stockpiles within 100 meters of buildings/offices must be below two meters in height.
- When stockpiling or unloading dusty/friable material, ensure that the loader bucket is close to the truck so that drop height is below three meters.
- Equipment and vehicles should be turned off when not in use to minimize gaseous emissions and fuel consumption.
- Use low sulphur diesel, ultra-low sulphur diesel or bio-diesel to minimize the emission of sulphur dioxide, where practical.
- Use equipment fitted with pollution control devices (e.g., diesel particulate matter filter), where possible.
- Maintain equipment and vehicles as per manufacturer recommendations and remove any malfunctioning or sub-standard equipment and vehicles from service, particularly if observed to be emitting black smoke.

- Open burning on site will be prohibited.
- Locate toilet utilities, sewage tanks (if any) and waste storage facilities away from sensitive receptors on-site (e.g., site office, works area) and off-site.
- Maintain the sanitary and waste disposal facilities in good, clean conditions with any leaks fixed as soon as possible.
- Waste bins holding putrescible waste should be covered to minimize odour emission and attraction of vectors.
- Regular off-site disposal of waste should be arranged.

9.5.2 Operational Phase

Alba proposes to install Low NOx burners to the gas turbine to optimize the air / fuel ratio producing a uniform low temperature flame in the combustion chamber to minimize the production of NOx. Low NOx burners are recommended as Best Available Technique (BAT) for new gas turbines.

These emission controls will be adopted into the design of the plant to ensure that the air quality objectives set out in the Air Quality Standards are achieved in the vicinity of the Block 4 and at the nearby sensitive receptors. The design of the plant and the incorporation of the emission controls have been considered according to the principle of Best Available Technique (BAT). For higher GTCC efficiency, a higher temperature of the gas turbine plays an important role. OEM proceeded with the development of the next-generation JAC (J-Air-Cooled) series gas turbine to further improve the efficiency and operability by applying to the following core technology. The JAC series gas turbine has achieved a high turbine inlet temperature of 1,600^{0}C class.

9.5.2.1 Compressor

Advanced three-dimensional design techniques are used to improve performance while reducing the shockwave loss in the initial stages and frictional loss in the intermediate and final stages. The inlet guide vanes and variable stationary vanes at the first three stages are controlled to ensure stable operation at the start-up and enhanced performance at partial load in combined.

9.5.2.2 Combustor

The JAC-Series combustor is based on the air-cooling system proven with the conventional gas turbine. An improved fuel nozzle is used to help produce a more homogeneous mixture of fuel and air and low-NOx technologies for lowering the local flame temperature in the combustion area and have been applied to attain a NOx emission concentration equivalent to that of the previous model.

9.5.2.3 Turbine

The turbine inlet temperature is approx. 100^0C higher than that of the previous model, the application of high-performance cooling technologies and advance thermal barrier coating (TBC) developed in a Japanese national project for the development of $1{,}700^0C$ class gas turbines, helps to maintain the metal temperature of the turbine blades at the level of conventional gas turbines.

9.5.2.4 Continuous Emission Monitoring System

Continuous emission monitoring system will be installed during operational phase to measure CO, NOx, H_2S and SO_2 to measure flue gas emissions and to ensure compliance with SCE and IFC point source emission guidelines.

9.6 Residual Impacts

The results of the air dispersion modeling indicates that the maximum ground level concentrations, for each scenario, based on emission limit concentrations, do not result in exceedance of the relevant ambient air quality standards at the nearest sensitive receptor locations. When background concentrations are included as appropriate, the predicted maximum ground level concentrations exceed the ambient air quality standards. However, it is important to note that the worst-case emission scenario was considered for the PS5 Block 4, and the maximum recorded emissions were considered for the existing PS5, PS4 and PS3 units in the modeling exercise.

The long-term impact of the Block 4 on local air quality can be negligible and minimum to minor adverse in the future years of operation assuming that the recommended mitigation measures are implemented to a high standard.

No significant impacts on the local air quality have been identified during the construction phase.

9.7 Monitoring

The EPC contractor and the OEM shall undertake air quality monitoring during construction and operational phases. The monitoring methodology will be developed in the CESMP and OESMP. An outline of the monitoring program is given in the table below:

Table 9-47 Air Quality Monitoring Program

Parameter	Frequency / Duration	Location
Construction Phase		
Construction Dust	Visual inspection daily	Construction site, site entrance and exit, and nearest receptors

Parameter	Frequency / Duration	Location
	Dust monitoring shall be undertaken if any complaints received from nearest receptors	
Vehicular Emissions	Visual inspection daily. Operators shall always maintain vehicle inspection checklist in the vehicle and fill the checklist every morning	All vehicles and equipment
Odor from Sanitary Facilities	Visual inspection daily basis by the Environmental Engr. / HSE Officer	All sanitary facilities in the construction site.
Operational Phase		
Initial Performance Test during Plant Start-Up	Carbon Monoxide – USEPA Method 10 Nitrogen Dioxide – USEPA Method 6C Sulphur Dioxide – USEPA Method 7E	HRSG Main Stack
Stack Emission Monitoring	Monthly stack emission monitoring and submission of reports during first year of operations Quarterly stack emission monitoring and reporting from second year onwards	HRSG Main Stack
Acid Gas Monitoring	Determination of sulphur dioxide deposition rates as per ISO 9225:2012 (E)	Nearest receptor locations, accommodation, and commercial areas.

10 NOISE AND VIBRATIONS

This chapter of the ESIA will address the potential impacts of noise and vibration generated during the construction and operation phases of PS 5 Block 4.

10.1 Applicable Standards and Guidelines

10.1.1 Noise Guidelines

10.1.1.1 Noise Level Guidelines – Kingdom of Bahrain

Ministerial Order No. 3 of 2005 with respect to the environmental regulations and standards at workplace stipulates the following standards for workplace.

Table 10-1 Noise Standards for Workplace

Hours	Allowable Maximum Noise Levels dB(A)
8	85
4	88
2	91
½	94
¼	97
1/8	100

10.1.1.2 Noise Level Guidelines – International Finance Corporation

IFC adopted noise guidelines from Community noise guidelines of World Health Organization (WHO), 1999 and is presented in Table 10-2.

Table 10-2 WHO Noise Level Guidelines

Receptor	One Hour LAeq, dB(A)	
	Daytime 07:00 - 22:00	Night-time 22:00 - 07:00
Residential; institutional; educational	55	45
Industrial; commercial	70	70

Note:

1. *Noise monitoring should be carried out using a Type 1 or 2 sound level meter meeting all appropriate IEC standards.*

10.1.2 Vibration Guidelines

There are no specific guidelines in the Kingdom of Bahrain on Vibration levels. Hence references are made to:

1. BS 5228-4: 1992 (BSI, 1992) provides guidance on damage in relation to vibration from piling;
2. BS 7385-2: 1993 (BSI, 1993) provides guidance on acceptable values of transient vibration for avoidance of cosmetic damage to buildings;
3. BS 6472 – Part 1 (BSI, 1992) - Evaluation of human exposure to vibration in buildings [1 Hz to 80 Hz].

Vibration guideline values proposed are presented in Table 10-3 and Table 10-4.

Table 10-3 Guideline Vibration Limits for Occupied Buildings

Type of Building	Vibration PPV (mm/s) 1 to 100 Hz
Any permanently occupied residential building, medical facility, or school	1.0
Any occupied hotel or commercial/industrial building	3.0

Table 10-4 Transient Vibration Guide Values for Cosmetic Damage

Sl.No.	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Note: Values refer to vibration measured at the base or foundation of the building.

10.2 Methodology

10.2.1 Noise Monitoring Methodology

Based on the initial site visits, sources of noise adjacent to the allocated plot are identified from existing PS 5 Blocks 1 to 3, Potline 6 operations and operational noise from industries located towards the west of the plot. The proposed plot is located at

South of the existing PS 5 facilities which includes operational GT's, HRSG's and ST's.

To establish the baseline, a background noise survey was undertaken at noise sensitive receptors[1] around the proposed Project site.

Noise survey was carried out using Class 2 Integrating Sound Level Meter (ISLM) Cirrus CR 162 C. The ISLM will be placed on a tripod at height of 1.5 meter above ground with its microphone pointing towards the equipment / plant. Measurements will be taken. Baseline noise monitoring was carried out on 19th and 20th November 2020.

10.2.1.1 Monitoring Locations

Six (6) monitoring locations are identified along the nearest receptors and existing PS 5 boundary line with one (1) location at the Block 4 site (refer Figure 10-1). A brief input of monitoring locations is presented in the table below:

Table 10-5 Noise Monitoring Location Details

Noise Monitoring Location No.	Co-Ordinates	Location Description
NML1	459481.81 m E 2886284.09 m N	Adjacent to accommodation and recreational area located ~650 meters towards North of Block 4
NML2	459298.53 m E 2886011.35 m N	Outside North-West fence line of existing Power Station 5 Blocks. Adjacent to gas metering station
NML3	459480.73 m E 2885664.05 m N	Block 4 site. ~50 meters away from existing PS 5 Block 3
NML4	461123.38 m E 2884904.18 m N	Adjacent to Princess Sabeeka Oasis within the Alba Complex, located ~1.8 Km towards South East of Block 4
NML5	459647.73 m E 2884841.82 m N	Adjacent to Alba Potline 6 fence line. Located at ~850 meters towards South West of Block 4
NML6	459408.63 m E 2885602.11 m N	Outside West fence line of proposed Block 4 site

[1] A point of reception or receptor may be defined as any point on the premises occupied by persons where extraneous noise and/or vibration are received. Examples of receptor locations may include permanent or seasonal residences; hotels / motels; schools and daycares; hospitals and nursing homes; places of worship; and parks and campgrounds [**Error! Reference source not found.** – IFC].

10.2.1.2 Noise Monitoring Methodology

Noise monitoring was carried out on 19th and 20th November 2020 covering a weekday day, night, and weekend day times. Noise monitoring was carried out at each location for a period of 30 minutes as follows:

- Noise monitoring was carried out at least 3 meters away from any reflecting surfaces.
- Noise level meter was mounted on a tripod with microphone to achieve a height of 1.5 meter above ground level.
- Data Logging for LAeq at every minute interval were preset to enable to generate 30 noise level data record at each station.
- A-weighted continuous equivalent sound level (LAeq) along with LAmax, LAmin, LA10, LA 50, LA 90 and LA95 were logged.

Monitoring was conducted in normal weather conditions. An average wind speed of 5 m/sec is preferred for the noise monitoring with maximum 7 m/sec as an upper limit. Wind Speed during the monitoring period was measured using anemometer.

Cirrus Class 2 Sound Level Meter (Cirrus CK 162C) handheld device with microphones, calibrator was used for the noise monitoring campaign. Details of the sound level meter are provided in Table 10-6. The device has the inbuilt features that measure the 'A'-weighted equivalent sound level (LAeq) and also calculate the statistical noise level parameters including LA10, LA50, LA90, LA95, LAmax and LAmin.

Table 10-6 Details of Sound Level Meter

Sound Level Meter	Description
Noise Meter Cirrus CR 162 C	Cirrus CR 162 C (1:1 & 1:3 Octave Band Analyser) handheld noise meter with Noise Tools Software. Serial Number: G300713
Noise Meter Calibrator	Cirrus CR 515 Acoustic Calibrator, Type 2

Noise monitoring was conducted in normal weather conditions. An average wind speed of 5 m/sec is preferred for the noise monitoring with maximum 7 m/sec as an upper limit. Wind Speed during the monitoring period was measured using anemometer.

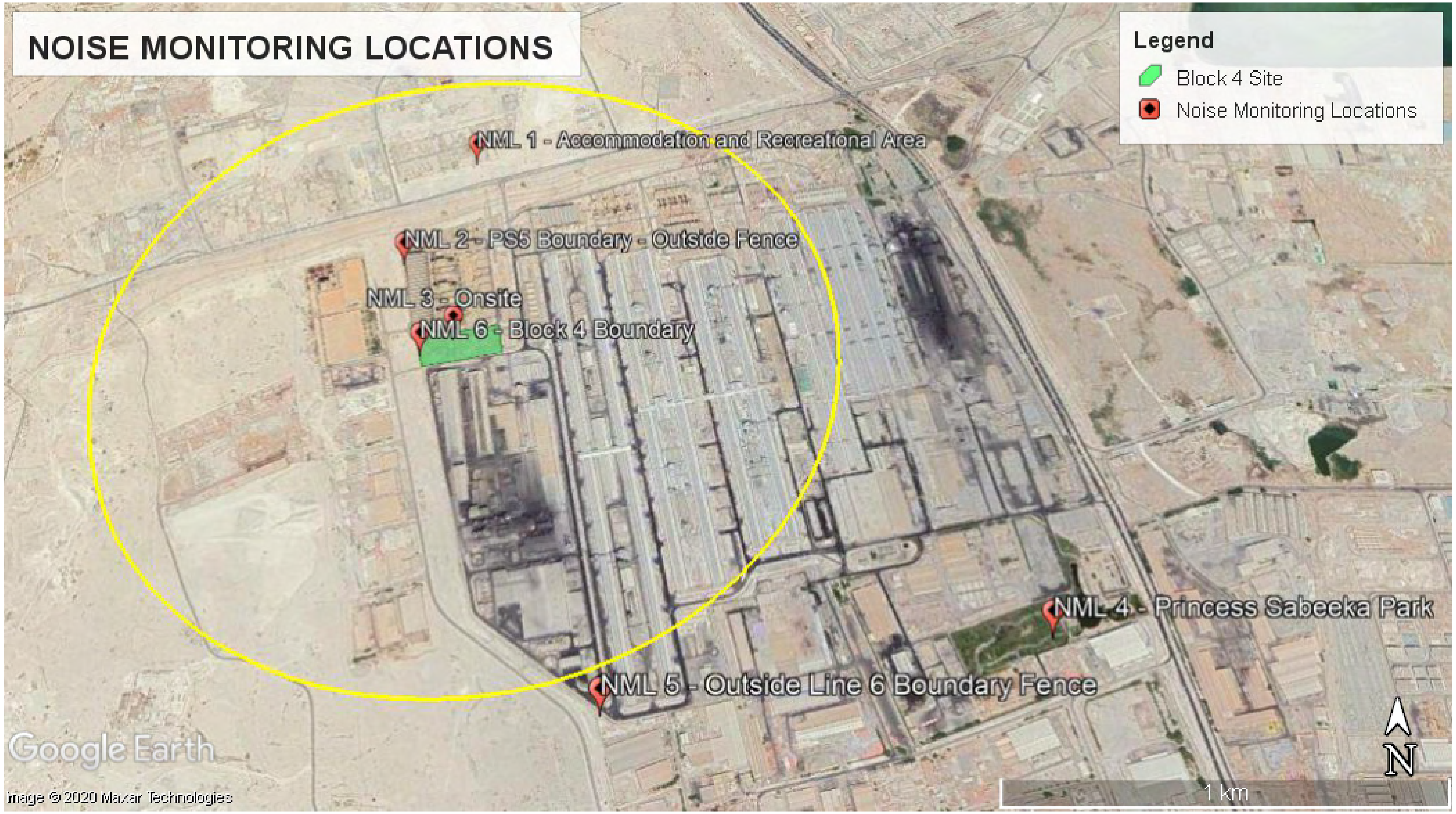


Figure 10-1 Proposed Noise Monitoring Locations

10.2.2 Noise Modeling Methodology

Noise predictions were made for the operational phase of the Block 4 CCP using SoundPLAN 8.2 noise modeling software. SoundPLAN is a software package that enables the prediction of sophisticated scenarios and displaying said scenarios into digitized maps containing contours. SoundPLAN can generate noise emission levels considering meteorological effects, shielding attenuation, ground absorption, distance attenuation and source power levels.

Noise predictions for this noise assessment was carried out using ISO 9613 – 2, Attenuation of Sound during Propagation Outdoors – Part 2 General Calculation. The plant was digitized using the input data provided by Alba and with the aid of satellite imaging. For equipment input data, measurements were conducted at 1 – meter distance from each equipment or accessories to calculate sound power level using the following equation:

$$L_w = L_p + \left[10 \times \log\left(\frac{Q}{4\pi\, x\, r^2}\right)\right]$$

Where,

- Lw is the sound power level
- Lp is the sound pressure level
- Q is the sound directivity
- r is the distance from the source

10.3 Baseline Environment

10.3.1 Noise

The statistical review of noise data during baseline monitoring events are presented in Table 10-7 to Table 10-15.

10.3.1.1 Weekday - Day Time Monitoring Event

Table 10-7 Statistical Review of Noise Data during Weekday – Day Time Monitoring Events - Mean

Monitoring Locations	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Figure
NML1	63.7	68.6	63.9	68.3	**65.7**	67.1	65.3	64.3	64.2	Figure 10-2
NML2	68.7	71.8	68.8	71.5	**69.6**	70.6	69.3	69.0	68.9	Figure 10-3
NML3	73.3	75.6	73.4	75.3	**74.0**	74.5	73.8	73.5	73.5	Figure 10-4
NML4	60.2	65.5	60.3	65.0	**61.8**	62.8	61.4	60.6	60.5	Figure 10-5

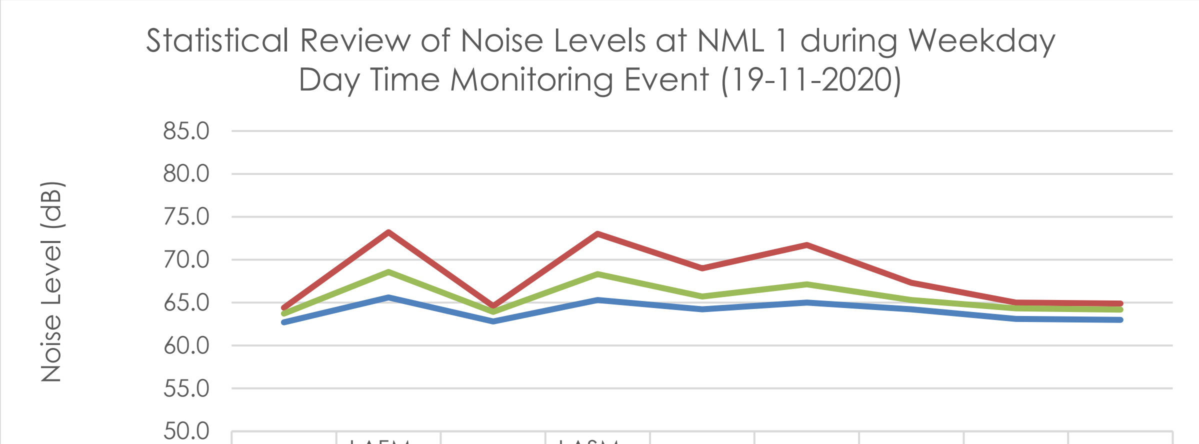
Monitoring Locations	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Figure
NML5	60.7	66.5	60.8	65.7	**62.0**	63.3	61.6	61.1	60.9	Figure 10-6
NML6	63.7	65.5	63.8	65.3	**64.4**	64.8	64.3	64.0	63.9	Figure 10-7

Table 10-8 Statistical Review of Noise Data during Weekday – Day Time Monitoring Events - Maximum

Monitoring Locations	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Figure
NML1	64.4	73.2	64.6	73.0	**69.0**	71.7	67.3	65.0	64.9	Figure 10-2
NML2	69.2	78.8	69.3	78.1	**71.7**	75.6	69.9	69.4	69.4	Figure 10-3
NML3	73.6	81.6	73.7	81.2	**75.2**	78.0	74.0	73.8	73.7	Figure 10-4
NML4	61.3	75.1	61.4	74.1	**64.0**	65.8	62.3	61.6	61.5	Figure 10-5
NML5	61.4	75.4	61.4	73.7	**63.9**	67.0	63.7	61.9	61.7	Figure 10-6
NML6	64.8	68.5	64.9	68.0	**66.1**	67.3	65.7	65.0	64.9	Figure 10-7

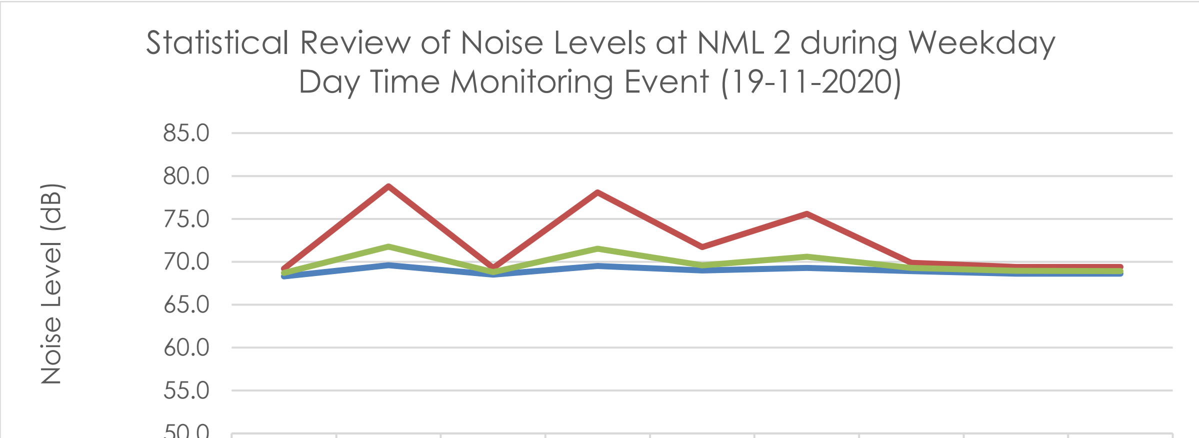
Table 10-9 Statistical Review of Noise Data during Weekday – Day Time Monitoring Events– Minimum

Monitoring Locations	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Figure
NML1	62.7	65.6	62.8	65.3	**64.2**	65.0	64.2	63.1	63.0	Figure 10-2
NML2	68.3	69.6	68.5	69.5	**69.0**	69.3	68.9	68.6	68.6	Figure 10-3
NML3	73.0	74.2	73.1	74.0	**73.7**	73.9	73.6	73.2	73.2	Figure 10-4
NML4	58.3	62.2	58.6	61.9	**60.2**	60.9	59.9	59.4	59.2	Figure 10-5
NML5	60.1	61.7	60.4	61.5	**61.1**	61.3	61.0	60.6	60.5	Figure 10-6
NML6	63.3	64.5	63.5	64.4	**64.0**	64.2	64.0	63.6	63.6	Figure 10-7



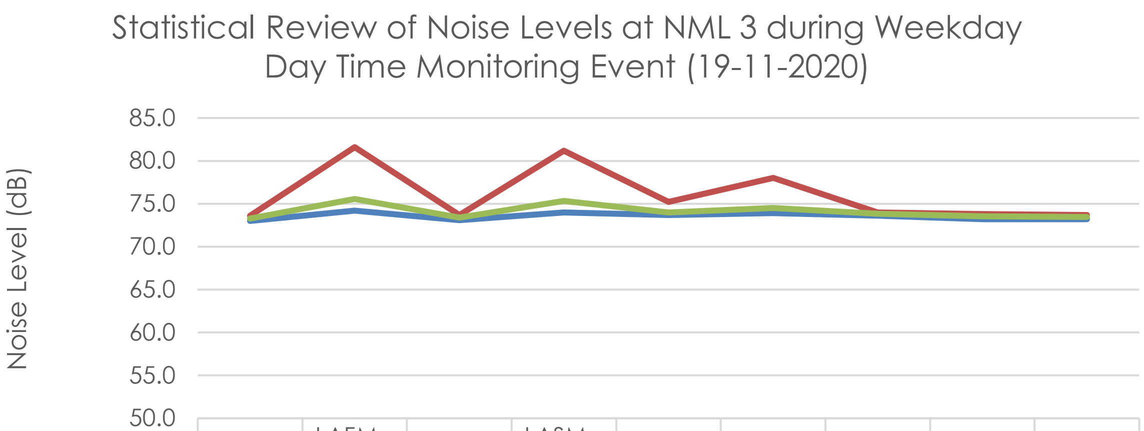
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	62.7	65.6	62.8	65.3	64.2	65.0	64.2	63.1	63.0
Maximum	64.4	73.2	64.6	73.0	69.0	71.7	67.3	65.0	64.9
Average	63.7	68.6	63.9	68.3	65.7	67.1	65.3	64.3	64.2

Figure 10-2 Statistical Review of Weekday Day Time Noise Levels at NML1



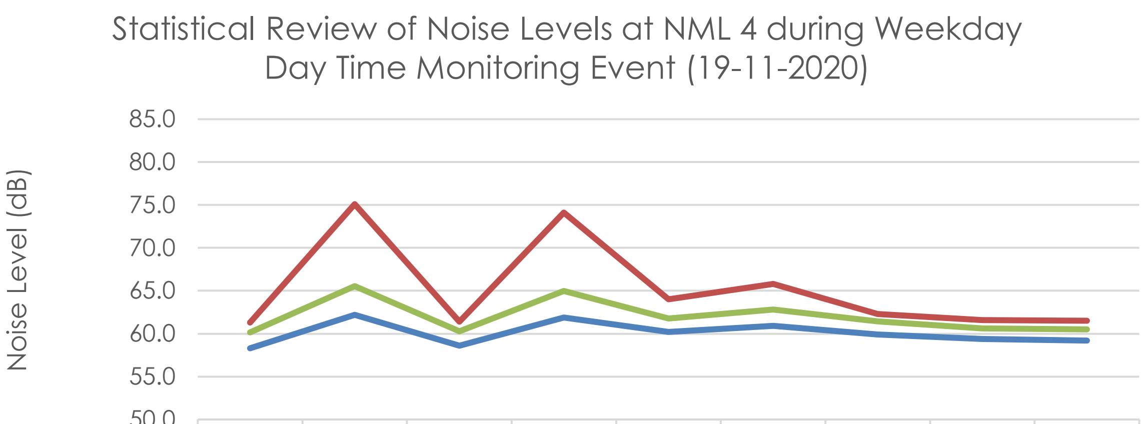
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	68.3	69.6	68.5	69.5	69.0	69.3	68.9	68.6	68.6
Maximum	69.2	78.8	69.3	78.1	71.7	75.6	69.9	69.4	69.4
Average	68.7	71.8	68.8	71.5	69.6	70.6	69.3	69.0	68.9

Figure 10-3 Statistical Review of Weekday Day Time Noise Levels at NML2



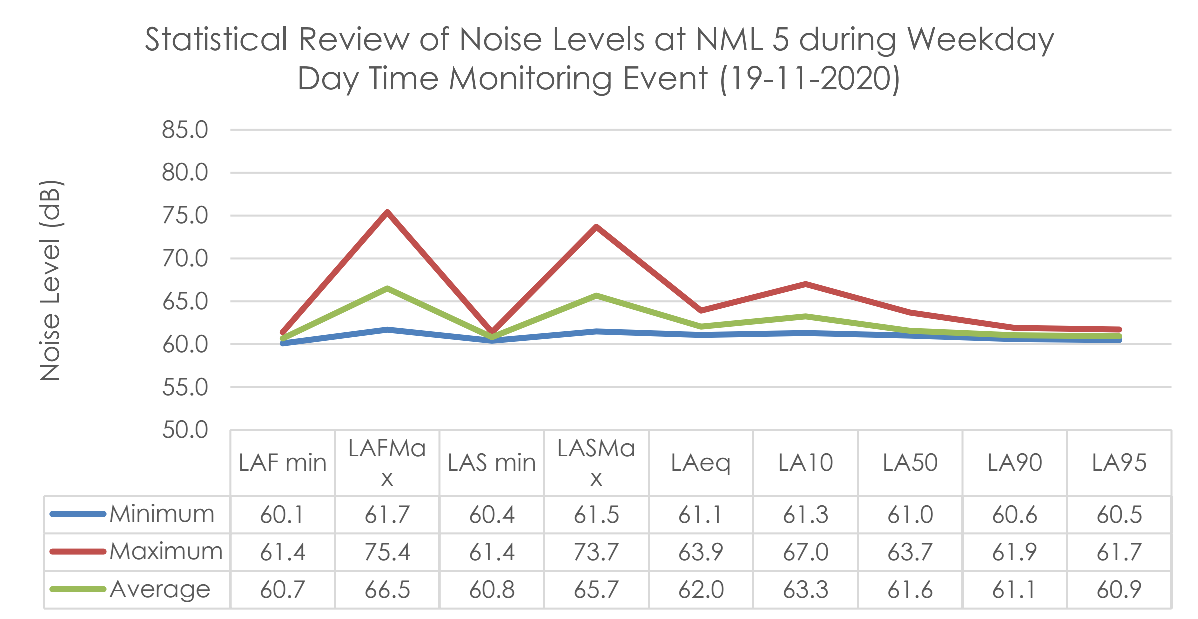
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	73.0	74.2	73.1	74.0	73.7	73.9	73.6	73.2	73.2
Maximum	73.6	81.6	73.7	81.2	75.2	78.0	74.0	73.8	73.7
Average	73.3	75.6	73.4	75.3	74.0	74.5	73.8	73.5	73.5

Figure 10-4 Statistical Review of Weekday Day Time Noise Levels at NML3



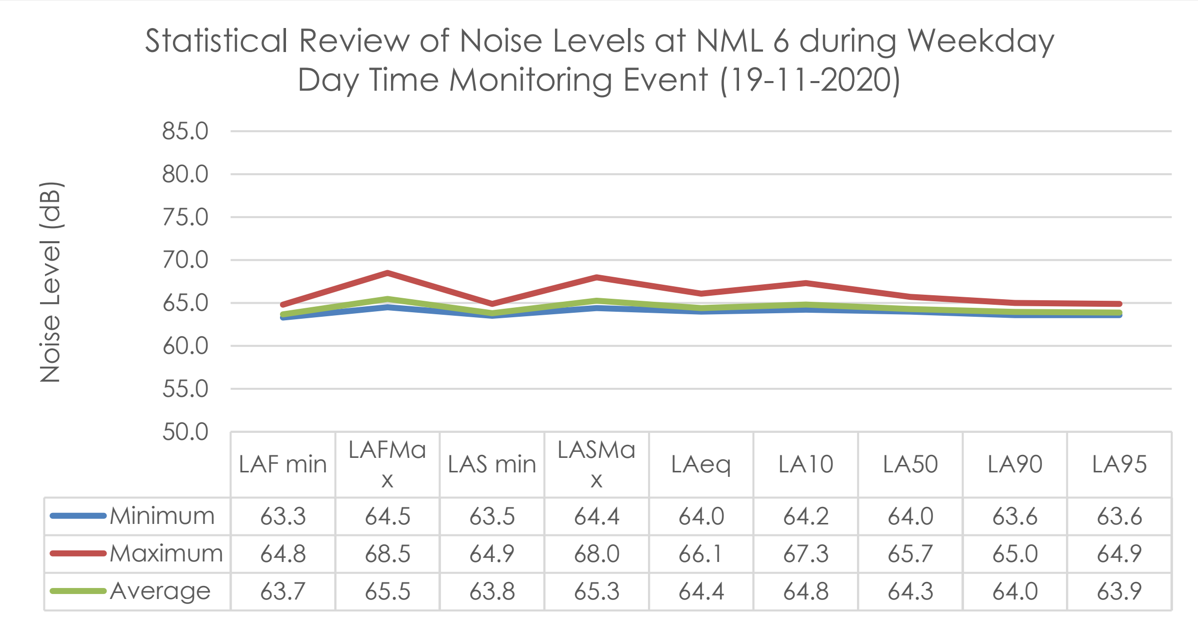
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	58.3	62.2	58.6	61.9	60.2	60.9	59.9	59.4	59.2
Maximum	61.3	75.1	61.4	74.1	64.0	65.8	62.3	61.6	61.5
Average	60.2	65.5	60.3	65.0	61.8	62.8	61.4	60.6	60.5

Figure 10-5 Statistical Review of Weekday Day Time Noise Levels at NML4



	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	60.1	61.7	60.4	61.5	61.1	61.3	61.0	60.6	60.5
Maximum	61.4	75.4	61.4	73.7	63.9	67.0	63.7	61.9	61.7
Average	60.7	66.5	60.8	65.7	62.0	63.3	61.6	61.1	60.9

Figure 10-6 Statistical Review of Weekday Day Time Noise Levels at NML5



	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	63.3	64.5	63.5	64.4	64.0	64.2	64.0	63.6	63.6
Maximum	64.8	68.5	64.9	68.0	66.1	67.3	65.7	65.0	64.9
Average	63.7	65.5	63.8	65.3	64.4	64.8	64.3	64.0	63.9

Figure 10-7 Statistical Review of Weekday Day Time Noise Levels at NML6

10.3.1.2 Weekday – Nighttime Monitoring Event

Table 10-10 Statistical Review of Noise Data during Weekday – Nighttime Monitoring Events – Mean

Monitoring Locations	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Figure
NML1	64.4	67.0	64.5	66.8	**65.3**	66.0	65.1	64.7	64.6	Figure 10-8
NML2	70.0	73.3	70.1	72.9	**70.6**	70.7	70.4	70.2	70.1	Figure 10-9
NML3	72.6	73.7	72.7	73.6	**73.2**	73.4	73.1	72.8	72.8	Figure 10-10
NML4	59.7	64.6	59.8	64.0	**61.3**	62.6	60.8	60.1	59.9	Figure 10-11
NML5	59.4	63.3	59.5	62.9	**60.6**	61.7	60.4	59.7	59.6	Figure 10-12
NML6	63.4	64.6	63.7	64.6	**64.1**	64.4	64.1	63.8	63.7	Figure 10-13

Table 10-11 Statistical Review of Noise Data during Weekday – Nighttime Monitoring Events - Maximum

Monitoring Locations	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Figure
NML1	64.9	71.0	65.1	70.5	**66.3**	69.3	65.7	65.2	65.2	Figure 10-8
NML2	70.2	78.2	70.2	77.6	**71.3**	71.4	70.6	70.3	70.3	Figure 10-9
NML3	73.0	74.1	73.1	74.0	**73.5**	73.8	73.4	73.2	73.1	Figure 10-10
NML4	61.7	75.2	61.8	74.2	**66.7**	70.9	62.1	61.8	61.8	Figure 10-11
NML5	60.2	66.5	60.3	65.9	**62.0**	64.6	61.1	60.7	60.5	Figure 10-12
NML6	64.5	67.1	64.5	66.9	**65.1**	65.5	65.0	64.6	64.5	Figure 10-13

Table 10-12 Statistical Review of Noise Data during Weekday – Nighttime Monitoring Events– Minimum

Monitoring Locations	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Figure
NML1	63.7	65.1	63.8	65.0	**64.6**	64.9	64.5	64.0	63.9	Figure 10-8

Monitoring Locations	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Figure
NML2	69.8	70.6	69.9	70.5	**70.2**	70.3	70.2	69.9	69.9	Figure 10-9
NML3	72.2	73.3	72.4	73.2	**72.8**	72.9	72.7	72.5	72.4	Figure 10-10
NML4	57.0	59.2	57.2	59.1	**58.1**	58.7	58.1	57.5	57.3	Figure 10-11
NML5	58.7	60.7	58.7	60.6	**59.6**	60.0	59.5	59.0	58.8	Figure 10-12
NML6	63.4	64.6	63.7	64.6	**64.1**	64.4	64.1	63.8	63.7	Figure 10-13

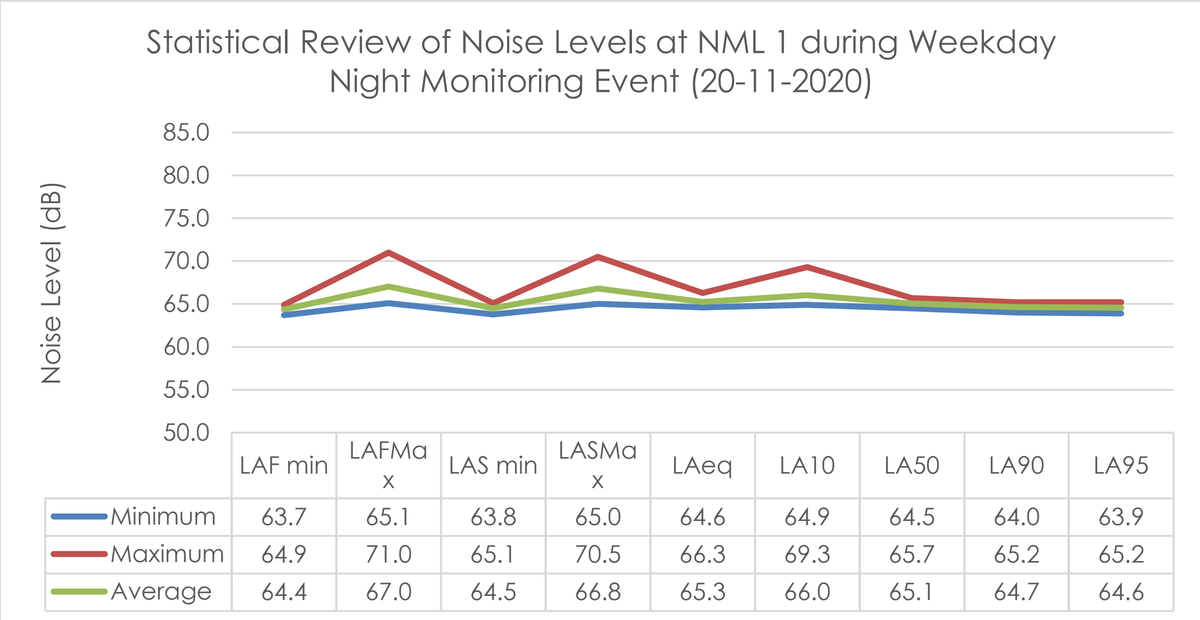
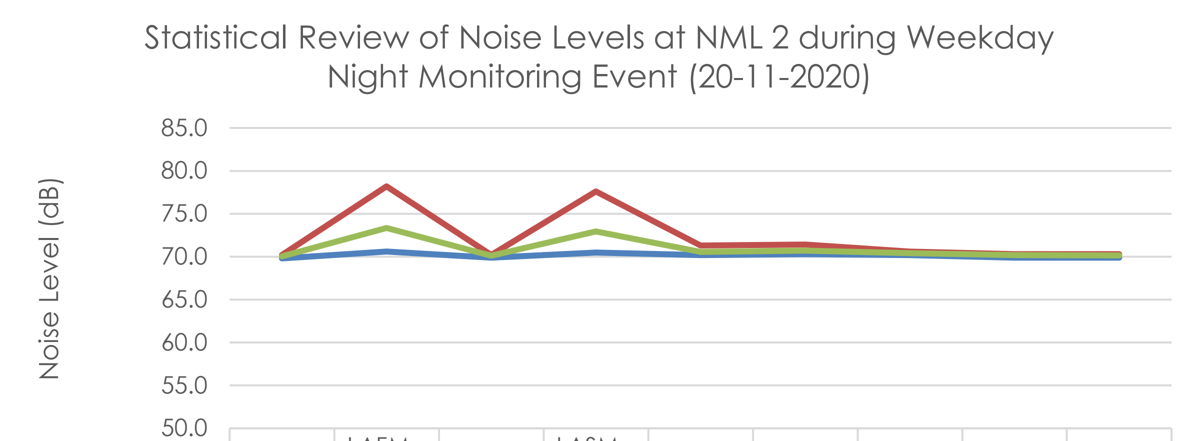
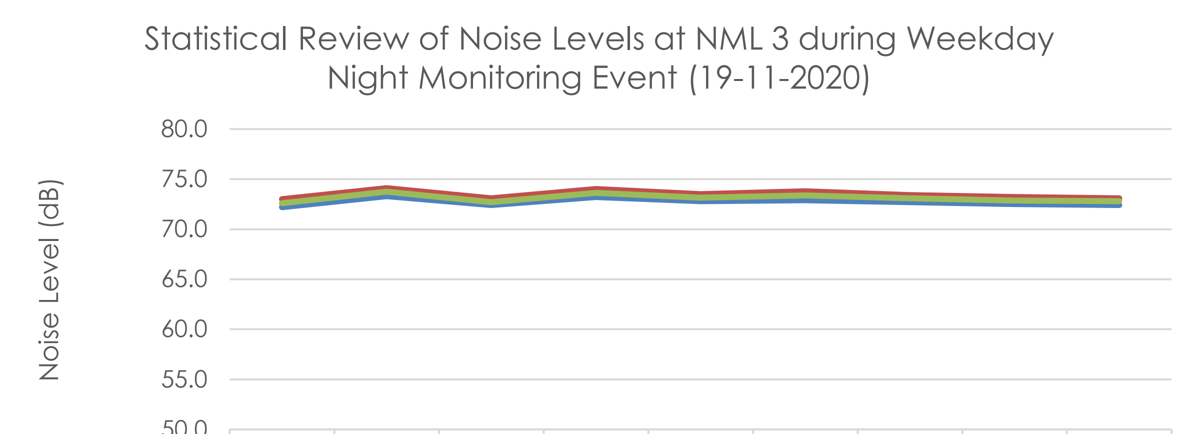


Figure 10-8 Statistical Review of Weekday Nighttime Noise Levels at NML1



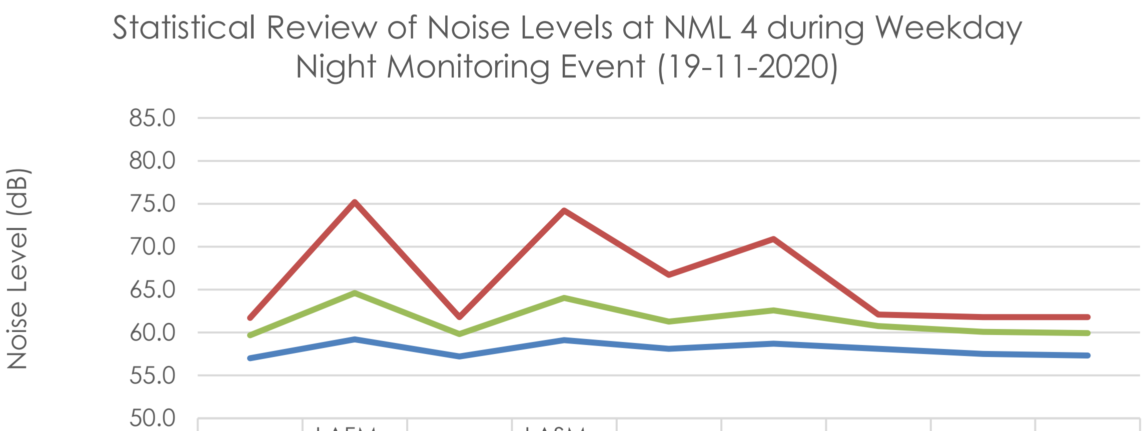
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	69.8	70.6	69.9	70.5	70.2	70.3	70.2	69.9	69.9
Maximum	70.2	78.2	70.2	77.6	71.3	71.4	70.6	70.3	70.3
Average	70.0	73.3	70.1	72.9	70.6	70.7	70.4	70.2	70.1

Figure 10-9 Statistical Review of Weekday Nighttime Noise Levels at NML2



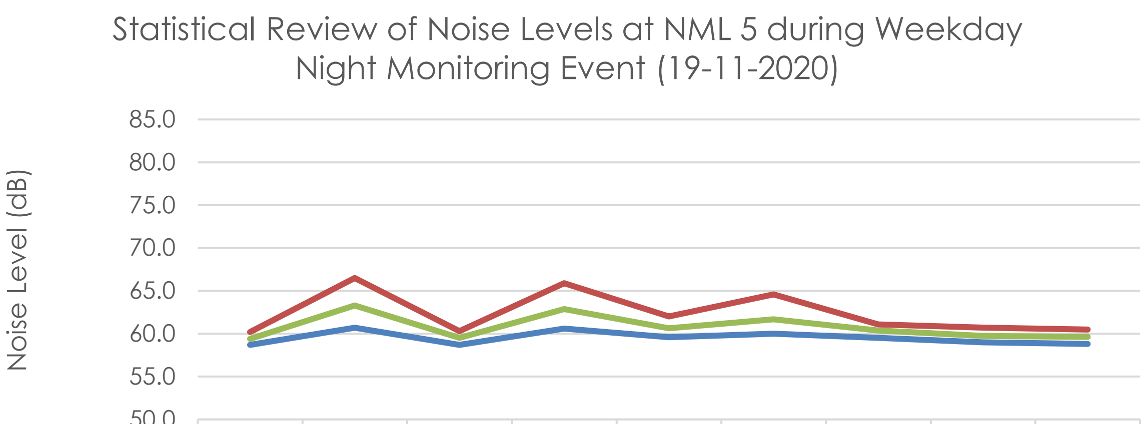
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	72.2	73.3	72.4	73.2	72.8	72.9	72.7	72.5	72.4
Maximum	73.0	74.1	73.1	74.0	73.5	73.8	73.4	73.2	73.1
Average	72.6	73.7	72.7	73.6	73.2	73.4	73.1	72.8	72.8

Figure 10-10 Statistical Review of Weekday Nighttime Noise Levels at NML3



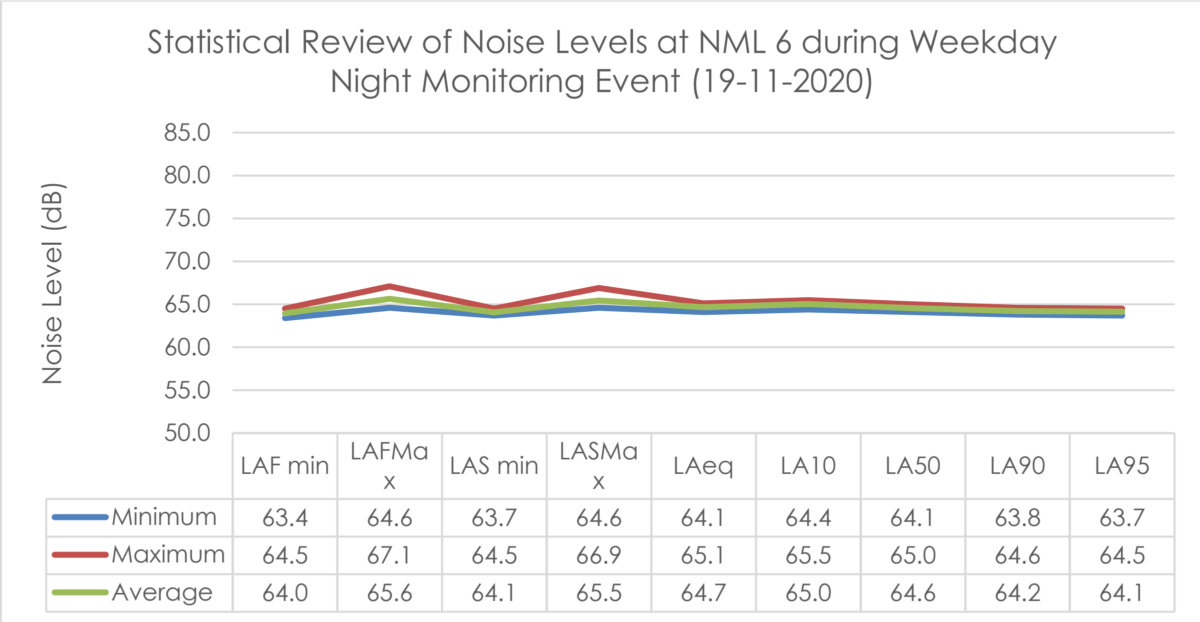
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	57.0	59.2	57.2	59.1	58.1	58.7	58.1	57.5	57.3
Maximum	61.7	75.2	61.8	74.2	66.7	70.9	62.1	61.8	61.8
Average	59.7	64.6	59.8	64.0	61.3	62.6	60.8	60.1	59.9

Figure 10-11 Statistical Review of Weekday Nighttime Noise Levels at NML4



	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	58.7	60.7	58.7	60.6	59.6	60.0	59.5	59.0	58.8
Maximum	60.2	66.5	60.3	65.9	62.0	64.6	61.1	60.7	60.5
Average	59.4	63.3	59.5	62.9	60.6	61.7	60.4	59.7	59.6

Figure 10-12 Statistical Review of Weekday Nighttime Noise Levels at NML5



	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	63.4	64.6	63.7	64.6	64.1	64.4	64.1	63.8	63.7
Maximum	64.5	67.1	64.5	66.9	65.1	65.5	65.0	64.6	64.5
Average	64.0	65.6	64.1	65.5	64.7	65.0	64.6	64.2	64.1

Figure 10-13 Statistical Review of Weekday Night Time Noise Levels at NML6

10.3.1.3 Weekend – Day Time Monitoring Event

Table 10-13 Statistical Review of Noise Data during Weekend – Day Time Monitoring Events - Mean

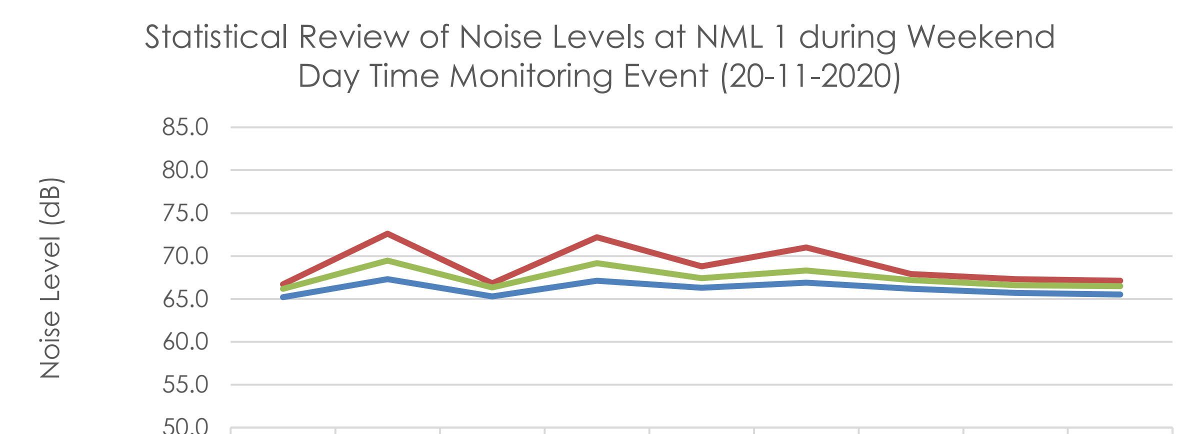
Monitoring Locations	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Figure
NML1	66.2	69.5	66.3	69.2	**67.4**	68.3	67.2	66.6	66.5	Figure 10-14
NML2	70.1	74.4	70.2	73.6	**71.0**	71.3	70.8	70.4	70.3	Figure 10-15
NML3	71.9	73.2	72.0	73.1	**72.5**	72.7	72.4	72.1	72.1	Figure 10-16
NML4	55.4	63.6	55.7	62.8	**58.4**	60.1	57.9	56.3	56.0	Figure 10-17
NML5	57.7	62.0	57.8	61.6	**58.9**	60.3	58.5	58.0	57.9	Figure 10-18
NML6	62.2	64.1	62.4	63.8	**63.1**	63.3	63.0	62.7	62.6	Figure 10-19

Table 10-14 Statistical Review of Noise Data during Weekend – Day Time Monitoring Events - Maximum

Monitoring Locations	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Figure
NML1	66.7	72.6	66.8	72.2	**68.8**	71.0	67.9	67.3	67.1	Figure 10-14
NML2	70.5	79.9	70.7	78.4	**71.7**	72.2	71.2	70.7	70.7	Figure 10-15
NML3	72.1	74.5	72.1	74.3	**72.9**	73.5	72.7	72.3	72.3	Figure 10-16
NML4	56.9	72.0	57.5	71.3	**62.5**	64.9	61.6	58.9	58.2	Figure 10-17
NML5	59.1	69.4	59.3	69.0	**61.5**	66.0	59.8	59.6	59.4	Figure 10-18
NML6	63.3	65.2	63.3	65.0	**64.0**	64.4	63.9	63.5	63.4	Figure 10-19

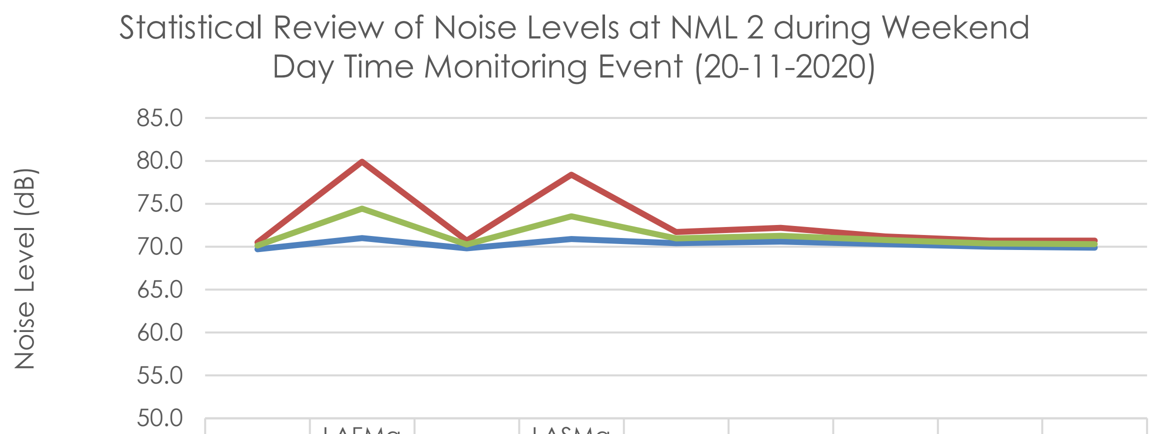
Table 10-15 Statistical Review of Noise Data during Weekend – Day Time Monitoring Events– Minimum

Monitoring Days	LAFmin	LAFmax	LASmin	LASmax	LAeq	LA10	LA50	LA90	LA95	Refer Appendix A
NML1	65.2	67.3	65.3	67.1	**66.3**	66.9	66.2	65.7	65.5	Figure 10-14
NML2	69.7	71.0	69.8	70.9	**70.4**	70.6	70.3	70.0	69.9	Figure 10-15
NML3	71.5	72.7	71.7	72.6	**72.2**	72.4	72.2	71.9	71.8	Figure 10-16
NML4	54.1	57.3	54.5	57.2	**56.1**	56.7	55.6	54.9	54.8	Figure 10-17
NML5	56.9	58.8	57.0	58.6	**57.8**	58.3	57.7	57.4	57.3	Figure 10-18
NML6	62.7	64.6	62.8	64.4	**63.5**	63.9	63.4	63.1	63.0	Figure 10-19



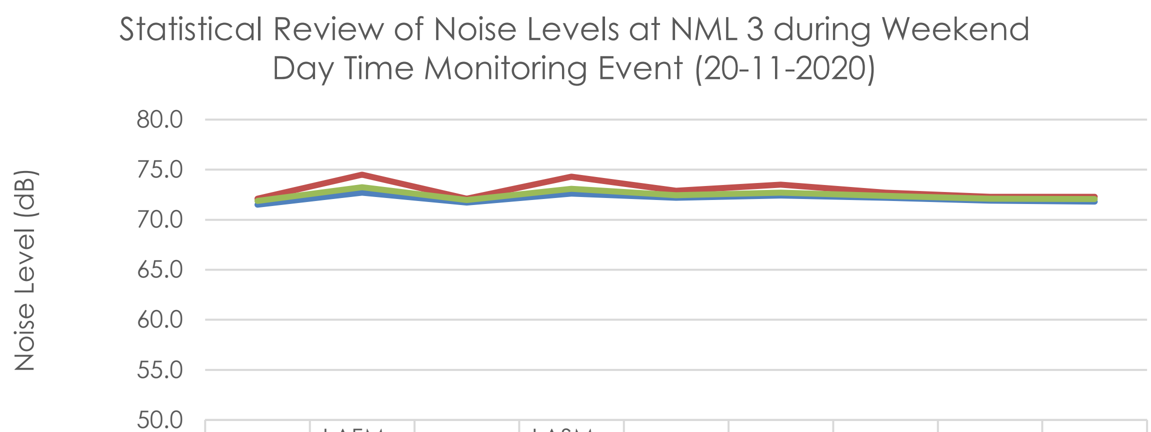
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	65.2	67.3	65.3	67.1	66.3	66.9	66.2	65.7	65.5
Maximum	66.7	72.6	66.8	72.2	68.8	71.0	67.9	67.3	67.1
Average	66.2	69.5	66.3	69.2	67.4	68.3	67.2	66.6	66.5

Figure 10-14 Statistical Review of Weekend Day Time Noise Levels at NML1



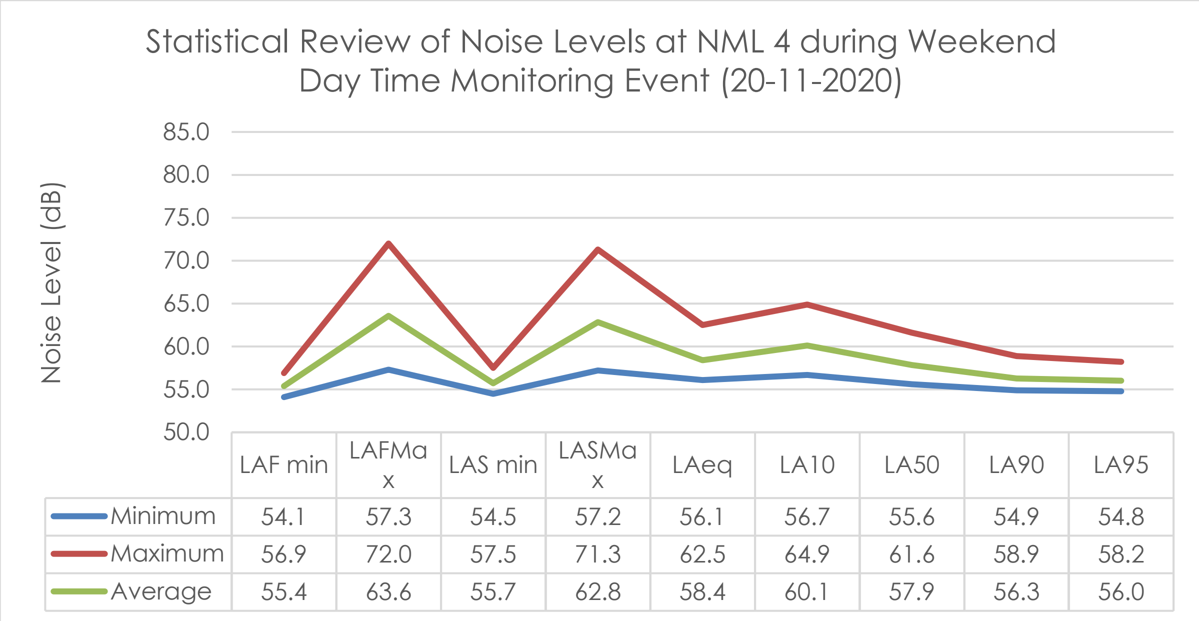
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	69.7	71.0	69.8	70.9	70.4	70.6	70.3	70.0	69.9
Maximum	70.5	79.9	70.7	78.4	71.7	72.2	71.2	70.7	70.7
Average	70.1	74.4	70.2	73.6	71.0	71.3	70.8	70.4	70.3

Figure 10-15 Statistical Review of Weekend Day Time Noise Levels at NML2



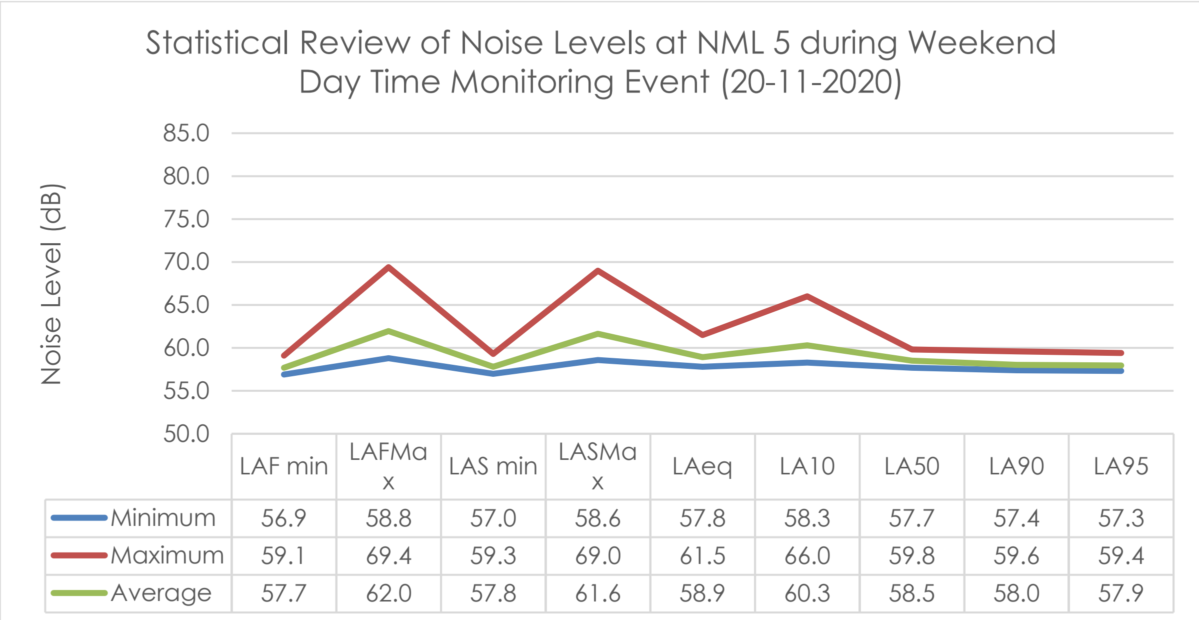
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	71.5	72.7	71.7	72.6	72.2	72.4	72.2	71.9	71.8
Maximum	72.1	74.5	72.1	74.3	72.9	73.5	72.7	72.3	72.3
Average	71.9	73.2	72.0	73.1	72.5	72.7	72.4	72.1	72.1

Figure 10-16 Statistical Review of Weekend Day Time Noise Levels at NML3



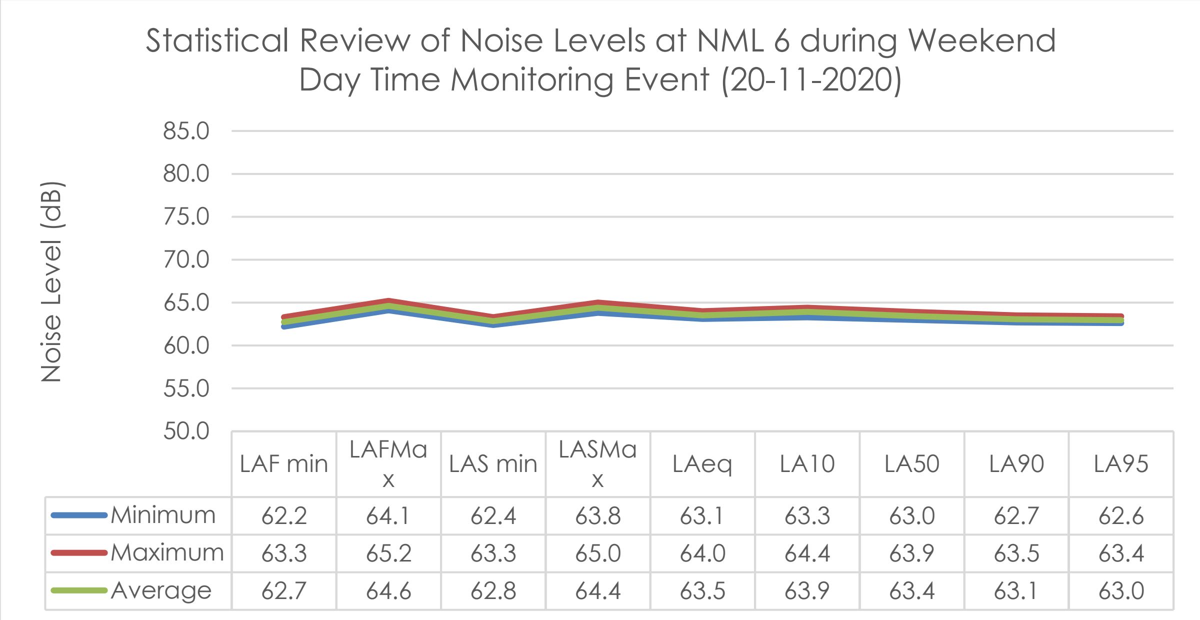
	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	54.1	57.3	54.5	57.2	56.1	56.7	55.6	54.9	54.8
Maximum	56.9	72.0	57.5	71.3	62.5	64.9	61.6	58.9	58.2
Average	55.4	63.6	55.7	62.8	58.4	60.1	57.9	56.3	56.0

Figure 10-17 Statistical Review of Weekend Day Time Noise Levels at NML4



	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	56.9	58.8	57.0	58.6	57.8	58.3	57.7	57.4	57.3
Maximum	59.1	69.4	59.3	69.0	61.5	66.0	59.8	59.6	59.4
Average	57.7	62.0	57.8	61.6	58.9	60.3	58.5	58.0	57.9

Figure 10-18 Statistical Review of Weekend Day Time Noise Levels at NML5



	LAF min	LAFMax	LAS min	LASMax	LAeq	LA10	LA50	LA90	LA95
Minimum	62.2	64.1	62.4	63.8	63.1	63.3	63.0	62.7	62.6
Maximum	63.3	65.2	63.3	65.0	64.0	64.4	63.9	63.5	63.4
Average	62.7	64.6	62.8	64.4	63.5	63.9	63.4	63.1	63.0

Figure 10-19 Statistical Review of Weekend Day Time Noise Levels at NML6

10.3.1.4 Discussion of Results

Baseline monitoring was carried out on 19th and 20th November 2020. The noise monitoring data along all six (6) monitoring locations are presented in Table 10-7 to Table 10-15. Noise measurement results can be summarized as:

4. Weekday - Day Time Monitoring - The mean LAeq noise levels ranged from 61.8 dB (A) at NML 4 to 74.0 dB (A) at NML 3. LAeq noise levels at other monitoring stations falls within this range.
5. Weekday - Night Time Monitoring - The mean LAeq noise levels ranged from 60.6 dB (A) at NML 5 to 73.2 dB (A) at NML 3. LAeq noise levels at other monitoring stations falls within this range.
6. Weekend – Day Time Monitoring - The mean LAeq noise levels ranged from 58.4 dB (A) at NML 4 to 72.5 dB (A) at NML 3. LAeq noise levels at other monitoring stations falls within this range.

From the monitoring results it is evident that the mean LAeq noise levels are:

- Within the SCE and IFC guideline value of 70 dB(A) at:
  - NML 2, NML 4, NML 5 and NML 6 during weekday day time monitoring events,
  - NML 4, NML 5 and NML 6 during weekday night time monitoring events, and
  - NML 4, NML 5 and NML 6 during weekend day time monitoring events.
- Exceeding the SCE and IFC guideline value of 70 dB(A) at:

  - NML 3 during weekday day time monitoring events,
  - NML 2 and NML 3 during weekday night time monitoring events, and
  - NML 2 and NML 3 during weekend day time monitoring events.
- NML 1 was located next to accommodation and recreational area. The noise levels at NML 1 are exceeding IFC and SCE guideline values for residential areas during weekday day, night, and weekend day monitoring events. However, it is important to note that the accommodation and recreational area is located in a designated Special Nature Projects Area.

The noise monitoring location NML 2 was located at north-east boundary of existing PS 5 next to gas metering station and NML 3 was located at proposed block 4 site close to the southern boundary of existing PS 5 Block 3. Operational noise from Power Station was a major contributor in the noise level exceedances.

The mean LAeq in decreasing order at all noise monitoring locations during the baseline monitoring events are given below:

Weekday – Day Time Monitoring: NML 3 > NML 2 > NML 1 > NML 6 > NML 5 > NML 4

Weekday – Night Time Monitoring: NML 3 > NML 2 > NML 1 > NML 6 > NML 5 > NML 4

Weekend – Day Time Monitoring: NML 3 > NML 2 > NML 1 > NML 6 > NML 5 > NML 4

The noise level data from all the monitoring locations are compiled and graphical representation of the observed data are provided in Annexure A to Annexure C.

Noise level data obtained from the Weekday – Day time baseline noise levels were compared against the Weekday – Night time as well as Weekend – Day time noise levels. A comparison is provided in Table 10-16 and Table 10-17. Statistical review charts are provided in Figure 10-20 and Figure 10-21.

- In comparison to the Weekday – Day time monitoring events, the noise levels recorded during weekday night time monitoring event:
  - Decreased by 0.4 dB(A) at NML 1, 0.8 dB(A) at NML 3, 0.5 dB(A) at NML 4, and 1.4 dB (A) at NML 5.
  - Increased by 1.0 dB(A) at NML 2 and 0.3 dB(A) at NML 6.
- In comparison to the Weekday – Day time monitoring events, the noise levels recorded during weekend day time monitoring event:
  - Decreased by 1.5 dB(A) at NML 3, 3.4 dB(A) at NML 4, 3.1 dB(A) at NML 5, and 0.9 dB(A) at NML 6.
  - Increased by 1.7 dB (A) at NML 1, and 1.4 dB(A) at NML 2.

Table 10-16 Comparison of Weekday - Night Time Noise Levels with Day Time Noise Levels

Locations	LAeq dB(A)			LAF_{Max} dB(A)			LA_{10} dB(A)			LA_{90} dB(A)		
	Day Time	Night Time	Increase/ Decrease	Day Time	Night Time	Increase/ Decrease	Day Time	Night Time	Increase/ Decrease	Day Time	Night Time	Increase/ Decrease
NML1	65.7	65.3	-0.4	68.6	67.0	-1.6	67.1	66.0	-1.1	64.3	64.7	0.4
NML2	69.6	70.6	1.0	71.8	73.3	1.5	70.6	70.7	0.1	69.0	70.2	1.2
NML3	74.0	73.2	-0.8	75.6	73.7	-1.9	74.5	73.4	-1.1	73.5	72.8	-0.7
NML4	61.8	61.3	-0.5	65.5	64.6	-0.9	62.8	62.6	-0.2	60.6	60.1	-0.5
NML5	62.0	60.6	-1.4	66.5	63.3	-3.2	63.3	61.7	-1.6	61.1	59.7	-1.4
NML6	64.4	64.7	0.3	65.5	64.6	-0.9	64.8	64.4	-0.4	64.0	63.8	-0.2

Table 10-17 Comparison of Weekend - Day Time Noise Levels with Weekday - Day Time Noise Levels

Locations	LAeq dB(A)			LAF_{Max} dB(A)			LA_{10} dB(A)			LA_{90} dB(A)		
	Weekday	Weekend	Increase/ Decrease	Weekday	Weekend	Increase/ Decrease	Weekday	Weekend	Increase/ Decrease	Weekday	Weekend	Increase/ Decrease
NML1	65.7	67.4	1.7	68.6	69.5	0.9	67.1	68.3	1.2	64.3	66.6	2.3
NML2	69.6	71.0	1.4	71.8	74.4	2.6	70.6	71.3	0.7	69.0	70.4	1.4
NML3	74.0	72.5	-1.5	75.6	73.2	-2.4	74.5	72.7	-1.8	73.5	72.1	-1.4
NML4	61.8	58.4	-3.4	65.5	63.6	-1.9	62.8	60.1	-2.7	60.6	56.3	-4.3
NML5	62.0	58.9	-3.1	66.5	62.0	-4.5	63.3	60.3	-3.0	61.1	58.0	-3.1
NML6	64.4	63.5	-0.9	65.5	64.1	-1.4	64.8	63.3	-1.5	64.0	62.7	-1.3

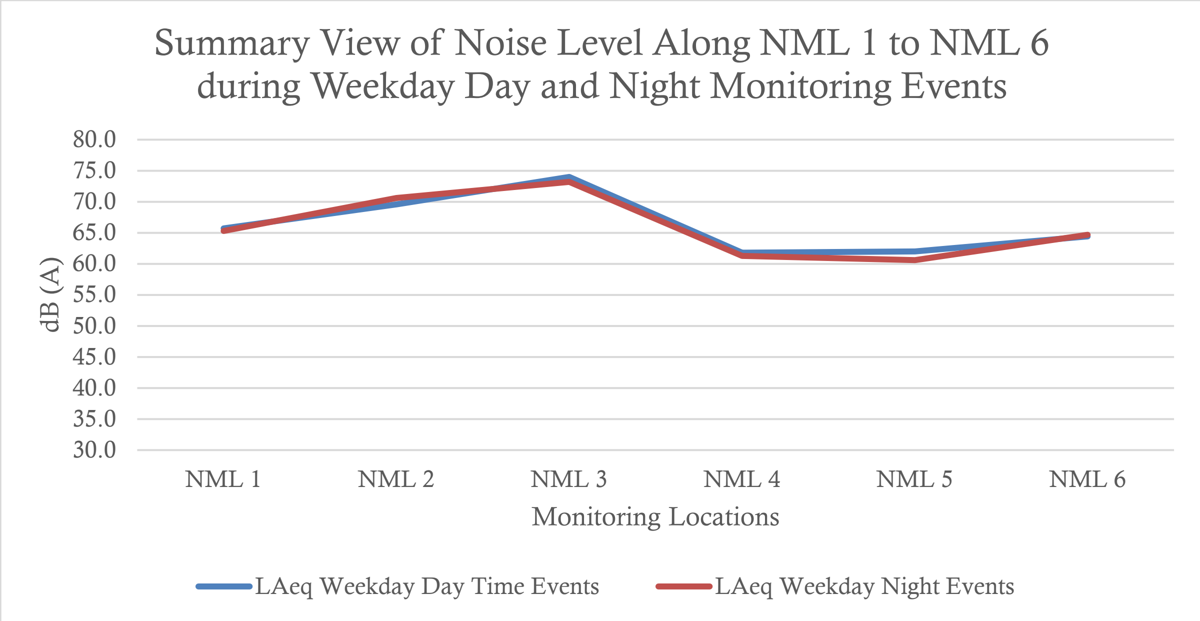


Figure 10-20 Comparative Chart of LAeq Levels – Weekday Day and Night Baseline Noise Levels

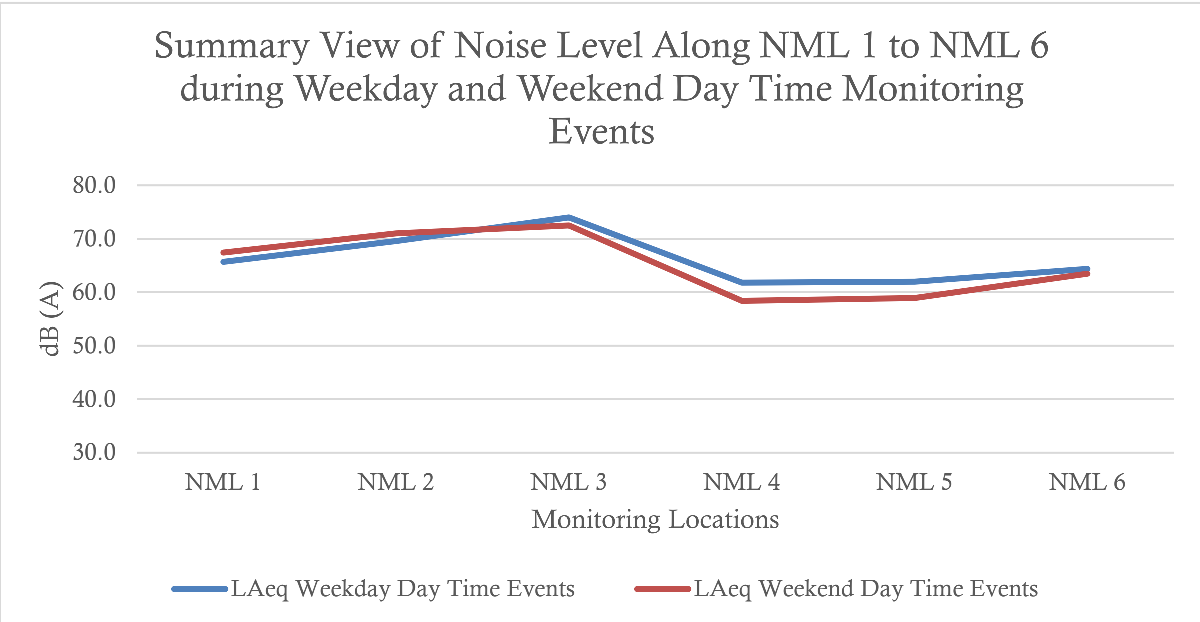


Figure 10-21 Comparative Chart of LAeq Levels – Weekday and Weekend Day Time Baseline Noise Levels

10.4 Impact Assessment

10.4.1 Construction Phase

10.4.1.1 Construction Noise

The major noise sources during construction phase will include a range of construction activities, earth moving and construction equipment. As observed during the baseline monitoring noise from existing industrial activities and road traffic are a major source of noise at the Project site. Vehicles accessing the site during delivery of materials and collection of waste, as well as transportation of workers and employees will also generate noise.

The increase in noise levels is expected to adversely affect the nearest sensitive receptors if appropriate noise management and abatement measures are not implemented. The nearest residential receptor is the workers accommodation and recreational area located approximately 650 meters North of the Project site as well as workers and occupants at the commercial and industrial facilities neighboring the Project site.

Noise impacts associated with Block 4 construction works were estimated using the following equation for noise propagation of semispherical waves from a point source:

$$L_p = L_w - 20 \times \log(r) - 8\ dB$$

Where,

Lp – Sound pressure level at receptor;

Lw – Sound power level at source;

r – Distance between source and receptor.

Typical noise levels generated by construction equipment and machinery expected to be used at site were obtained [9]. Noise propagation calculations consider sound intensity losses due to semispherical spreading, with additional minor losses such as atmospheric absorption, directivity and ground absorption ignored in the calculations.

Noise produced by anticipated activities during construction phase of the Project are shown in Table 10-18 for various distances, with no noise barriers or abatement measures in place and with each equipment / machinery is operating in full power. The sound pressure levels shown are maximum levels produced when machinery is operated under full load.

Table 10-18 Predicted Construction Noise Levels at Various Distances (dBA)

Equipment Used	LAeq (dBA)	Predicted Noise Levels at Various Distances (m)						
		100	200	300	400	500	650	1000
Excavator 30T	109	61.0	55.0	51.5	49.0	47.0	44.7	41.0
Backhoe	104	56.0	50.0	46.5	44.0	42.0	39.7	36.0
Bulldozer	108	60.0	54.0	50.5	48.0	46.0	43.7	40.0
Compactor	113	65.0	59.0	55.5	53.0	51.0	48.7	45.0
Mobile Crane	105	57.0	51.0	47.5	45.0	43.0	40.7	37.0
Vibratory Roller	106	58.0	52.0	48.5	46.0	44.0	41.7	38.0
Grader	106	58.0	52.0	48.5	46.0	44.0	41.7	38.0
Compressor	106	58.0	52.0	48.5	46.0	44.0	41.7	38.0
Asphalt Paver	104	56.0	50.0	46.5	44.0	42.0	39.7	36.0
Crane (up to 70T)	109	61.0	55.0	51.5	49.0	47.0	44.7	41.0
Jack Hammers	121	73.0	67.0	63.5	61.0	59.0	56.7	53.0
Rock Breaker	118	70.0	64.0	60.5	58.0	56.0	53.7	50.0
Loader	104	56.0	50.0	46.5	44.0	42.0	39.7	36.0
Generator	104	56.0	50.0	46.5	44.0	42.0	39.7	36.0
Grader	110	62.0	56.0	52.5	50.0	48.0	45.7	42.0

Equipment Used	LAeq (dBA)	Predicted Noise Levels at Various Distances (m)						
		100	200	300	400	500	650	1000
Truck >20 Tons	107	59.0	53.0	49.5	47.0	45.0	42.7	39.0
Concrete Truck	109	61.0	55.0	51.5	49.0	47.0	44.7	41.0
Concrete Pump Truck	108	60.0	54.0	50.5	48.0	46.0	43.7	40.0
Hand Tools (Electric)	102	54.0	48.0	44.5	42.0	40.0	37.7	34.0
Hand Tools (Pneumatic)	116	68.0	62.0	58.5	56.0	54.0	51.7	48.0
Vehicle Commercial	106	58.0	52.0	48.5	46.0	44.0	41.7	38.0
Welding	105	57.0	51.0	47.5	45.0	43.0	40.7	37.0
Average Noise Level (dBA)	**114.5**	**66.5**	**60.4**	**56.9**	**54.4**	**52.5**	**50.2**	**46.5**

The nearest sensitive receptor to the Block 4 Expansion Project is the accommodation and recreational area located 650 meters north from the site. From Table 10-18, it is evident that the noise levels are not exceeding the IFC guideline values during day time, except when jack hammers are used during construction.

Predicted noise levels are exceeding IFC guideline values while a number of equipments are operational. General construction activities shall be limited to day time working hours, where feasible and reasonable.

10.4.1.2 Construction Vibration

The nearest receiver to the Block 4 Expansion is approximately 650 meters away. Therefore, vibration impacts during construction are not anticipated to occur.

10.4.2 Operation Phase

The noise generated by a Power Station is perceived as a constant "hum" due to the cyclic nature of the machinery used. Operational noise modeling was undertaken using SoundPLAN 8.2 to predict noise impacts during operational phase.

SoundPLAN is a software package that enables the prediction of sophisticated scenarios and displaying said scenarios into digitized ground maps containing contours. SoundPLAN can generate noise emission levels considering meteorological effects, shielding attenuation, ground absorption, distance attenuation and source power levels.

Noise predictions for this assessment was carried out using ISO 9613 – 2, Attenuation of Sound during Propagation Outdoors – Part 2: General Method of Calculation. The plant drawing was digitized using the input data and with the aid of satellite imaging.

10.4.2.1 Operation Assumptions

Regular operation of PS 5 with all four (4) Blocks were considered in the modeling. The plant will be operating 24 hours; therefore, the noise guideline values for nighttime operations were considered in the modeling exercise.

10.4.2.2 Sensitive Receptors

Five receptors were considered around the PS 5, as presented in Table 10-19.

Table 10-19 List of Sensitive Receptors

Receptor Name	Type	Guideline Value (dBA)
Receptor – 1: Accommodation and Recreational Area	Residential / Recreational	45
Receptor 2 – PS 5 Boundary Outside Fence	Industrial	70

Receptor Name	Type	Guideline Value (dBA)
Receptor 3 – West Point Home	Industrial	70
Receptor – 4: Al Salam Workshop	Industrial	70
Receptor – 5: Tylos Plastics	Industrial	70

10.4.2.3 Model Input Data

10.4.2.3.1 Baseline

A baseline noise monitoring was conducted on 19th and 20th November 2020 at six (6) locations (refer Table 10-5).

Out of the six (6) locations, NML 3, NML 4 and NML 5 were not considered in the modeling as these located away from the PS 5 boundary and cannot be considered as a receptor.

The baseline noise measurement results at the considered locations are presented in Table 10-20.

Table 10-20 Baseline Environmental Monitoring Results

Location	LAeq (dBA)	LA90 (dBA)
NML 1 – Accommodation and Recreational Area	65.3	64.7
NML 2 – PS 5 North Boundary: Outside Fence	70.6	70.2
NML 6 – PS 5 West Boundary: Outside Fence	64.7	64.2

10.4.2.3.2 Near Field Noise Data

A near field noise measurement was carried out to obtain noise levels during operation of PS 5. Noise measurements were conducted at 1 – meter distance from each equipment source and used a model input (refer table below).

Table 10-21 Near Field Noise Measurement Results

Sl.No.	Monitoring Location	GPS Coordinates		LAeq (dBA)
		Latitude	Longitude	
1	Unit 3 Air Cooled Condenser (ACC) Fan	26°05'23.97"N	50°35'38.16"E	84.5
2	Unit 2 ACC Fan	26°05'26.88"N	50°35'37.35"E	73.2
3	Unit 1 ACC Fan	26°05'29.75"N	50°35'36.58"E	84.1
4	Gas Metering Station	26°05'33.08"N	50°35'34.85"E	85.1

Sl.No.	Monitoring Location	GPS Coordinates		LAeq (dBA)
		Latitude	Longitude	
5	Gas Metering Station	26°05'32.53"N	50°35'36.85"E	84.7
6	Fuel Compressing Station	26°05'34.14"N	50°35'37.43"E	96.4
7	Cooling Water (CCW) -2	26°05'33.85"N	50°35'39.66"E	85.6
8	CCW – 1	26°05'35.61"N	50°35'42.29"E	91.8
9	Block 1 Generator step-up Transformer (GSUT)	26°05'32.67"N	50°35'43.48"E	73.6
10	Gas Turbine (GT) 71	26°05'31.12"N	50°35'41.70"E	87.3
11	Steam Turbine (ST) 72	26°05'30.43"N	50°35'41.35"E	87.7
12	ST 72 – Bus Duct	26°05'30.10"N	50°35'42.58"E	85.6
13	Feed water Pump – Block 1	26°05'30.44"N	50°35'39.56"E	79.4
14	Heat Recovery Steam Generator (HRSG) Bypass Stack - Block 1	26°05'31.62"N	50°35'40.54"E	88.8
15	ST 82	26°05'24.80"N	50°35'42.64"E	89.8
16	Feed water Pump – Block 3	26°05'24.77"N	50°35'40.92"E	86.6
17	ST 82 Turbine Hall	26°05'24.42"N	50°35'44.02"E	86.1
18	HRSG Bypass Stack - Block 3	26°05'25.97"N	50°35'41.90"E	88.8
19	GT 81	26°05'25.40"N	50°35'43.06"E	88.3
20	Block 3 GSUT	26°05'27.10"N	50°35'45.02"E	74.0
21	ST 73 Turbine Hall	26°05'27.23"N	50°35'43.27"E	85.8
22	ST 74	26°05'27.61"N	50°35'42.04"E	88.2
23	Feed water Pump – Block 2	26°05'27.60"N	50°35'40.20"E	84.6
24	HRSG Bypass Stack - Block 2	26°05'28.75"N	50°35'41.21"E	88.8
25	GT 73	26°05'28.28"N	50°35'42.40"E	87.8
26	Block 2 GSUT	26°05'29.85"N	50°35'44.27"E	73.7

10.4.2.4 Noise Modeling Scenarios

Two (2) scenarios were considered for the noise modeling and contour maps were generated for each scenario. The table below describes list of each scenario and its purpose.

Table 10-22 List of Noise Modeling Scenarios

Scenarios	Description	
NM – 1	Baseline Conditions	Presents current situation – PS 5 Operating with three (3) blocks
NM – 2	Future Conditions	Presents future situation with cumulative impact of all four (4) PS 5 Blocks

10.4.2.5 Noise Modeling Results

10.4.2.5.1 Scenario 1 – Baseline Conditions

Noise levels from PS 5 Blocks 1, 2 & 3, and ancillary facilities were modeled. The modeling outcomes are presented in Table 10-23 and contour map is provided in **Error! Reference source not found.**.

Table 10-23 Modeling Results of Scenario 1

Location	LAeq (dBA)	Guideline Value (dBA)
NML 2 – PS5 Boundary Line	67.6	70
NML 6 – Block 4 Boundary	52.6	70
Receptor – 1 Accommodation and Recreational Area	48.9	45
Receptor 2 – PS 5 Boundary Outside Fence	48.2	70
Receptor 3 – West Point Home	51.3	70
Receptor 4 – Al Salam Workshop	45.5	70
Receptor 5 – Tylos Plastics	42.9	70

It is important to verify the model and the verification was done by comparing the baseline noise measurements. Since background noise from other sources are a contributing factor in noise levels at NML 3 and NML 6, NML 2 data was used to ensure model validity.

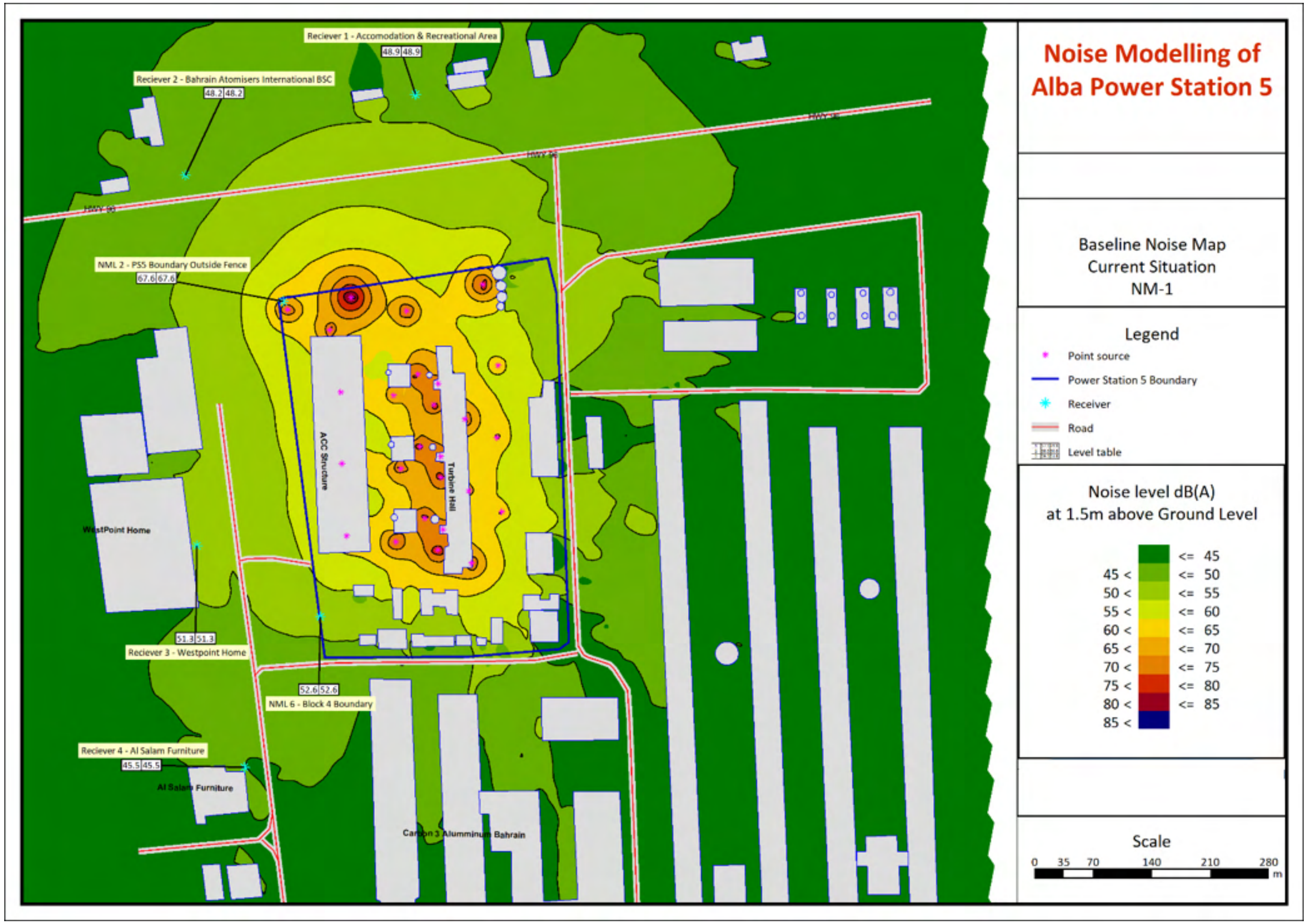


Figure 10-22 Scenario 1 – Baseline Conditions Contour Map

When comparing the modeled results of NML 2 and measured results, the difference is 3 dBA which is acceptable due to the following variables:

- Uncertainty of the model,
- Uncertainty of measurement instrument, and
- Background noise level raising the noise level.

From the baseline conditions modeling, it is evident that the LAeq levels at all receptor locations are within the guideline values except Receptor 1 – Accommodation and Recreational Area. The predicted LAeq levels at receptor 1 is 48.9 dBA which exceeds the guideline value by 3.9 dBA. It should be noted that the baseline noise levels at the receptor 1 location exceeds the guideline values of 45 dBA during weekday day, night and weekend day monitoring events and the traffic on adjacent Highway 96, Road 4815, and industrial facilities other than Alba in the vicinity are a contributing factor to the noise levels.

10.4.2.5.2 Scenario 2 – Future Conditions

This scenario includes PS 5 Block 1, 2, 3 and 4, and ancillary equipment. Table 10-23 presents the modeling results of Scenario 2. Noise contour map is presented in Figure 10-23.

Table 10-24 Modeling Results of Scenario 2

Location	LAeq (dBA)	Guideline Value (dBA)
NML 2 – PS5 Boundary Line	67.6	70
NML 6 – Block 4 Boundary	58.4	70
Receptor – 1 Accommodation and Recreational Area	49.1	45
Receptor 2 – PS 5 Boundary Outside Fence	48.4	70
Receptor 3 – West Point Home	52.6	70
Receptor 4 – Al Salam Workshop	48.0	70
Receptor 5 – Tylos Plastics	44.3	70

From the modeling results of Scenario 2, it can be concluded that the LAeq noise levels at all locations except receptor 1 – accommodation and recreational area are within the guideline values. In comparison to the predicted LAeq levels of Scenario 1, the noise level at receptor – 1 increased by 0.2 dBA. However, it should be noted that the Block 4 will be constructed on the Southern end of PS 5 which is away from receptor – 1. Hence, the impact of Block 4 operations will be less significant.

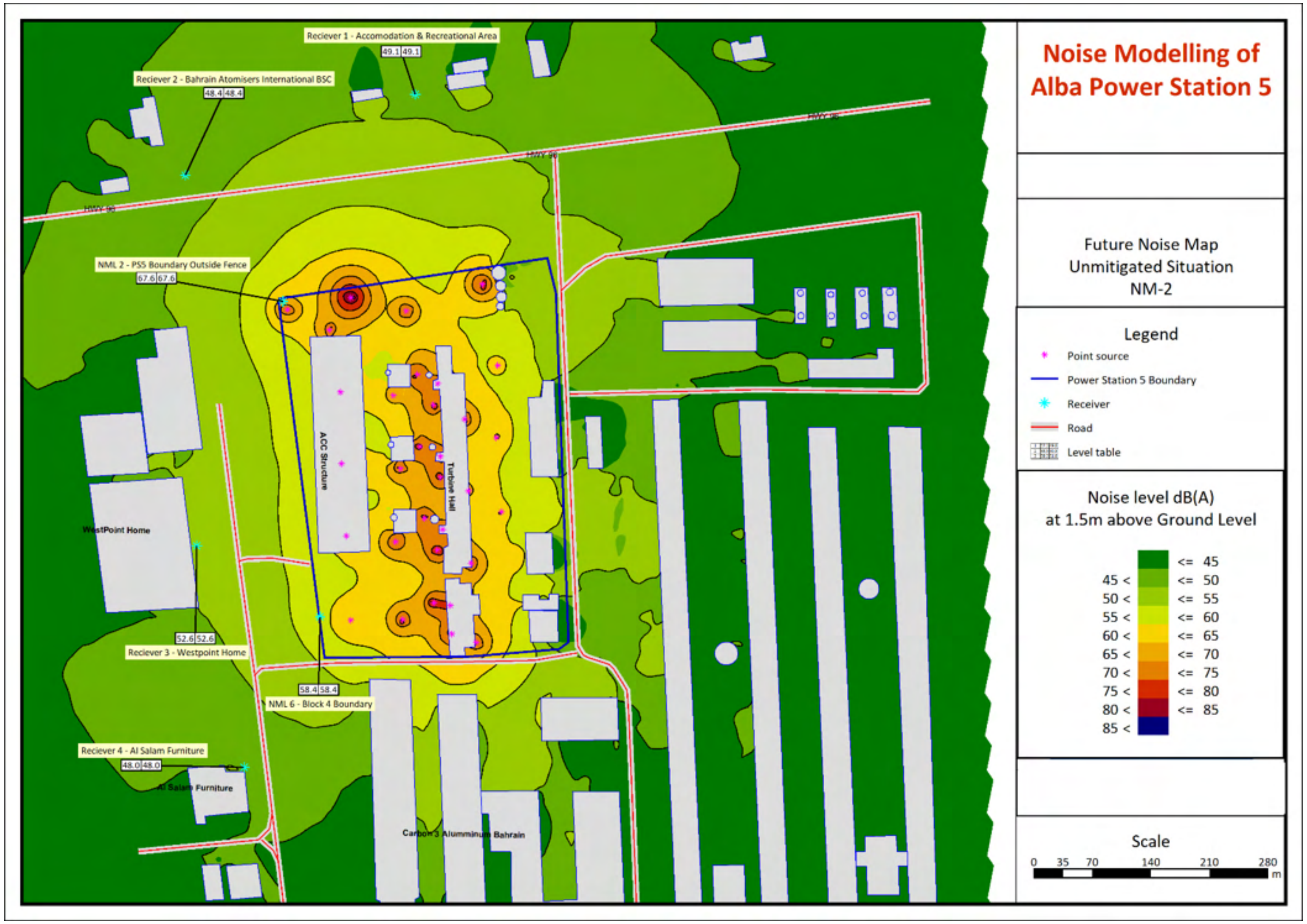


Figure 10-23 Scenario 2 – Future Conditions Contour Map

10.4.2.5.3 Conclusions

The predicted LAeq noise levels at all locations except Receptor – 1 Accommodation and Recreational Area located towards north of the PS 5 are within the guideline values.

The predicted LAeq levels of Scenario 1 modeling at receptor 1 is 48.9 dBA which exceeds the guideline value by 3.9 dBA and that of Scenario 2 modeling at receptor 1 is 49.1 dBA which exceeds the guideline value by 4.1 dBA. It should be noted that the baseline noise levels at the receptor 1 location exceeds the guideline values during weekday day, night, and weekend day monitoring events. Existing traffic flow on adjacent Highway 96, Road 4815, and industrial facilities other than Alba in the vicinity are a contributing factor to the elevated noise levels.

An assessment was conducted to identify major noise contributing sources to Receptor 1 at PS 5. The below table presents the contribution of the seven most significant noise sources:

Table 10-25 Noise Source Contribution List – Receptor 1

Source	Source Group	LAeq (dBA)
Fuel Compressing Station	Common Facilities	41.1
Heat Recovery System Generator	Block 1	35.9
CCW – 1	Common Facilities	35.2
Gas Turbine – GT 71	Block 1	34.1
HRSG Bypass Stack	Block 2	33.8
CCW – 2 Pumps	Common Facilities	33.5
Gas Turbine - GT 72	Block 2	32.5

10.4.3 Summary of Impacts

The summary of impacts associated with noise and vibration impacts during the construction and operation phases of the Project are summarized in the table below:

Table 10-26 Summary of Noise Impacts during Construction and Operational Phases

Potential Impact	Aspect Impacted	Magnitude of Impacts	Duration of Impacts	Extent of Impacts
Construction Phase				
Construction noise	Workers and occupants on site and surrounding facilities	Minor Adverse	Short Term	Local

Potential Impact	Aspect Impacted	Magnitude of Impacts	Duration of Impacts	Extent of Impacts
Construction vibration	Workers and occupants on site and surrounding facilities	No Impact	-	-
Operation Phase				
Operational Noise	PS 5 Staff and surrounding facilities	Minor adverse	Long Term	Local
Operational vibration	PS 5 Staff and surrounding facilities	No Impact	-	-

10.5 Mitigation Measures

10.5.1 Construction Phase

The following noise and vibration mitigation measures are proposed to reduce potential noise impacts during construction phase of the Project:

- Use modern, silenced, and well-maintained equipment and machinery.
- Equipment and machinery should be switched off when not in use.
- Equipment such as generators, etc., should be fitted with appropriate silencers and acoustic enclosures (where practical) and be in good working order. Machines found to produce excessive noise compared to normal industry expectations should be removed from the site or stood down until repairs or modifications can be made.
- To reduce the annoyance associated with reversing alarms, broadband alarms (audible movement alarms) should be used for all site equipment and reversing kept to a minimum through improved route choice/layout/dimensions, and operational procedures.
- General construction activities should be limited to daytime (7am to 8pm) working hours, where feasible and reasonable.
- Where practical, machines should be switched off when not being used rather than left idling for prolonged periods.
- All mechanical plant and equipment should be checked regularly to avoid any unnecessary noise caused by lack of maintenance.
- Truck drivers should be kept informed of designated vehicle routes, parking locations, operating hours, and on-site speed limit.
- All engine covers should be kept closed when equipment is operating.

- Ensure that all workers are given training with respect to minimizing noise and disturbance.
- Consider quieter working methods; for example, use vibratory-driven piles instead of impact driven piles.
- Vibration intensive activities should be implemented during the least sensitive time periods.
- Operations should be sequenced so that vibration intensive activities do not occur simultaneously.
- Where possible, vibration intensive activities should be located as far away from sensitive areas as possible.

10.5.2 Operation Phase

The following management measures are recommended during operation phase of the Project:

- Due to the noise levels generated by the gas and steam turbine / generator in particular, it is recommended that all major plant items are sufficiently isolation mounted to minimize noise transmission through to the building structure and the concrete floor. The vibration isolation employed must be specifically selected to suit the weight, frequency of oscillation and isolation efficiency of the plant item being considered. Otherwise, if noise is transmitted to the structure, the building envelop itself will become vibration excited and as a result emit excessive noise into the surrounding environment.
- All equipment should be selected to minimize noise emissions and maintained in good repair. Equipment should be fitted with appropriate silencers and be in good working order.
- Machines found to produce excessive noise compared to normal industry expectations should be removed from the site or stood down until repairs or modifications can be made.
- Identify and mark high noise areas and require that personal noise protecting gear is used all the time when working in such high noise areas (typically areas with noise levels >85 dBA).
- Provision of sound-insulated control rooms with noise levels below 60 dBA.
- All mechanical plant and equipment should be checked regularly to avoid any unnecessary noise caused by lack of maintenance.
- Drivers should be kept informed of designated vehicle routes, parking locations, operating hours, and on-site speed limit.

10.6 Residual Impacts

The nearest residential receptor is the workers accommodation and recreational area located approximately 650 meters North of the Project site as well as workers and occupants at the commercial and industrial facilities neighboring the Project site. The distance of the proposed Block 4 from the nearest receivers allows for significant noise attenuation due to distance.

From the modeling results of Scenario 2, it can be concluded that the LAeq noise levels at all locations except receptor 1 – accommodation and recreational area are within the guideline values. In comparison to the predicted LAeq levels of Scenario 1, the noise level at receptor – 1 increased by 0.2 dBA. However, it should be noted that the Block 4 will be constructed on the Southern end of PS 5 which is away from receptor – 1. Considering this, the impact of Block 4 operations is assessed to be of **minor adverse**. However, by implementing management measures, the significance of impacts can be **negligible and minimum**.

10.7 Monitoring

The construction contractor and Alba will undertake noise monitoring on a periodic basis during construction and operational phases. Requirements for the noise monitoring are outlined in the table below:

Table 10-27 Noise Monitoring Program

Monitoring Period	Parameter	Frequency & Duration	Monitoring Location
Construction Phase			
Day Time	LAeq & LAFmax	Monthly for a period of 30 minutes	Site boundaries and nearest residential receptors
Operational Phase			
Day Time	LAeq & LAFmax	Monthly for a period of 30 minutes	Site boundaries and nearest residential receptors
Night Time			
Occupational Noise Exposure	LAeq, 8hrs	Annually for a period of 8 hours	Selected employees working in noisy areas

11 WASTE STREAMS

11.1 Applicable Standards and Guidelines

Applicable regulatory guidelines are provided in the table below and applicable standards are detailed in the sub-sections:

Table 11-1 Applicable Regulatory Guidelines

SCE – Kingdom of Bahrain	International Finance Corporation
1. Ministerial Order No. 3 of 1996 with respect to Banning the Importing, Manufacturing and Circulation of Asbestos Material and Product which contains this Material. 2. Ministerial Order No. 4 of 1996 regarding Maintenance of Thermal Insulators which Contain Asbestos Material and Disposal Thereof. 3. Ministerial Order No. 4 of 1999 regarding Licensing Work in Maintaining Equipment and Buildings that Contain Asbestos, Removal and Transportation of this Material and Disposal of its Waste. 4. Decision No. (4) of the year 2005 with respect to the management of used oil. 5. Decision No. (3) of the year 2006 with respect to the Management of Hazardous Materials. 6. Decision No. (4) of the year 2006 with respect to Management of Hazardous Chemicals. 7. Ministerial Order No. 6 of 2013 with respect to Protection of Workers from the Hazards of Fire in Establishments and Work Sites. 8. Decision No. (6) of the year 2013 with respect to amending Decision No. 4/2006 with respect to Hazardous Chemicals Management.	1. IFC Environmental, Health, and Safety (EHS) Guidelines – April 30, 2007, and 2. IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants – December 19, 2008.

SCE – Kingdom of Bahrain	International Finance Corporation
9. Decision No. (7) of the year 2013 with respect to amending Decision No. 3/2006 with respect to Hazardous Waste Management. 10. Resolution No. (3) of the year 2021 with respect to Environmental Standards of Water. 11. Ministerial Order No. 28 of 2014 with respect to Determining the Services and Conditions Required for the Protection of Workers from the Hazards of Boilers, Steam Recovery Tanks and Air Receiver Tanks. 12. Ministerial Order No. 38 of 2014 with respect to Determining the Required Conditions and Precautionary Measures for the Protection of Workers from Mechanical and Environmental Hazards.	

11.1.1 Effluent Discharges to Sea

The standards of waste water discharges to sea as per Resolution No. (3) of the Year 2021 are presented in the table below:

Table 11-2 Standards of Effluent Discharge to Sea

Sl. No.	Pollutant	Unit	Standards	
			Monthly Average	Maximum Limit
Physiochemical				
1	Floating Particles	-	Nil	Nil
2	pH	-	6 – 9	6 – 9
3	Total Suspended Solids (TSS)	mg/l	20	30
4	Turbidity	NTU	25	50
5	Temperature Difference	^{0}C	$\Delta T \pm 3$	$\Delta T \pm 3$
Biochemical				
1	Biochemical Oxygen Demand (BOD)	mg/l	15	25

Sl. No.	Pollutant	Unit	Standards	
			Monthly Average	Maximum Limit
2	Chemical Oxygen Demand (COD)	mg/l	100	150
3	Dissolved Oxygen (DO)	mg/l	Min = 4	Min = 4
4	Total Organic Carbon (TOC)	mg/l	50	50
5	Total Kjeldahl Nitrogen (TKN)	mg/l	5	10
6	Oil and Grease	mg/l	8	10
7	Phenols	mg/l	0.2	0.2
Chemical				
1	Ammoniacal Nitrogen as N (NH_3-N)		1	3
2	Nitrate as N (NO_3-N)		10	10
3	Residual Chlorine		0.5	1.0
4	Total Cyanide (CN^-)		0.05	0.1
5	Sulfide (S)		0.5	1
6	Total Phosphorous (P)		1	2
7	Fluoride		15	25
8	Aluminium		1	5
9	Arsenic		0.05	0.1
10	Cadmium		0.01	0.05
11	Copper		0.2	0.5
12	Total Chromium		0.1	1.0
13	Iron		1	2
14	Lead		0.1	0.5
15	Mercury		0.001	0.001
16	Nickel		0.1	0.5
17	Zinc		0.5	1
Biological				
1	Total Coliforms	MPN / 100 ml CFU / 100 ml	1000	2500

11.1.2 Effluent Guidelines – International Finance Corporation

Effluent guidelines are described in Table 11-3. Effluent guidelines are applicable for direct discharges of treated effluents to surface waters for general use. Site-specific discharge levels may be established based on the availability and conditions in the use of publicly operated sewage collection and treatment systems or, if discharged directly to surface waters, on the receiving water use classification as described in the General EHS Guideline. Guideline values for process emissions and effluents in this sector are indicative of good international industry practice as reflected in standards of countries with recognized regulatory frameworks. These levels should be achieved, without dilution, at least 95 percent of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours.

Table 11-3 Effluent Guidelines

Parameter	mg/L, except pH and temp
pH	6 – 9
Total Suspended Solids (TSS)	50
Oil and Grease	10
Total Residual Chlorine	0.2
Chromium – Total (Cr)	0.5
Copper (Cu)	0.5
Iron (Fe)	1.0
Zinc (Zn)	1.0
Lead (Pb)	0.5
Cadmium (Cd)	0.1
Mercury (Hg)	0.005
Arsenic (As)	0.5
Temperature increase by thermal discharge from cooling system	• Site specific requirement to be established by the EA. • Elevated temperature areas due to discharge of once-through cooling water (e.g., 1 Celsius above, 2 Celsius above, 3 Celsius above ambient water temperature) should be minimized by adjusting intake and outfall design through the project specific EA depending on the sensitive aquatic ecosystems around the discharge point.

Parameter	mg/L, except pH and temp
Note: 1. Applicability of heavy metals should be determined in the EA. Guideline limits in the Table are from various references of effluent performance by thermal power plants. 2. To be applicable at relevant wastewater stream: e.g., from FGD system, wet ash transport, washing boiler / air preheater and precipitator, boiler acid washing, regeneration of demineralizers and condensate polishers, oil-separated water, site drainage, coal pile runoff, and cooling water.	

11.2 Baseline Environment

11.2.1 Construction Phase

During construction phase, expected waste would be coming from construction spoil / debris such as unusable materials from site preparation works, excavation etc. It may also include wood / steel trimmings, cement bags, plastic, paper board as material packaging, food waste and wrappers/plastic from the construction personnel and workers. It is also common that packed lunches including drinking water is placed either in plastic wares or containers that will be reusable for a long time. All these will most likely constitute the solid wastes during the construction stage.

Waste water generated from the sanitary facilities, and hand wash areas will be collected in septic tanks and transported to the nearest waste water treatment plant.

A provisional list of waste streams likely to be generated during construction phases is presented in Table 11-4.

Table 11-4 Anticipated Waste Streams during Construction Phase

Waste Stream Description	Source	Estimated Frequency	Estimated Quantities/month	Preferred Disposal Route	Disposal Site
Hazardous Wastes					
Soil/Sand (Contaminated)	Ground works / Excavation	As required	TBC	Treatment & Recycling or Landfill	Hafira
Domestic Sewage Water	Washrooms, Toilets, etc.	Monthly	~300,000 Liters	Treatment	STP
Paints, Oils, Solvents etc.	General Construction Activities	Monthly	20 Liters	Treatment & Recycling	TBC
Batteries (lead acid, Ni, Cd etc.)	Site Maintenance	Monthly	~10 No's	Treatment & Recycling	TBC
Medical Wastes	Operation of plant first aid rooms	Monthly	TBC	Treatment	TBC
Non-Hazardous Waste					
Concrete	General construction activities	Monthly	~25 m^3	Recycling	TBC
Soil/Sand (Uncontaminated)	Ground works / Excavation	Monthly	~5 m^3	Recycling/Landfill	TBC
Scrap Metal	Off-cuts, steel wrappings etc.	Monthly	~1,000 Kgs	Recycling	TBC
Timber	Pallets, packaging, off-cuts etc.	Monthly	~500 kgs	Recycling	TBC
Cabling	Building services	Monthly	TBC	Recycling	TBC
Packaging (cardboard, paper, plastic, polystyrene etc.)	Goods delivered to construction site	Monthly	~600 Kgs	Recycling	TBC
General wastes (food, paper, cans etc.)	Offices, canteen etc.	Monthly	~1,500 Kgs	Landfill	Askar

11.2.2 Operational Phase

Solid, semi-solid and liquid waste streams generated during the operation of the Block 4 CCP is provided in the table below:

Table 11-5 Waste Streams during Operational Phase of PS 5 Block 4

Waste Description	Type	Source	Quantity	Disposal Method / Treatment
Air Filter elements	Solid	GT Air intake filter house Oil filters from GT and ST	7.6 T/y	Disposed by the contractor (Crown Industries) to Askar landfill
Filter elements	Solid	Remin plant, HVAC, and oil system	0.5 T/y	Disposed by the contractor (Crown Industries) to Askar landfill
Lube oil wastes	Liquid	GT and ST Lube oil system	8 T/y	Recycled by contractor (Agas lubes)
Hydraulic oil wastes	Liquid	GT/ST/Diverter damper	0.16 T/y	Recycled by contractor (Agas lubes)
Hydrocarbon liquid	Liquid	Khuff and Residual gas system	12,000 m^3/y	Discharged directly to Tatweer through drain condensate pipe line
Hydrocarbon sludge with liquid	Liquid	Khuff and Residual gas system knock out drums and filters	120 m^3/y	Disposed to Tatweer through the tanker services
Air borne dust	Semi Solid	Dust collected from GT Air intake filter house	5 T/y	Disposed by the contractor to Askar landfill
Sulphur and Ferrous sulphates	Semi Solid	HRSG Stack outlet	3.2 T/Y	Disposed by the contractor (crown Industries) by incineration

The project will generate liquid waste from the process as described below:

1. **Gas Turbine Compressor Cleaning Solution**

In order to avoid/reduce the gas turbines performance degradation, offline compressor washing, and on-line washing will be performed at certain intervals. The used gas turbine cleaning solution will be temporarily stored in a drain tank and then disposed to outside by the tanker services to the treatment plant. Water requirement for off line compressor wash cycle is estimated at 10.5 m^3 and on-line compressor wash cycle is 0.87 m^3. Average water consumption for one online was per week and three offline wash per year is estimated 0.01 m^3/hr.

2. **Blow-Down**
   During blow-down operation, water is blown down into the blow-down tank. Normal blowdown volume is estimated at 7 m^3 per hour per gas turbine. This is a water/steam flushing mixture when it enters the blow-down tank. Here, the effluent is cooled prior to being discharged to the effluent treatment plant where it is treated prior to being discharged to irrigation pond.
3. **Effluents Resulting from Plant Commissioning**
   During plant commissioning effluent related to plant cleaning procedures (e.g., condensate resulting from pre-operational steam blowing of steam piping) will be produced. If not classified as hazardous liquid waste, these effluents will be diverted to the effluent treatment plant.
   If it is not meeting the SCE Criteria, then the contractor shall prepare a method statement extracted from the OESMP related to Effluents handling. Method statement shall describe the scope of work, chemical's quantities to be used, expected effluents quantities, cleaning stages, temporary storage, spillage prevention, disposal stages, third party analysis, treatments, transportation, disposal destinations etc. in adherence to supreme council of environment and Alba environment section procedures and guidelines. Disposal of all hazardous waste shall be in accordance with the thus approved method statement.
4. **ACC Cleaning Water**
   During the cleaning of ACC, 2,620 m^3/year wastewater will be generated. This is comparably low volume of water with potential for oil contamination and will be collected separately through oily water drainage system and routed through a water/oil separator prior to discharge to waste water system.
5. **Surface / Stormwater**
   Surface water collected from roofed and paved areas will be delivered to the site storm water drainage system.

11.2.2.1 Existing Waste Disposal Methodology in Alba Power Stations

The following procedure is applicable in the disposal of waste in Alba Power Stations:

- Fill the "Waste Disposal Request" (WDR) form issued by the SCE including waste description, source etc. and submit to Alba Environmental Department.
- The Environmental team will review the document and forward to the waste transported for their signature and stamp (A valid Purchase Order should be available with the transporter) and then submit back.

- Environmental team will send the request with all relevant attachments to the SCE. SCE will suggest the parameters to analyze prior to disposal and submit the analysis report. Alba will appoint a third-party laboratory for the sampling and analysis.
- During sampling Alba invites SCE representative to witness the sampling.
- Upon receipt of the analysis report, Environmental team submit it to the SCE. Based on the analysis result SCE will suggest whether to dispose it in Askar or Hafira.

11.3 Potential Impacts

11.3.1 Construction Phase

Without proper management, the generation, storage, and disposal of construction waste may lead to the following potential impacts:

- **Soil and Groundwater Contamination:** The impact is primarily associated with the storage of sewage, waste oil and chemical waste on site. During the geotechnical study carried for the Line 6 expansion, groundwater was not encountered at depths >22 meters. Hence, groundwater impacts are not anticipated. However, potential soil contamination may occur due to spillages of fuels or chemicals. Any spills or leaks should be mitigated immediately.
- **Litters / Debris:** Litters / Debris from the construction area could disperse in and around the Project site. An impact may not be readily apparent at the time of discharge, some contaminants tend to accumulate over time.
- **Odor:** The impacts is typically local and will not affect construction works. Odor may arise from leak / spill of sewage. Odor may also be a potential indication of contamination.
- **Health and Safety:** Construction debris could possibly cause injury or fatalities to workers or visitors to the site from contact with sharp, flammable, or hazardous materials.

Improper handling solid and liquid waste can cause significant impacts on human health and soil environment. Potential waste impacts of the project can be reduced by implementing the proposed mitigation measures provided in Section 11.4.1. Segregation of wastes during construction will be crucial, with proper signage and disposal containers allotted for separation of different waste streams.

11.3.2 Operational Phase

The operation and maintenance of the plat will generate non-hazardous waste typica for power generation facilities. This waste will include scrap metal and plastic, insulation material, paper, glass, empty containers, and other miscellaneous wastes. General wastes from the offices and plant will be segregated as recyclable and non-recyclable. Recyclable wastes will be sold to local dealers whereas non-recyclable wastes will be disposed at approved landfill site or send for incineration.

Solid and liquid waste stream that are expected during the operational phase of Block 4 including the anticipated quantities and disposal route is presented in Section 11.2.2.

11.3.2.1 Solid and Semi-Solid Wastes

Filter elements from GT air intake filter house, Remin plant, HVAC and oil system will be collected by the appointed contractor – Crown Industries – and disposed in Askar Landfill site.

Hydrocarbon sludge from Khuff and residual gas system knock out drums and filters will be sent back to Tatweer Petroleum through tanker services. Airborne dust from the GT air intake baghouse will be disposed in Askar Landfill site by the contractor. Sulphur and Ferrous Sulphate from HRSG stack outlet will be incinerated by Crown Incineration Services.

11.3.2.2 Liquid Waste

Sewage network will collect the waste water from sanitary facilities and will be connected to the sewage treatment plant. Surface water collected from roofed and paved areas will be delivered to the site storm water drainage system.

During the cleaning of ACC, wastewater will be generated. This is comparably low volume of water with potential for oil contamination and will be collected separately through oily water drainage system and routed through a water/oil separator prior to discharge to waste water system. The water will be used for irrigation purposes.

The process waste water generated will be treated in the effluent treatment plant and will be stored in the irrigation pond.

Used lubricating oil and hydraulic oil wastes will be generated from the plant. The generated waste oil will be stored in sealed containers. Waste oil will be recycled by Agas Lubes.

Hydro carbon liquid will be generated from Khuff and residual gas system which will be discharged directly to Tatweer Petroleum through drain condensate pipeline.

Improper storage, handling and transport of solid, semi-solid and liquid wastes can cause impacts on soil and human health.

11.3.3 Summary of Impacts

The summary of impacts associated with waste management during the construction and operation phases of the Project are summarized in the table below:

Table 11-6 Summary of Noise Impacts during Construction and Operational Phases

Potential Impact	Aspect Impacted	Magnitude of Impacts	Duration of Impacts	Extent of Impacts
Construction Phase				
Construction waste	Workers and occupants on site	Negligible and minimum to Minor Adverse	Short Term	Local
Operation Phase				
Operational waste	Operational Staff	Negligible and minimum to Minor Adverse	Long Term	Local

11.4 Mitigation Measures

11.4.1 Construction and Operational Phases

The following measures shall be implemented during construction and operational phases of Block 4 Project. Contractor(s), Sub-Contractor(s) and visitor(s) will be required to adhere to these measures at all times.

- Institute good housekeeping and operating practices, including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off specification, contaminated, damaged, or excess to needs.
- Institute procurement measures that recognize opportunities to return usable materials such as containers and which prevents the over ordering of materials.
- Minimize hazardous waste generation by implementing stringent waste segregation to prevent the commingling of non-hazardous and hazardous waste to be managed.
- Contractors and sub-contractors are required to identify the types of waste generated from their activities. Waste registers shall be maintained and kept updated on a regular basis depending on waste generation rates.
- Construction work methods shall be developed, and corresponding site instruction issued to facilitate the efficient use of construction material and minimize waste generation.
- Reuse and recycle scrap materials for site works including measures such as:
    - Establishment of waste segregation areas on site. The minimum requirement is to segregate the hazardous waste from the non-hazardous wastes. Further, segregation (e.g., paper, wood, general waste, metal, plastic, food etc.) will facilitate recycling.

  - Re-use excavated material for back-fill purposes during site preparation or foundation works provided it is of suitable quality.
  - Use of scrap materials such as wood and metals for formworks and other temporary structures on site.
  - Recycling through approved service provider. Where possible, paper, wood, metal, and plastic wastes shall be sent to suitable recycling facilities.

— Provide appropriate waste bins for different wastes. Skips and bins shall also be covered to prevent littering by light-weight materials, particularly during periods of strong wind which could disperse litter offsite.

— Label waste bins / containers and collection areas in English and other languages understood by the general workers including the name of the waste and safety risks and precautions to assist workers in segregating waste and reduce cross contamination.

— Locate waste bins / containers where waste is produced.

— Provide suitable temporary sewage holding tank on site. The tanks should be leak proof to prevent soil contamination or health issues. Contractor HSE personnel should inspect the tank regularly and ensure that the volume of sewage will not exceed 80% of the tank capacity, and regular collection of sewage for offsite disposal will be arranged.

— Ensure that contractors handling, treating, and disposing hazardous wastes are reputable and licensed by the SCE and following good international industry practice for the waste being handled.

— Hazardous wastes must be stored in closed containers away from direct sunlight, wind, and rain.

— Provide adequate ventilation where volatile wastes are stored.

— Secondary containment should be included wherever liquid wastes are stored in volumes greater than 220 liters. The available volume of secondary containment should be at least 110 percent of the largest storage container, or 25 percent of the total storage capacity (whichever is greater), in that specific location.

— Secondary containment systems should be constructed with materials appropriate for the wastes being contained and adequate to prevent loss to the environment.

— Spill kits and fire extinguishers shall be available where there is a risk of spill and fire.

- Provide training and Personal Protective Equipment (PPE) for workers for the proper handling, storage, and disposal of waste as the proper usage of PPE. Restrict access to waste storage areas, particularly hazardous waste.
- Provide readily available information (e.g., MSDS) on chemical compatibility to employees, including labeling each container to identify its contents.
- Hazardous waste storage areas should be clearly labelled and demarcated including documentation of its location on site plan.
- Conduct periodic (e.g., daily, or weekly) reconciliation of storage areas, contents, and inspection of visible leaks.
- On-site and Off-site transportation of waste should be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public.
- All waste containers designated for off-site shipment should be secured and labeled with the contents and associated hazards, be properly loaded on the transport vehicles before leaving the site and be accompanied by a waste manifest that describes the load and its associated hazards.

11.4.2 Operational Waste Management System

Prior to disposal, operational waste should be temporarily stored on site. Temporary storage facilities shall be designed to account for internationally accepted requirements for the type of waste being stored (i.e., with appropriate coverings, ventilation, labelling, bunding etc.). It is likely that temporary storage will be located at a number of areas around the site, local to the source of wastes; alternatively, the feasibility of a standalone shall be investigated as the design progresses.

The operational waste management system should be based upon principles of re-use and recycle, wherever possible.

11.5 Residual Impacts

With the mitigation measures in place, neither construction phase nor operation phase of the Block 4 will result in any significant negative impacts.

11.6 Monitoring

IFC recommended monitoring activities during construction and operation phases associated with the management of non-hazardous and hazardous wastes include:

- Regular visual inspection of all waste storage collection and storage areas for evidence of accidental releases and to verify that wastes are properly labeled and stored. When significant quantities of hazardous wastes are generated and stored on site, monitoring activities should include:

  - Inspection of vessels for leaks, drips, or other indications of loss.
  - Identification of cracks, corrosion, or damage to tanks, protective equipment, or floors.
  - Verification of locks, emergency valves, and other safety devices for easy operation (lubricating if required and employing the practice of keeping locks and safety equipment in standby position when the area is not occupied).
  - Check the operability of emergency systems.
  - Document results of testing for integrity, emissions, or monitoring stations (air, soil, vapor, or groundwater).
  - Document any changes to the storage facility, and any significant changes in the quantity of materials in storage.
- Regular audits of waste segregation and collection practices.
- Track waste generation trends by type and amount of waste generated, preferably by Alba HSE department.
- Characterize waste at the beginning of generation of a new waste stream, and periodically document the characteristics and proper management of the waste, especially hazardous wastes.
- Keep manifests or other records that document the amount of waste generated and its destination.
- Periodic auditing of third-party treatment, and disposal services including re-use and recycling facilities when significant quantities of hazardous wastes are managed by third parties. Whenever possible, audits should include site visits to the treatment storage and disposal location.
- Monitoring records for hazardous waste collected, stored, disposed, or shipped should include:
  - Name and identification number of the material(s) composing the hazardous waste.
  - Physical state (i.e., solid, liquid, gaseous or a combination of one, or more, of these)
  - Quantity (e.g., kilograms or liters, number of containers).
  - Waste shipment tracking documentation to include, quantity and type, date dispatched, date transported, and date received, record of the originator, the receiver, and the transporter.
  - Method and date of storing, repacking, treating, or disposing at the facility, cross-referenced to specific manifest document numbers applicable to the hazardous waste.

- Location of each hazardous waste within the facility, and the quantity at each location.

12 HEALTH AND SAFETY

12.1 Applicable Guidelines and Standards

12.1.1 Guidelines

Guidelines relevant to the Health and Safety are as follows:

1. Ministerial Order No. 3 of 1996 with respect to Banning the Importing, Manufacturing and Circulation of Asbestos Material and Product which contains this Material.
2. Ministerial Order No. 4 of 1996 regarding Maintenance of Thermal Insulators which Contain Asbestos Material and Disposal Thereof.
3. Ministerial Order No. 4 of 1999 regarding Licensing Work in Maintaining Equipment and Buildings that Contain Asbestos, Removal and Transportation of this Material and Disposal of its Waste.
4. Ministerial Order No. 3 of 2001 on Periodic Medical Examination for Workers Exposed to Occupational Diseases.
5. Ministerial Order No. 3 of 2005 with respect to Environmental Regulations and Standards in the Work Place.
6. Law No (25) of 2009 with respect to approving the Accession of the Kingdom of Bahrain to the International Labour Convention No. (155) of 1981 with respect to Occupational Safety and Health, and Work Environment.
7. Ministerial Order No. 3 of 2013 with respect to Banning Work during Noon Time.
8. Ministerial Order No. 6 of 2013 with respect to Protection of Workers from the Hazards of Fire in Establishments and Work Sites.
9. Ministerial Order No. 8 of 2013 with respect to Regulating Occupational Safety and Health in Establishments.
10. Ministerial Order No. 12 of 2013 with respect to Procedures Required to Report Occupational Injuries and Diseases.
11. Ministerial Order No. 31 of 2013 regarding Protection of Workers from Electrical Hazards in Establishments and Work Sites.
12. Ministerial Order No. 4 of 2014 with respect to Determining the Required Conditions and Precautionary Measures for the Protection of Workers Engaged in Building Works, Construction and Civil Engineering.
13. Ministerial Order No. 5 of 2014 with respect to Determining the Required Conditions and Precautionary Measures for the Protection of Workers from the Hazards of Work on Lifting Equipment.

14. Ministerial Order No. 9 of 2014 with respect to Protecting Workers from Natural (physical) Hazards at Establishments and Worksites.
15. Ministerial Order No. 15 of 2014 with respect to Protecting Workers from the Hazards of Highly Flammable Liquids and Liquefied Petroleum Gases at Establishments and Worksites.
16. Ministerial Order No. 28 of 2014 with respect to Determining the Services and Conditions Required for the Protection of Workers from the Hazards of Boilers, Steam Recovery Tanks and Air Receiver Tanks.
17. Ministerial Order No. 38 of 2014 with respect to Determining the Required Conditions and Precautionary Measures for the Protection of Workers from Mechanical and Environmental Hazards.
18. IFC Environmental, Health, and Safety (EHS) Guidelines – April 30, 2007.
19. IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants – December 19, 2008.
20. IFC Performance Standards – Environmental and Social Sustainability, January 1 2012: Performance Standard 4 – Community Health and Safety.

12.1.2 Standards

12.1.2.1 Occupational Noise

National guideline values for occupational noise are presented in Table 10-1.

Noise limits for different working environments in accordance with International Finance Corporation, General EHS Guidelines is provided in Table 12-1.

Table 12-1 Noise Limits for Various Working Environments

Location / Activity	Equivalent Level, LA_{eq}, 8h	Maximum, LAF_{max}
Heavy Industry (no demand for oral communication)	85 dB(A)	110 dB(A)
Light industry (decreasing demand for oral communication)	50 – 65 dB(A)	110 dB(A)
Open offices, control rooms, service counters or similar	45 – 50 dB(A)	-
Individual offices (no disturbing noise)	40 – 45 dB(A)	-
Classrooms, lecture halls	35 – 40 dB(A)	-
Hospitals	30 – 35 dB(A)	40 dB(A)

12.1.2.2 Illumination Intensity

The minimum limits for illumination intensity for a range of locations/activities Table 12-2 [3 - IFC].

Table 12-2 Minimum Limits for Workplace Illumination Intensity

Location / Activity	Light Intensity
Emergency light	10 lux
Outdoor non-working areas	20 lux
Simple orientation and temporary visits (machine storage, garage, warehouse)	50 lux
Workspace with occasional visual tasks only (corridors, stairways, lobby, elevator, auditorium, etc.)	100 lux
Medium precision work (simple assembly, rough machine works, welding, packing, etc.)	200 lux
Precision work (reading, moderately difficult assembly, sorting, checking, medium bench and machine works, etc.), offices.	500 lux
High precision work (difficult assembly, sewing, colour inspection, fine sorting etc.)	1,000 – 3,000 lux

12.1.2.3 Electrical

No approach zones for high voltage high voltage power lines are given in the table below:

Table 12-3 No Approach Zones for High Voltage Power Lines

Nominal Phase-to-Phase Voltage Rating	Minimum Distance
750 or more volts, but no more than 150,000 volts	3 meters
More than 150,000 volts, but no more than 250,000 volts	4.5 meters
More than 250,000 volts	6 meters

12.1.2.4 Exposure to Electro-Magnetic Field

Indicators specifically applicable to the electric power sector activities include the ICNIRP exposure limits for occupational exposure to electric and magnetic fields and are listed in the table below:

Table 12-4 ICNIRP Exposure Limits for Occupational Exposure to Electric and Magnetic Fields

Frequency	Electric Field (V/m)	Magnetic Field (µT)
50 Hz	10,000	500
60 Hz	8,300	415
Source: [10 – ICNIRP]		

12.2 Baseline

Construction and operation of industrial facilities can give rise to an impact on the health and safety of personnel if such activities are not managed in an appropriate manner.

The Project is located in a designated industrial are. The nearest sensitive receptor is the accommodation and commercial area located ~650 meters towards north of the Block 4. Due to the distance of the proposed Block 4 from the nearest receivers, impacts because of construction and operational activities will not directly affect the receptors.

The COVID-19 pandemic is a human tragedy that presents many challenges to employers globally, including IFC clients, who provide key products and services in many countries as well as jobs and livelihoods for workers and their families. Preventing the spread of COVID-19 in the workplace and providing safe working conditions for those still working is of paramount importance for all companies and for society in general.

12.3 Potential Impacts

12.3.1 Construction Phase

The construction activities can give rise to an impact on the health and safety of human beings if such activities are not managed in an appropriate manner. During the construction phase of Block 4, there is a potential impact on the health and safety of human beings due to the increased volume of traffic accessing the site and the typical health and safety issues associated with any construction site such as slips, trips, falls etc. There is a risk of nuisance levels of dust and noise being generated on site and impacting in a minor way on the health and safety of employees. There is a low risk that persons visiting the site or accessing the site illegally during the construction phase may potentially be subjected to a range of impacts on their health and safety associated with construction sites. Further, there is a risk of spread of COVID – 19 in the workplace.

12.3.2 Operational Phase

The operation of the industrial facilities can give rise to an impact on health and safety of employees if such undertakings are not managed in an appropriate manner. The health and safety of persons working at the facility and those off site may be affected by a range of hazards associated with industrial facilities of this type.

The potential hazards which have been identified consist of the following:

- Non-Ionizing Radiation
- Heat
- Noise
- Confined Spaces
- Electrical Hazards
- Fire and Explosion Hazards
- Chemical Hazards
- Air Quality
- COVID – 19

12.3.3 Summary of Impacts

The summary of impacts associated with health and during the construction and operation phases of the Project are summarized in the table below:

Table 12-5 Summary of Noise Impacts during Construction and Operational Phases

Potential Impact	Aspect Impacted	Magnitude of Impacts	Duration of Impacts	Extent of Impacts
Construction Phase				
Occupational health and safety	Workers and occupants on site	Significant to minor adverse	Short Term	Local
Community health and safety	General public	No impacts	Short Term	Local
Operation Phase				
Occupational health and safety	Operational Staff	Significant to minor adverse	Long Term	Local
Community health and safety	General public	Less significant to significant	Long Term	Local

12.4 Mitigation Measures

12.4.1 Mitigation Measures for Construction and Operation Phases

12.4.1.1 Preventing and Managing Health Risks of COVID – 19

Following measures detailed in IFC Interim Advise on Preventing Managing Health Risks of COVID – 19 shall be implemented:

- EPC Contractor should ensure that all personnel at site received vaccination.
- Appoint a dedicated team with responsibilities to identify and implement actions that can mitigate the effects of COVID-19 on the company and community.
- Develop and provide information on good practices for preventing COVID-19 transmission, particularly observing recommendations on social distancing, and for training staff to recognize the symptoms of COVID-19 and understand their required response.
- There should be no discrimination against, or stigmatization of persons affected by COVID-19.
- Alba should identify focal points and communication channels (for example, SMS and email) within the company to address workers' concerns on an ongoing basis and ensure that such channels are adequately resourced (for example, 24-hour staffing of the emergency response call line).
- To prevent potentially infected staff from entering the workplace and infecting co-workers, the company should ask workers to stay away from work in cases where they exhibit any COVID-19 symptoms or have been in close contact with a confirmed COVID-19 patient during the previous 14 days.
- Workers who do not feel well should seek immediate medical advice. An employee who works while evidencing mild COVID-19 symptoms can risk spreading this infectious disease to others.
- To prevent person-to-person infection, it is important to minimize direct contact as much as possible. Where people are regularly working or meeting, a safe distance of 2 meters (six feet) between people should be observed.
- Alba should identify all places where people normally work closer than 2 meters from each other. Adjust workplace design and work processes to minimize this likelihood as much as possible.
- Alba should promote frequent and thorough water-soap hand washing and provide enough places for employees to wash their hands. If soap and running water are not immediately available, provide alcohol-based hand rubs containing at least 60% alcohol. Ensure that these facilities are sufficient in number and are available close to the work area.

- To prevent the spread of the virus, frequently – and at least daily - clean touched surfaces, such as tables, doorknobs, handrails, light switches, appliances, countertops, handles, desks, phones, keyboards, toilets, faucets, sinks, and so forth.
- Employees should use (disposable) gloves and breathing protection with a minimum rating of N95 (U.S. standard) or P2 (EU standard) or similar.

12.4.1.2 Non-Ionizing Radiation

[4 – IFC] Combustion facility workers may have a higher exposure to electric and magnetic fields (EMF) than the general public due to working in proximity to electric power generators, equipment, and connecting high-voltage transmission lines. Occupational EMF exposure should be prevented or minimized through the preparation and implementation of an EMF safety program including the following components:

- Identification of potential exposure levels in the workplace, including surveys of exposure levels and the use of personal monitors during working activities.
- Training of workers in the identification of occupational EMF levels and hazards.
- Establishment and identification of safety zones to differentiate between work areas with expected elevated EMF levels compared to those acceptable for public exposure, limiting access to properly trained workers.
- Implementation of action plans to address potential or confirmed exposure levels that exceed reference occupational exposure levels developed by international organizations such as the International Commission on Non-Ionizing Radiation Protection (ICNIRP), the Institute of Electrical and Electronics Engineers (IEEE) (refer Table 12-4).Personal exposure monitoring equipment should be set to warn of exposure levels that are below occupational exposure reference levels (e.g., 50 percent). Action plans to address occupational exposure may include limiting exposure time through work rotation, increasing the distance between the source and the worker, when feasible, or the use of shielding materials.

12.4.1.3 Heat

[4 – IFC] Occupational exposure to heat occurs during operation and maintenance of combustion units, pipes, and related hot equipment. Recommended prevention and control measures to address heat exposure at thermal power plants include:

- Regular inspection and maintenance of pressure vessels and piping.
- Provision of adequate ventilation in work areas to reduce heat and humidity.
- Reducing the time required for work in elevated temperature environments and ensuring access to drinking water.

- Shielding surfaces where workers come in close contact with hot equipment, including generating equipment, pipes etc.
- Use of warning signs near high temperature surfaces and personal protective equipment (PPE) as appropriate, including insulated gloves and shoes.

12.4.1.4 Noise

Noise sources in combustion facilities include the turbine generators and auxiliaries; gas turbine, steam turbine, HRSG, motors, transformers, ACC etc. Recommendations for reducing noise and vibration are discussed in Section 10.5. In addition, recommendations to prevent, minimize, and control occupational noise exposures in thermal power plants include [3, 4 – IFC]:

- Provision of sound-insulated control rooms with noise levels below 60 dBA.
- Design of generators to meet applicable occupational noise levels.
- No employee should be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day without hearing protection. In addition, no unprotected ear should be exposed to a peak sound pressure level (instantaneous) of more than 140 dB(C).
- The use of hearing protection should be enforced actively when the equivalent sound level over 8 hours reaches 85 dB(A), the peak sound levels reach 140 dB(C), or the average maximum sound level reaches 110dB(A). Hearing protective devices provided should be capable of reducing sound levels at the ear to at least 85 dB(A).
- Although hearing protection is preferred for any period of noise exposure in excess of 85 dB(A), an equivalent level of protection can be obtained, but less easily managed, by limiting the duration of noise exposure. For every 3 dB(A) increase in sound levels, the 'allowed' exposure period or duration should be reduced by 50 percent.
- Identify and mark high noise areas and require that personal noise protecting gear is used all the time when working in such high noise areas (typically areas with noise levels >85 dBA).
- Prior to the issuance of hearing protective devices as the final control mechanism, use of acoustic insulating materials, isolation of the noise source, and other engineering controls should be investigated and implemented, where feasible.
- Periodic medical hearing checks should be performed on workers exposed to high noise levels.

12.4.1.5 Confined Spaces

Specific areas of confined space entry may include turbines, condensers etc. (during maintenance activities). Recommended management approaches include [3, 4 – IFC]:

- Engineering measures should be implemented to eliminate, to the degree feasible, the existence and adverse character of confined spaces.
- Permit-required confined spaces should be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible. The area adjoining an access to a confined space should provide ample room for emergency and rescue operations.
- Access hatches should accommodate 90% of the worker population with adjustments for tools and protective clothing. The most current ISO and EN standards should be consulted for design specifications.
- Prior to entry into a permit-required confined space:
  - Process or feed lines into the space should be disconnected or drained, and blanked and locked-out.
  - Mechanical equipment in the space should be disconnected, de-energized, locked-out, and braced, as appropriate.
  - The atmosphere within the confined space should be tested to assure the oxygen content is between 19.5 percent and 23 percent, and that the presence of any flammable gas or vapor does not exceed 25 percent of its respective Lower Explosive Limit (LEL).
  - If the atmospheric conditions are not met, the confined space should be ventilated until the target safe atmosphere is achieved, or entry is only to be undertaken with appropriate and additional PPE.
- Safety precautions should include Self Contained Breathing Apparatus (SCBA), life lines, and safety watch workers stationed outside the confined space, with rescue and first aid equipment readily available.
- Before workers are required to enter a permit-required confined space, adequate and appropriate training in confined space hazard control, atmospheric testing, use of the necessary PPE, as well as the serviceability and integrity of the PPE should be verified. Further, adequate and appropriate rescue and / or recovery plans and equipment should be in place before the worker enters the confined space.

12.4.1.6 Electrical Hazards

Energized equipment and power lines can pose electrical hazards for workers at thermal power plants. Recommended measures to prevent, minimize, and control electrical hazards at thermal power plants include [4 – IFC]:

- Consider installation of hazard warning lights inside electrical equipment enclosures to warn of inadvertent energization.
- Use of voltage sensors prior to and during workers' entrance into enclosures containing electrical components.
- Deactivation and proper grounding of live power equipment and distribution lines according to applicable legislation and guidelines whenever possible before work is performed on or proximal to them.
- Provision of specialized electrical safety training to those workers working with or around exposed components of electric circuits. This training should include, but not be limited to, training in basic electrical theory, proper safe work procedures, hazard awareness and identification, proper use of PPE, proper lockout/tagout procedures, first aid including CPR, and proper rescue procedures. Provisions should be made for periodic retraining as necessary.

12.4.1.7 Fire and Explosions

Fires and or explosions resulting from ignition of flammable materials or gases can lead to loss of property as well as possible injury or fatalities to project workers. Prevention and control strategies include [3, 4 – IFC]:

- Storing flammables away from ignition sources and oxidizing materials. Further, flammables storage area should be:
  - Remote from entry and exit points into buildings.
  - Away from facility ventilation intakes or vents.
  - Have natural or passive floor and ceiling level ventilation and explosion venting.
  - Use spark-proof fixtures.
  - Be equipped with fire extinguishing devices and self-closing doors and constructed of materials made to withstand flame impingement for a moderate period of time.
- Providing bonding and grounding of, and between, containers and additional mechanical floor level ventilation if materials are being, or could be, dispensed in the storage area.
- Where the flammable material is mainly comprised of dust, providing electrical grounding, spark detection, and, if needed, quenching systems.
- Defining and labeling fire hazards areas to warn of special rules (e.g. prohibition in use of smoking materials, cellular phones, or other potential spark generating equipment).
- Providing specific worker training in handling of flammable materials, and in fire prevention or suppression.

- Use of automated combustion and safety controls.

12.4.1.8 Chemical Hazards

Chemical hazards represent potential for illness or injury due to single acute exposure or chronic repetitive exposure to toxic, corrosive, sensitizing or oxidative substances. They also represent a risk of uncontrolled reaction, including the risk of fire and explosion if incompatible chemicals are inadvertently mixed. Chemical hazards can most effectively be prevented through a hierarchical approach that includes [3 – IFC]:

- Replacement of the hazardous substance with a less hazardous substitute.
- Implementation of engineering and administrative control measures to avoid or minimize the release of hazardous substances into the work environment keeping the level of exposure below internationally established or recognized limits.
- Keeping the number of employees exposed, or likely to become exposed, to a minimum.
- Communicating chemical hazards to workers through labeling and marking according to national and internationally recognized requirements and standards, including the International Chemical Safety Cards (ICSC), Materials Safety Data Sheets (MSDS), or equivalent. Any means of written communication should be in an easily understood language and be readily available to exposed workers and first-aid personnel.
- Training workers in the use of the available information (such as MSDSs), safe work practices, and appropriate use of PPE.

12.4.1.9 Air Quality

Poor air quality due to the release of contaminants into the work place can result in possible respiratory irritation, discomfort, or illness to workers. Employers should take appropriate measures to maintain air quality in the work area. These include [3 – IFC]:

- Maintaining levels of contaminant dusts, vapors, and gases in the work environment at concentrations below those recommended by the ACGIH [11] as TWA-TLV's (threshold limit value)—concentrations to which most workers can be exposed repeatedly (8 hours/day, 40 hrs/week, week-after week), without sustaining adverse health effects.
- Developing and implementing work practices to minimize release of contaminants into the work environment including:
  - Direct piping of liquid and gaseous materials
  - Minimized handling of dry powdered materials;
  - Enclosed operations

- Local exhaust ventilation at emission / release points
- Vacuum transfer of dry material rather than mechanical or pneumatic conveyance
- Indoor secure storage, and sealed containers rather than loose storage

— Where ambient air contains several materials that have similar effects on the same body organs (additive effects), considering combined exposures using calculations recommended by the ACGIH [11].

— Where work shifts extend beyond eight (8) hours, calculating adjusted workplace exposure criteria recommended by the ACGIH [11].

12.4.1.10 Personal Protective Equipment

[3 – IFC] Personal Protective Equipment (PPE) provides additional protection to workers exposed to workplace hazards in conjunction with other facility controls and safety systems.

PPE is considered to be a last resort that is above and beyond the other facility controls and provides the worker with an extra level of personal protection. Table 2.7.1 presents general examples of occupational hazards and types of PPE available for different purposes. Recommended measures for use of PPE in the workplace include:

— Active use of PPE if alternative technologies, work plans or procedures cannot eliminate, or sufficiently reduce, a hazard or exposure.

— Identification and provision of appropriate PPE that offers adequate protection to the worker, co-workers, and occasional visitors, without incurring unnecessary inconvenience to the individual.

— Proper maintenance of PPE, including cleaning when dirty and replacement when damaged or worn out. Proper use of PPE should be part of the recurrent training programs for employees.

— Selection of PPE should be based on the hazard and risk ranking and selected according to criteria on performance and testing established by recognized organizations.

Table 12-6 Summary of Personal Protective Equipment According to Hazard

Objective	Workplace Hazards	Suggested PPE
Eye and face protection	Flying particles, molten metal, liquid chemicals, gases or vapours, light radiation.	Safety Glasses with side-shields, protective shades, etc.
Head protection	Falling objects, inadequate height clearance, and overhead power cords.	Plastic Helmets with top and side impact protection.

Objective	Workplace Hazards	Suggested PPE
Hearing protection	Noise, ultra-sound.	Hearing protectors (ear plugs or ear muffs).
Foot protection	Falling or rolling objects, pointed objects. Corrosive or hot liquids.	Safety shoes and boots for protection against moving & falling objects, liquids and chemicals.
Hand protection	Hazardous materials, cuts or lacerations, vibrations, extreme temperatures.	Gloves made of rubber or synthetic materials (Neoprene), leather, steel, insulating materials, etc.
Respiratory protection	Dust, fogs, fumes, mists, gases, smokes, vapours.	Facemasks with appropriate filters for dust removal and air purification (chemicals, mists, vapours, and gases). Single or multi-gas personal monitors, if available.
	Oxygen deficiency	Portable or supplied air (fixed lines). On-site rescue equipment.
Body/leg protection	Extreme temperatures, hazardous materials, biological agents, cutting and laceration.	Insulating clothing, body suits, aprons etc. of appropriate materials.

12.4.1.11 Labor and Working Conditions

IFC Performance Standard 2 [2 – IFC] recognizes that the pursuit of economic growth through employment creation and income generation should be accompanied by protection of the fundamental rights of workers. For any business, the workforce is a valuable asset, and a sound worker-management relationship is a key ingredient in the sustainability of a company. Failure to establish and foster a sound worker-management relationship can undermine worker commitment and retention and can jeopardize a project. Conversely, through a constructive worker-management relationship, and by treating the workers fairly and providing them with safe and healthy working conditions, clients may create tangible benefits, such as enhancement of the efficiency and productivity of their operations.

The following measures will be implemented during construction and operational phases [2 – IFC]:

— Alba / EPC Contractor will adopt and implement human resources policies and procedures appropriate to its size and workforce that set out its approach to managing workers consistent with the requirements of Performance Standard 2 and national law.

- Alba / EPC Contractor will provide workers with documented information that is clear and understandable, regarding their rights under national labor and employment law and any applicable collective agreements, including their rights related to hours of work, wages, overtime, compensation, and benefits upon beginning the working relationship and when any material changes occur.
- Alba will identify migrant workers and ensure that they are engaged on substantially equivalent terms and conditions to non-migrant workers carrying out similar work.
- Where accommodation services are provided to workers covered by the scope of Performance Standard 2, Alba / EPC Contractor will put in place and implement policies on the quality and management of the accommodation and provision of basic services. The accommodation services will be provided in a manner consistent with the principles of non-discrimination and equal opportunity. Workers' accommodation arrangements should not restrict workers' freedom of movement or of association.
- Alba / EPC Contractor will not make employment decisions on the basis of personal characteristics (such as gender, race, nationality, ethnic, social and indigenous origin, religion or belief, disability, age, or sexual orientation) unrelated to inherent job requirements.
- Alba / EPC Contractor will base the employment relationship on the principle of equal opportunity and fair treatment and will not discriminate with respect to any aspects of the employment relationship, such as recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, job assignment, promotion, termination of employment or retirement, and disciplinary practices.
- Alba / EPC Contractor will take measures to prevent and address harassment, intimidation, and/or exploitation, especially in regard to women. The principles of non-discrimination apply to migrant workers.
- Alba / EPC Contractor will provide a grievance mechanism for workers (and their organizations, where they exist) to raise workplace concerns. Alba / EPC Contractor will inform the workers of the grievance mechanism at the time of recruitment and make it easily accessible to them. The mechanism should involve an appropriate level of management and address concerns promptly, using an understandable and transparent process that provides timely feedback to those concerned, without any retribution. The mechanism should also allow for anonymous complaints to be raised and addressed. The mechanism should not impede access to other judicial or administrative remedies that might be available under the law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements.

- Alba / EPC Contractor will not employ children in any manner that is economically exploitative or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. The client will identify the presence of all persons under the age of 18.
- Alba / EPC Contractor will provide a safe and healthy work environment, taking into account inherent risks in its particular sector and specific classes of hazards in the client's work areas, including physical, chemical, biological, and radiological hazards, and specific threats to women.
- Alba / EPC Contractor will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, as far as reasonably practicable, the causes of hazards. In a manner consistent with good international industry practice, as reflected in various internationally recognized sources including the World Bank Group Environmental, Health and Safety Guidelines, the client will address areas that include the (i) identification of potential hazards to workers, particularly those that may be life-threatening; (ii) provision of preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; (iii) training of workers; (iv) documentation and reporting of occupational accidents, diseases, and incidents; and (v) emergency prevention, preparedness, and response arrangements.
- If child labor or forced labor cases are identified, Alba / EPC Contractor will take appropriate steps to remedy them. Alba / EPC Contractor will monitor its primary supply chain on an ongoing basis in order to identify any significant changes in its supply chain and if new risks or incidents of child and/or forced labor are identified, Alba / EPC Contractor will take appropriate steps to remedy them.

12.5 Residual Impacts

Strict adherence to the measures recommended in Sections 9.5, 10.5, 11.4, and 12.4, will ensure that there will be no negative impacts or effects on human beings from the construction and operation phases of the proposed Project.

12.6 Monitoring

The health and safety monitoring program during construction and operational phases shall include:

- **Safety inspection, testing and calibration:** This should include regular inspection and testing of all safety features and hazard control measures focusing on engineering and personal protective features, work procedures, places of work, installations, equipment, and tools used. The inspection should verify that issued PPE continues to provide adequate protection and is being worn as required. All instruments installed or used for monitoring and recording of working environment parameters should be regularly tested and calibrated, and the respective records maintained.

— **Surveillance of the working environment:** EPC Contractor and Alba should document compliance using an appropriate combination of portable and stationary sampling and monitoring instruments. Monitoring and analyses should be conducted according to internationally recognized methods and standards. Monitoring methodology, locations, frequencies, and parameters should be established individually for each project following a review of the hazards. Generally, monitoring should be performed during commissioning of facilities or equipment and at the end of the defect and liability period, and otherwise repeated according to the monitoring plan.

— **Surveillance of workers health:** When extraordinary protective measures are required (for example, against biological agents Groups 3 and 4, and/or hazardous compounds), workers should be provided appropriate and relevant health surveillance prior to first exposure, and at regular intervals thereafter. The surveillance should, if deemed necessary, be continued after termination of the employment.

— **Training:** Training activities for employees and visitors should be adequately monitored and documented (curriculum, duration, and participants). Emergency exercises, including fire drills, should be documented adequately. Service providers and contractors should be contractually required to submit to the employer adequate training documentation before start of their assignment.

13 SOCIO-ECONOMICS

13.1 Baseline

13.1.1 Population and Demography

The Bahraini society is characterized by its cultural, ethnic, and religious diversity. According to the official census for the year 2020 issued by the Central Informatics Organization, the Kingdom of Bahrain had a total resident population of 1,501,635.

The population is distributed across five Governorates (the Capital Manama, Muharraq, Northern, Central and Southern). Alba is in the Southern Governorate of the Kingdom.

A breakdown of the socio-demographic indicators of the Kingdom of Bahrain for the year 2020 is provided in Table 13-1. Labor force indicators shows that the majority of the workforce is male, while the education indicators show a very high literacy rate and good health and living conditions.

Table 13-1 Socio-Demographic Indicators of Kingdom of Bahrain

Indicator	Year 2020	
	Male	Female
Demography / Population (Numbers)	942,895	558,740
Educational Indicators (15 Years and Above)		
Illiterate / Read Only	6,735	14,660
Read and Write	25,916	31,341
Primary	98,930	28,004
Preparatory	126,510	70,677
Secondary	290,195	137,769
Above Secondary	78,871	27,797
B.Sc. or BA	126,007	83,297
High Diploma	21,234	10,318
Masters	12,540	5,856
Doctorate	1,976	729
Labor Force Participation (15 Years and Above)		
Employed	670,598	192,490

Indicator	Year 2020	
	Male	Female
Unemployed	3,217	9,253
Students	58,207	57,076
Housewife	-	134,796
Unable to Work	1,766	1,584
Retired	30,613	10,870
Others	21,065	3,952
65 Years and Above	3,448	427

13.1.2 Gross Domestic Product (GDP)

[19] The preliminary data issued by the national accounts showed that the Kingdom of Bahrain's GDP recovered slightly in the fourth quarter at current prices, equivalent to 0.20%, compared to the previous quarter of 2020, in light of the continuous efforts of the Government to mitigate the impact of COVID-19 pandemic situation in Bahrain.

The quarterly report indicated that the gross domestic product of the non-oil sectors grew by 3.32% and 2.07% at constant and current prices respectively, supported by the recovery of the transportation and communications sector, government services and financial services.

With the fiscal support measures launched by the Kingdom to reduce the burden on the economy and to stimulate its ability to confront the pandemic severe impact, this was evident in all government services, as it grew by 5.25% at real prices and 13.05% at current prices compared to the third quarter of 2020.

Quarterly GDP performance for the period between 2010 and 2020 is presented in Figure 13-1.

The preliminary figures for the fourth quarter of 2020 compared to the corresponding quarter for 2019 indicate the following results:

- The Gross domestic product had declined by 5.51% in constant prices and by 7.28% at current prices.
- A decrease in the oil sector GDP by 8.62% at constant prices, and by 30.90% at current prices.
- The non-oil sector GDP declined by 4.82% and 3.27% at constant and current prices, respectively.

- Private educational services decreased by 5.67% and 2.27% at constant and current prices, respectively.
- Private health services decreased by 1.56% in constant prices and 0.68% in current prices.
- The manufacturing industries decreased by 9.12% and 0.79% at constant and current prices, respectively.
- Mines and quarries sector decreased by 8.08% in constant prices and by 28.59% at current prices.
- The building and construction activity recorded a decrease of 2.14% at constant prices and 10.89% at current prices.
- Hotels and restaurants decreased by 42.22% and 42.58% in constant and current prices, respectively.
- Total government services increased by 12.68% and 13.72% in constant and current prices, respectively.
- Transportation and communications decreased by 30.78% in constant prices and 29.27% in current prices
- Financial services sector grew by 11.04% in constant prices and at a rate of 12.48% at current prices.

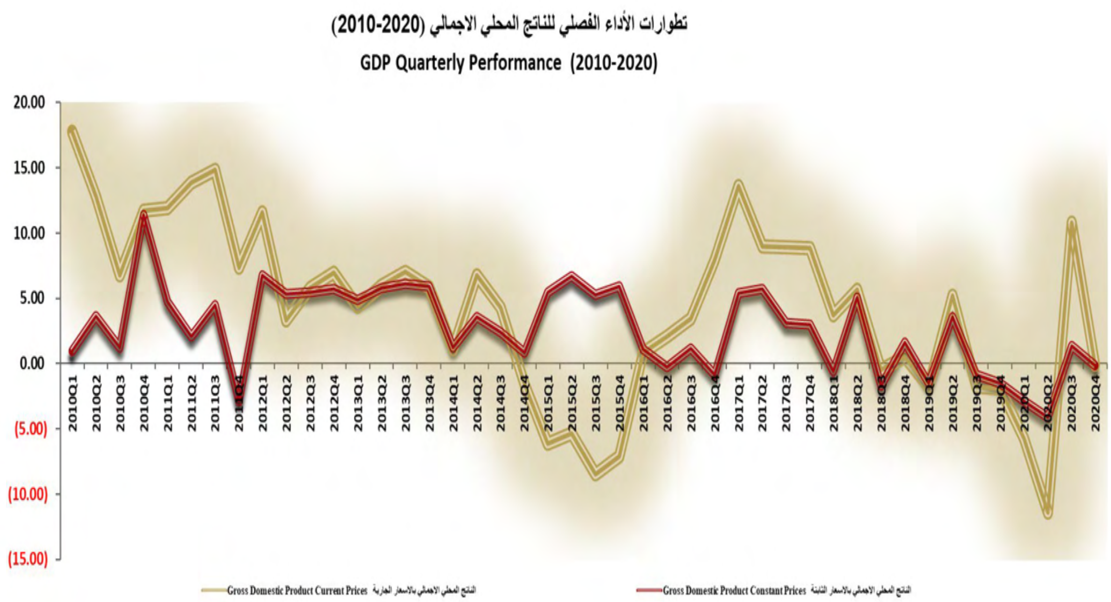


Figure 13-1 Quarterly GDP Performance (2010 – 2020)

The economic structure is further divided by activity as in Table 13-2.

Table 13-2 Economic Activity Area (BD Million – Constant Prices)

Economic Activity	2019, 4th Quarter		2020, 4th Quarter	
	Value Added	% Share to GDP	Value Added	% Share to GDP
Agriculture and Fishing	9.13	0.28	8.99	0.30
Crude Petroleum & Natural Gas	586.67	18.29	536.10	18.59
Quarrying	26.33	0.82	27.35	0.90
Manufacturing	483.36	15.07	439.26	14.49
Electricity and Water	35.22	1.10	45.48	1.50
Construction	237.88	7.42	232.80	7.68
Trade	146.25	4.56	132.26	4.36
Hotels and Restaurants	77.38	2.41	44.71	1.48
Transport and Communication	248.23	7.74	171.81	5.67
Private Education Services	82.07	2.56	77.42	2.55
Private Health Services	45.33	1.41	44.62	1.47
Other Social & Personal Services	83.31	2.60	49.71	1.64
Real Estate	123.92	3.86	123.18	4.06
Business Activities	54.92	1.71	41.17	1.36
The Financial Corporations	519.63	16.20	576.99	19.04
Government Services	349.47	10.89	393.78	12.99
Private Non-Profit Institutions	1.21	0.04	1.24	0.04
Households with Employed Persons	26.45	0.82	21.71	0.72
Tax on Products	70.95	2.21	62.44	2.06

The Project is included within the Manufacturing sector. The manufacturing industries decreased by 9.12% and 0.79% at constant and current prices, respectively in the 4th Quarter of 2020. However, the manufacturing industry made much progress in the pre-pandemic period. During 4th Quarter of 2019, manufacturing industries grew by 0.66% at constant prices.

13.2 Potential Impacts

13.2.1 Construction Phase

13.2.1.1 Socio-Economic Impacts

During the construction phase, a significant positive impact of the Project will be the generation of employment and business opportunities. The Project is anticipated to employ approximately 1,500 workers during peak construction period, which will generally comprise of construction laborers and skilled trades people.

Employment generation will provide income for workers and subsequently maintain and/or improve the standard of living of their respective families. The workers' wages will also contribute to the local economy as a result of multiplier effects. Business opportunities that are anticipated to contribute to the overall economic growth of Bahrain include trading of materials and equipment rental.

13.2.1.2 Impacts on Workers

As per existing policies and practices in the Kingdom, majority of construction workforce are provided with accommodation; as such, accommodation facilities will be provided to workers during construction phase. Existing labor camps used by contractors are located in Ras Zuwaid and Askar area. Transportation services from labor accommodation to the construction site will be provided by contractors.

The workers or staff members at the Project site could be exposed to various occupational and safety hazards (e.g., exposure to heat, noise, electrical hazards, fire, and explosion, fall from height, inhalation of toxic chemicals, dangers associated with general construction equipment and materials, etc.) which are inherent to construction works. Contractors will be required to develop safe work methodologies to ensure protection of workers from injuries or ill health effects. The Proponent, through the contractors, will ensure that construction work will meet all Bahraini Labour Law requirements.

Child labour and forced labour will not be tolerated at all phases of project development. The Proponent will ensure that safety and protection of workers will be prioritized.

The construction activities are likely to emit fugitive dust and gaseous pollutants and generate noise that could potentially cause annoyance or sleep disturbance to surrounding sensitive receptors in case night-time construction activities are undertaken. The workers may also be exposed to hazardous substances when hazardous materials and their wastes are delivered to and removed from the construction site, respectively, if they are not properly handled.

Air and noise emissions during construction are likely to be temporary, reversible, and localized. Air and noise impacts on sensitive receptors are discussed in Section 9.5 and 10.5, respectively, while an assessment of waste is provided in Section 11.4.

13.2.2 Operation Phase

13.2.2.1 Socio-Economic Impacts

On completion of PS 5 Block 4 Expansion Project, the capacity of PS5 will increase from 1,800 MW to 2,410 MW. Since the efficiency of this CCP is much higher than the CCP's of PS 3 and PS 4, PS3 which is running on a lower load will be shut down and will be kept as emergency standby. Power Station 4 will be running partially. Thus, the operation of PS 5 Block 4 will reduce the overall emissions from the Alba Power Plants.

Due to limited requirements, the operations of Block 4 will be managed by existing workforce of PS5.

The workers' wages will contribute to the local economy as a result of multiplier effect that will potentially benefit local businesses such as food and beverages, tourism, and other establishments. Operation and maintenance activities will also generate business opportunities in relation to maintenance and material supplies.

13.2.2.2 Impact on Workers

The operation and maintenance of the Power Stations will have associated occupational health and safety risks, which require control measures to ensure protection of workers. Alba will be responsible for managing health and safety risks associated with the operation of the plant and activities of the employees.

The following occupational health and safety risks are anticipated during operation of the Plant:

- Heat exposure.
- Exposure to air quality emissions.
- Exposure to noise.
- Electrical hazards.
- Fire and explosion hazards.
- Chemical hazards.
- Hazardous waste management.

13.2.3 Summary of Impacts

Summary of impacts during construction and operational phases are presented in the table below:

Table 13-3 Potential Socio-economic Impacts of PS5 – Block 4

Impact	Beneficial	Adverse
Social	– Indirect beneficial community impacts from employment and provision of skilled workforce. – Provision of training and medical services at least for employees and workers.	– Risks of occupational and environmental health issues. – Impacts on air quality, noise, and traffic.
Economic	– Expenditure of wages in local area. – House purchase and rental. – Equipment and services procurement. – Government revenue.	– Risks of occupational and environmental health issues. – Impacts on air quality, noise, and traffic

13.3 Mitigation Measures

The following management measures shall be implemented during construction and operation phases.

13.3.1 Enhancement Measures for Positive Impacts

In order to optimize the benefits from employment and business opportunities, the following enhancement measures shall be implemented:

- As with the current trend in the Kingdom, workers will most likely consist of expatriates; however, local workers shall be prioritized. This is in line with Kingdom's Bahranization Policy.
- During procurement of materials and services required for the Project, priority shall be given to local suppliers and service companies, if available. This will optimize the economic benefits to the Kingdom.
- All parties involved in the Project shall comply with the Bahraini Labor Law provisions on the minimum salary, working hours and working conditions (e.g., occupational health and safety, labor accommodation).
- All form of forced or compulsory labor shall be prohibited. Regular monitoring shall be undertaken to ensure that worker's rights are protected.

13.3.2 Mitigation Measures for Potential Adverse Impacts

The following measures shall be implemented to mitigate potential adverse impacts during construction and operation phases:

- EPC Contractor and Alba shall maintain a good relationship with neighboring industries or facilities or other stakeholder groups who may potentially be affected by construction and operation activities. Where possible, regular project updates should be disseminated to the stakeholders via newsletter and / or posters on site.

- A grievance management procedure shall be developed to ensure that all complaints are addressed appropriately. Any complaints received with regard to the Project should be logged through a Complaints Register. Any feedback, both positive and negative, received will be considered by management, registered, investigated, and addressed through appropriate management measures.
- With consistent implementation of environmental management measures described throughout the ESIA, potential nuisance / disturbance / adverse impacts (e.g., dust, odour, noise, traffic) to nearby facilities can be avoided. Similarly, any reduced amenity impacts in the surrounding areas will be minimized.
- Built-in pollution control measures are included in the design to avert the perceived adverse impacts of the Project. This includes the use of flue gas treatment system.
- The site layout, construction logistics and methods shall consider the potential environmental health and safety risk to the neighboring facilities. This shall include review of procurement and logistics schedules to minimize deliveries as far as practicable; limit deliveries to day time hours to reduce night time noise; limit deliveries and workforce transport outside of peak hours to reduce congestion; and implementation of air and noise control measures to minimize health impacts.

14 GEOLOGY, SOILS AND GROUNDWATER

14.1 Applicable Standards

The Ministerial Order No.1 of 1998 does not specify numerical standards for potential contaminants in soils; similarly, there are no internationally agreed soil quality standards.

Although not technically international standards, many appraisals of soil quality utilize the Dutch guidelines for soil contamination, also referred to as "The Dutch List". These guideline values, which have been generated using a risk-based approach, are intended to highlight the need for any potential remedial action. The Dutch List values, typically used for initial screening of soil quality, are the Dutch Target Values (DTVs) and the Dutch Intervention Values (DIVs). The intervention values are given in Table 14-1.

DIVs indicate the concentrations at which soil remediation may be required (i.e., the concentrations at which the functional properties of the soil in relation to humans, plant life and animal life are seriously impaired or threatened).

Table 14-1 Dutch Soil Circular 2013

Name of substance	Intervention Values	
	Soil (mg/kg)	Groundwater (µg/l)
Metals		
Aluminium (Al)	-	-
Antimony (An)	22	20
Arsenic (As)	76	60
Barium (Ba)	-	625
Cadmium (Cd)	13	6
Chromium (Cr)	-	30
Cobalt (Co)	190	100
Copper (Cu)	190	75
Lead (Pb)	530	75
Iron (Fe)	-	-
Manganese (Mn)	-	-
Mercury (Hg)	-	0.3
Molybdenum (Mo)	190	300
Nickel (Ni)	100	75
Zinc (Zn)	720	800
Non-Metals		
Calcium (Ca)	-	-

Name of substance	Intervention Values	
	Soil (mg/kg)	Groundwater (µg/l)
Chloride (Cl)	-	-
Cyanide (Cn)	20	1500
Fluoride (Fl)	-	-
Magnesium (Mg)	-	-
Phosphate (P)	-	-
Sulphur (S)	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)		
Acenaphthene	-	-
Anthracene	-	5
Benzo(a)anthracene	-	0.5
Benzo(a)fluoranthene	-	0.05
Benzo(ghi)perylene	-	0.05
Benzo(a)pyrene	-	0.05
Chrysene	-	0.2
Fluorene	-	-
Fluoranthene	-	1
Indeno(1,2,3cd)pyrene	-	0.05
Naphthalene	-	70
Phenanthrene	-	5
Pyrene	-	-
BTEX		
Benzene	1.1	30
Toluene	32	1000
Ethyl benzene	110	150
Xylene	17	70

14.2 Baseline Environment

14.2.1 Site Conditions

The proposed plot for Block 4 is approximately 20,000 m^2 and located at south of the existing PS 5. Plot is used for PS 5 project offices and material storage. Portable office cabins and material will be moved out of site prior to the construction.

Signs of potential contamination were not observed during initial site visit.

Figure 14-1 Overview of the Project Site

14.2.2 Geology

14.2.2.1 General Information

Bahrain may be divided into five physiographic zones (12 – Doornkamp et al., 1980). The Central Plateau and Jabals, which is basically, an anticlinal dome occurring in the center of the island and consisting mostly of sedimentary limestone rocks. The general surface level is 40-66m, with numbers of steep-sided and flat-topped residual hills (or Jabals), rising to a maximum elevation of 122.4 m above sea level at Jabal Al Dukhan. The Interior Basin, created over millions of years through erosion, surrounds the central plateau. The Multiple Escarpments surrounding and overlooking the Interior Basin is a continuous belt of multiple, inward-facing escarpments with a maximum height of 20 m above sea level. The Main Backslope decline away from the crest of the escarpment is an extensive, gently inclined surface. At the base of the backslope, solid geology gives way to a surrounding fringe of young, unconsolidated, superficial deposits laid down by a combination of marine and Aeolian processes. This zone represents about 50% of the total area of the main island. The products of erosion of the backslope are washed and deposited in many areas in the coastal lowlands forming sand sheets [13 – SCE, 2015; 14 – Alkhuzai, 2015a; 15 – Zainal and Loughland, 2009).

The main Island of Bahrain consists of a partially eroded dome of sedimentary deposits which are of Eocene age flanked by formations of Pleistocene and Holocene.

Geological records indicate that the site is likely to be underlying by Ras Aqr formation.

Three main units are recognized within this formation:

a) Cap rock (limestone and sand stone),

b) Mudflood deposits (unconsolidated soils), and

c) Carbonate rich, fine-grained rocks (calcisiltite and calcilutite).

Above the Ras Al Aqr Formation, shallow sediments of marine origin (clay/silt, sand, gravel, shells, and shell fragments) can be expected.

14.2.2.2 Geotechnical Investigation

During Alba Potline 6 Expansion Project a geotechnical investigation was carried out by QEL Bahrain at the PS 5 location. The study was conducted from 15th September to 19th October 2016. 31 boreholes and four (4) trial pits were drilled as part of the study. Boreholes were drilled by a combination of cable tool percussion (shell and auger) boring and rotary core drilling methods. Three (3) TOHO D2-K92 P2 percussion-boring rigs with rotary attachments were employed for this work. Water was added to assist boring and as a flushing medium for rotary coring. Trial Pits were excavated to the Rock head.

The drilled boreholes and Trial pits show that there are general similarities and continuities of the subsurface materials, in spite of some local variations. Limestone was the dominant rock type and was encountered from the ground surface or from very near to the ground surface.

The surface and subsurface ground materials in the study area can be divided into the following types as summarized in Table 14-2:

- Top Soil
- Limestone rock (at places interbedded with calcisiltite (carbonate siltstone), Calcilutite (carbonate mudstone) and Calcarenite (carbonate sandstone).

Table 14-2 Soil and Rock Formation with its Approximate Boundaries

Borehole No.	Top Soil	Limestone	Calcisiltite/Calcilutite
BH 1	GL – 1.55	3.55 – 12.00	1.55 – 3.55
		13.65 – 20.00	12.00 – 13.65
BH 2	GL 1.50	1.50 – 10.65	10.65 – 12.18
		12.18 – 16.00	16.00 – 17.00
		17.00 – 18.45	18.45 – 20.00
BH 3	GL 2.00	2.00 – 11.75	11.75 – 14.20
		14.20 – 21.64	21.64 – 24.40

Borehole No.	Top Soil	Limestone	Calcisiltite/Calcilutite
		24.40 – 35.60	
BH 4	-	GL – 13.00	13.00 – 14.00
		14.00 – 20.00	
BH 5	GL 2.00	2.00 – 11.90	11.90 – 13.05
		13.05 – 20	
BH 6	GL 2.50	2.50 – 12.00	12.00 – 13.75
		13.75 – 20.00	
BH 7	GL 0.80	0.80 – 13.10	13.10 – 13.82
		13.82 – 20.10	
BH 8	GL 2.20	2.20 – 11.60	12.70 – 13.60
		12.00 – 12.70	
		13.60 – 20.00	
BH 9		GL – 10.30	10.30 – 11.08
		11.08 – 18.75	18.75 – 20.00
BH 10	GL – 0.40	0.40 – 8.90	8.90 – 9.80
		9.80 – 11.80	11.80 – 13.90
		13.90 – 20.30	
BH 11	GL – 0.50	0.50 – 8.45	8.45 – 9.10
		9.10 – 10.60	10.60 – 11.47
		11.47 – 18.05	18.05 – 20.68[2]
		21.25 – 25.50	
BH 12	GL – 1.50	1.50 – 11.65	11.65 – 12.64
		12.64 – 20.00	
BH 13	GL – 1.00	1.00 – 13.17	13.17 – 15.00
		15.20 – 20.00	
BH 14	GL – 1.55	1.55 – 9.85	9.85 – 10.50
		10.50 – 12.85	12.85 – 13.50
		13.50 – 20.00	

[2] In BH 11, between 20.68m-21.25m ,a layer of calcarenite was encountered

Borehole No.	Top Soil	Limestone	Calcisiltite/Calcilutite
BH 15	GL – 0.60	0.60 – 22.04	22.04 – 25.00
		25.00 – 26.90	26.90 – 29.63
		29.63 – 39.35	39.35 – 40.00
BH 16	GL – 1.00	1.00 – 13.26	13.26 – 13.90
		13.90 – 21.00	21.00 – 23.63[3]
		24.08 – 26.10	26.10 – 28.26
		28.26 – 31.14	31.14 – 31.56
		31.56 – 38.30	38.30 – 39.10
		39.10 – 40.00	
BH 17	GL – 1.00	1.00 – 12.35	12.35 – 13.70
		13.70 – 20.87	20.87 – 23.11
		23.11 – 25.00	25.00 – 25.60
		25.60 – 40.30	
BH 18	GL – 0.30	0.30 – 11.90	11.90 – 12.60
		12.60 – 20.00	
BH 19		GL – 12.50	12.50 – 13.00
		13.00 – 20.00	
BH 20	GL – 0.85	0.85 – 12.25	12.25 – 13.12
		13.12 – 20.05	
BH 21	GL – 0.50	0.50 – 12.85	12.85 – 13.18
		13.18 – 20.00	
BH 22	GL – 0.90	0.90 – 13.25	13.25 – 14.00
		14.00 – 20.00	
BH 23	GL – 1.30	1.30 – 2.30	2.30 – 12.10
		12.10 – 13.15	13.15 – 13.61
		13.61 – 20.00	
BH 24	GL – 0.60	0.60 – 4.50	4.50 – 5.80
		5.80 – 12.40	12.40 – 13.00

[3] In BH 16, between 23.63m-24.08m, a layer of calcarenite was encountered.

Borehole No.	Top Soil	Limestone	Calcisiltite/Calcilutite
		13.00	19.60
BH 25		GL – 11.30	11.30 – 11.80
		11.80 – 20.00	
BH 26	GL – 1.70	1.70 – 13.73	13.73 – 14.80
		14.80 – 20.00	
BH 27	GL – 0.50	0.50 – 10.74	10.74 – 12.00
		12.00 – 19.50	19.50 – 20.10
BH 28	GL – 0.70	0.70 – 9.35	9.35 – 10.70
		10.70 – 18.00	18.00 – 20.00
BH 29	GL – 2.80	2.80 – 11.55	11.55 – 12.80
		12.80 – 14.80	14.80 – 16.10
		16.10 – 20.10	
BH 30	GL – 0.95	0.95 – 20.40	20.40 – 22.33
		22.33 – 22.88	22.88 – 25.18
		25.18 – 26.15	261.5 – 28.20
		28.20 – 38.07	38.07 – 39.93
		39.93 – 40.10	
BH 31	GL – 0.30	0.30 – 12.90	12.90 – 14.35
		14.35 – 20.00	

14.2.3 Groundwater

14.2.3.1 General Information

The Dammam aquifer is the most important underground water source which forms extensive part of the regions aquifer system, and the aquifer is confined from the top by the Neogene claystones (10-60 m) and from the bottom by the shale beds of Sharks Tooth shale member (8-20 m), Figure 14-2.

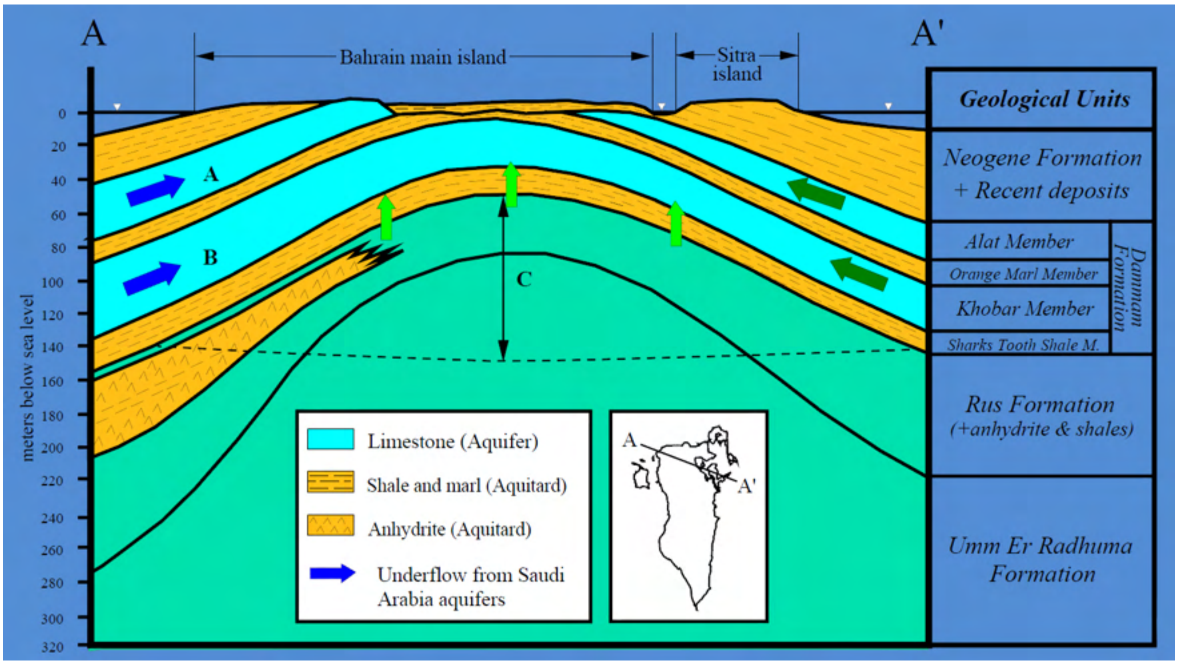


Figure 14-2 Regional hydrogeological cross section- Bahrain & Dammam Domes (Modified after GDC 1983)

14.2.3.2 Groundwater Level

Groundwater was encountered in the boreholes at depths as provided below during the investigation period.

Table 14-3 Groundwater Level

Borehole No.	Date of Measurement	Standing Water Level Depth (m) BEGL	Elevation with respect to NSD	Standing Water Level Elevation (m) BEGL w.r.t to NSD
BH 3	12-10-2016	26.20	27.61	1.41
	28-10-2016	26.10	27.61	1.51
	03-11-2016	26.00	27.61	1.61
	08-11-2016	26.30	27.61	1.31
BH 15	01-10-2016	22.80	24.00	1.50
	28-10-2016	22.50	24.00	1.50
	03-11-2016	22.50	24.00	1.50
	08-11-2016	22.75	24.00	1.25
BH 16	07-10-2016	22.80	24.00	1.20
	28-10-2016	22.75	24.00	1.25

Borehole No.	Date of Measurement	Standing Water Level Depth (m) BEGL	Elevation with respect to NSD	Standing Water Level Elevation (m) BEGL w.r.t to NSD
	03-11-2016	22.85	24.00	1.15
	08-11-2016	22.80	24.00	1.20
BH 17	13-10-2016	22.80	24.25	1.45
	28-10-2016	22.65	24.25	1.60
	03-11-2016	22.80	24.25	1.45
	08-11-2016	22.80	24.25	1.45
BH 30	06-10-2016	24.50	25.58	1.08
	28-10-2016	24.45	25.58	1.13
	03-11-2016	24.50	25.58	1.08
	08-11-2016	24.50	25.58	1.08

Fluctuations in these levels are not expected to occur due to tidal influences as the site is far away from sea shore.

14.3 Potential Impacts

14.3.1 Construction Phase

14.3.1.1 Contaminated Ground

Evidence of soil contamination were not observed during the visual inspection. Hence, impacts due to contaminated soils are not anticipated during construction phase.

14.3.1.2 Soil Erosion

The nature of construction works will require disturbance and exposure of soils during construction. This has the potential to cause soil erosion while soils are exposed.

14.3.1.3 Fuel Storage

There is a potential impact on soils and geology from accidental spillages or leaks from vehicles on site during construction phase.

Since the observed groundwater levels are deeper, no impacts are anticipated to groundwater resources.

14.3.1.4 Geotechnical Issues

There are no deep excavations planned as part of Block 4 construction. There are no areas of soft ground on site and issues with regard to slope stability have been identified at the site.

14.3.2 Operation Phase

14.3.2.1 Fuel and Chemical Storage

A number of chemicals will be stored on site during normal operations. An assortment of lubricants, oils and greases will also be required to store on site.

There is potential for soil contamination in the event of an accidental spillage or leak of above material.

Since the groundwater levels are deeper, significant impacts are not anticipated during operational phase.

14.3.3 Summary of Impacts

The summary of impacts associated with waste management during the construction and operation phases of the Project are summarized in the table below:

Table 14-4 Summary of Noise Impacts during Construction and Operational Phases

Potential Impact	Aspect Impacted	Magnitude of Impacts	Duration of Impacts	Extent of Impacts
Construction Phase				
Soil erosion	Soils and Geology	Less significant to Minor Adverse	Short Term	Local
Fuel storage				
Geotechnical issues				
Soil erosion	Groundwater	No Impact	-	-
Fuel storage				
Geotechnical issues				
Operation Phase				
Fuel and Chemical Storage	Soils and Geology	Less significant to Minor Adverse	Long Term	Local
Fuel and Chemical Storage	Groundwater	No Impact	-	-

14.4 Mitigation Measures

14.4.1 Construction Phase

14.4.1.1 Fuel and Chemical Storage

An environmental operating plan shall be developed during construction phase which will minimize the potential for accidental spillage / leakage. This plan shall include measures to minimize environmental impact including the following:

- Chemicals and other construction materials will be safely stored to ensure the risk of oil or chemical contamination of soil is minimized.
- A program of routine checking of equipment, machinery and vehicles should be implemented to ensure there is no leakage of oil and fuel.
- Chemical or fuel spills should be cleaned up as soon as practicable to prevent contaminants from percolating into the soil and groundwater.
- Appropriate hazardous waste management practices shall be employed, covering storage and handling (i.e., use of 110% bunded storage areas, availability of MSDS, spill kits and emergency equipment, labelling of containers and areas, access restrictions at storage areas and provision of training to relevant staff).
- Appropriate measures will be put in place to minimize the risk of soil contamination from refueling of vehicles, e.g., re-fueling to be undertaken in designated areas with drained hard standing, and spill kits in place.
- Good housekeeping (daily site clean-ups, use of disposal bins, etc.) on the project site, and the proper use, storage and disposal of many substances used on construction sites, such as lubricants, fuels and oils and their containers can prevent soil contamination.

A contingency plan for pollution emergencies shall also be developed by the appointed EPC Contractor prior to work and regularly updated, which would identify the actions to be taken in the event of a pollution incident. The contingency plan should address the following:

- Containment measures;
- Emergency discharge routes;
- List of appropriate equipment and clean-up materials;
- Maintenance schedule for equipment;
- Details of trained staff, location, and provision for 24-hour cover;
- Details of staff responsibilities;
- Notification procedures to inform the SCE;
- Audit and review schedule;
- Telephone numbers of Sewage handling companies and nearest STP;
- List of specialist Waste handling companies and their telephone numbers.

14.4.1.2 Soil Erosion

The following measures shall be implemented during construction phase:

- The disturbance/exposure of soils from the site shall be carried out during suitable weather conditions in order to minimize the production of sediment and to reduce nutrient loss.
- Where possible, excavated spoil material shall be reused on site for fill / backfill purposes; where it is necessary to stockpile spoil, appropriate protection measures should be implemented to prevent wind and water erosion.
- Progressive compaction (stabilization) should be undertaken immediately after excavation.
- Provision of efficient temporary drainage system on site to prevent loose soil from being scoured off by surface runoff.
- Soil stockpiles should be maintained at minimum height.

14.4.2 Operational Phase

14.4.2.1 Fuel and Chemical Storage

The management measures detailed in Section 14.4.1.1 and Section 12.4.1.8 shall be implemented during operational phase.

14.5 Residual Impacts

There will be a temporary less significant to minor adverse impacts on soils and geology from the construction activities.

There will be temporary less significant to minor adverse impact from accidental spillages or leakages from chemicals or fuels stored on site during construction and operational phases.

With mitigation measures described above the impacts are considered to be **negligible**.

There will be no impact relating to geotechnical issues and groundwater resources during both construction and operational phases.

14.6 Monitoring

Visual inspection of waste storage areas, raw materials, and products storage area on a regular basis.

15 ACCESS AND VEHICULAR TRAFFIC

15.1 Baseline Assessment Methodology

As per Kingdom of Bahrain, Ministry of Municipalities & Agriculture Urban Planning Affairs, Traffic Impact Assessment Guide for Developers [20], the peak hours periods in Bahrain are as follows and capacities of typical mid-block roads in urban locations are given in Table 15-1:

- AM Peak (07:00 to 08:00)
- PM Peak (13:00 to 14:00)
- Evening Peak (16:00 to 19:00)

An important consideration in determining the impact of a development proposal on the road system is to assess the effect on traffic efficiency, the objective of which is to maintain the existing level of service (LOS).

As per Kingdom of Bahrain, Ministry of Municipalities & Agriculture Urban Planning Affairs, Traffic Impact Assessment Guide for Developers, the level of service is used as the performance standard. This is a qualitative assessment of the quantitative effect of factors such as speed, volume of traffic, geometric features, traffic interruptions, delays, and freedom to maneuver. There are six levels of LOS:

Level of Service A: This, the top level is a condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to maneuver within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent.

Level of Service B: This level is in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to maneuver within the traffic stream, although the general level of comfort and convenience is little less than that of the level of Service A.

Level of Service C: This service level is also in the zone of stable flow, but most drivers are restricted to some extent in their freedom to select their desired speed and to maneuver within the traffic stream. The general level of comfort and convenience declines noticeably at this level.

Level of Service D: This level is close to the limit of stable flow but is approaching unstable flow. All drivers are severely restricted in their freedom to select their desired speed and to maneuver within the traffic stream. The general level of comfort and convenience is poor, and small increases in traffic flow will generally cause operational problems.

Level of Service E: This occurs when traffic volumes are at or close to capacity and there is virtually no freedom to select desired speeds or to maneuver within the traffic stream. Flow is unstable and minor disturbances within the traffic stream will cause a traffic-jam.

Level of Service F: This service level is in the zone of forced flow. With it, the amount of traffic approaching the point under consideration exceeds that which can pass it. Flow break-down occurs and queuing and delays result.

Table 15-1 sets out peak hour flows for one and two lanes of unidirectional travel, based on volume / capacity ratios applicable for rural roads in level terrain with no sight distance restrictions on overtaking. It should be noted that these are indicative figures based on the rural volume / capacity ratios with a lane capacity of 1400 veh/hr.

Table 15-1 Urban Road Peak Hour Flows per Direction

Level of Service	One Lane (veh/hr)	Two Lane (veh/hr)
A	200	900
B	380	1,400
C	600	1,800
D	900	2,200
E	1,400	2,800

Vehicle classification observed during the study are given below:

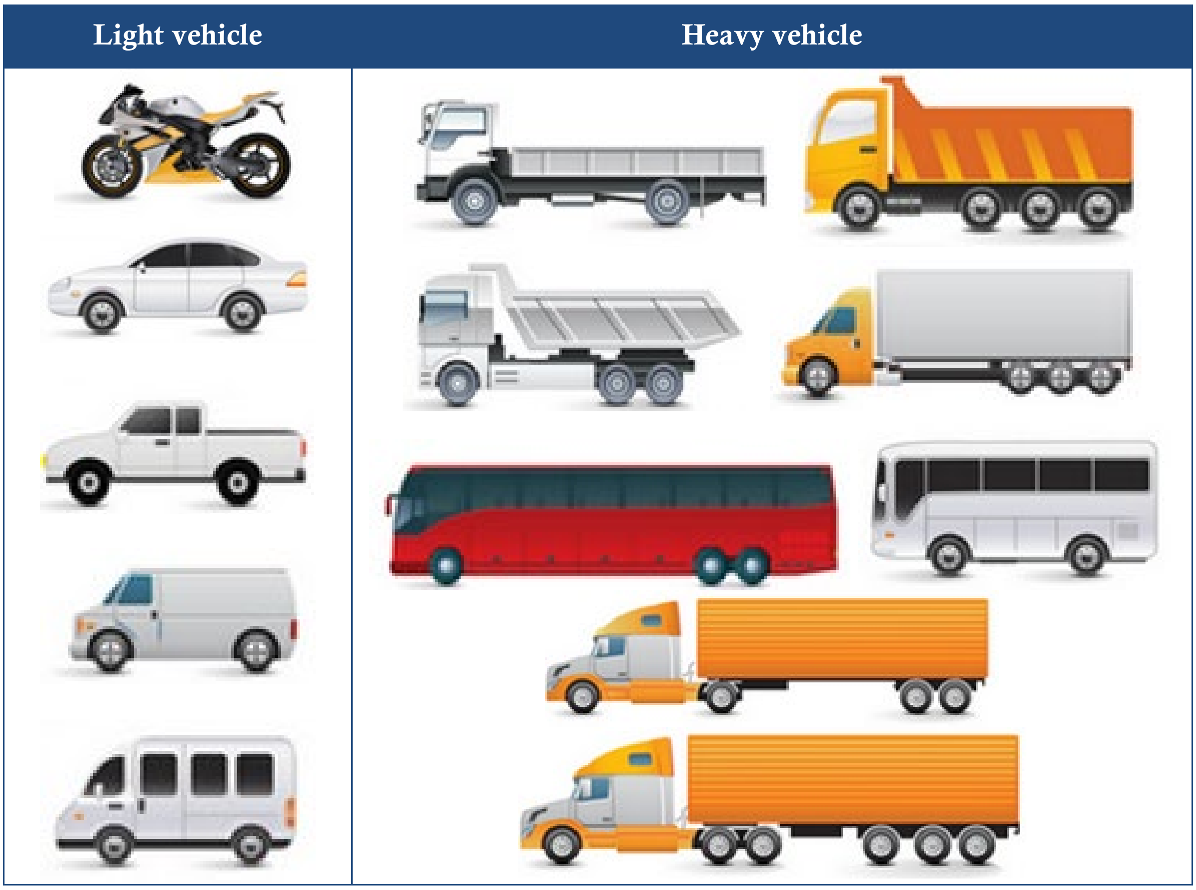


Figure 15-1 Vehicle Classifications

15.2 Baseline Environment

15.2.1 Construction Site Office and Laydown Yard

Figure 4-7 presents proposed plan for temporary construction facilities and access route to the Block 4 site. Temporary construction areas will be located to the West of project site. At present the area is empty barren land.

The temporary construction area is expected to include construction site offices, material storage area, and sanitary facilities. Accommodation for the construction staff will be organized by the EPC contractor outside Alba.

Location for the laydown yard is not proposed yet. However, it is anticipated that the EPC contractor may use their existing laydown yard located in Al Dur for the Block 4 Expansion Project.

15.2.2 Existing Traffic Conditions

It is proposed that the existing road network will be utilized for to access the PS 5 Block 4 Site during construction and operation phases. To that extent, during construction phase, roads accessible to the plot is Road 5146 via Road 5135, and Road 5138 or via Road 5136 from King Hama Highway for vehicles coming from North (from Alba side) and Road 5146 via Road 5156, Road 5141, and Road 5136 from King Hamad Highway for vehicles coming from South (from Al Dur side).

During operational phase of Block 4, vehicles will use existing road network within Alba complex to access the plant. The existing staff at PS 5 will be managing the newly built Block 4 and the new block will be utilizing resources from the existing PS 5 facilities. Hence, additional traffic is not expected during operational phase.

Roads 5135 and 5136 starts from King Hamad Highway and used to access Al-Mazara'a Industrial Park. Both roads are undivided median lane with 900 PCU per hour capacity. Road 5156 starts from the traffic signal on King Hamad Highway and goes towards Askar. It is also an undivided median lane with 900 PCU per hour capacity. Roads 5146, 5141, and 5138 are internal roads within Al-Mazara'a Industrial park which are undivided median lane with 900 PCU per hour capacity.

Traffic volume counts on the roads 5135 and 5146 were carried out on weekdays – 22nd and 23rd December 2021 and weekend – 24th December 2021. Traffic volume counts on the Road 5156 was carried out on weekdays – 8th and 9th December 2021 and weekend – 10th December 2021.

Traffic volume counts are presented in

Figure 15-2 PS 5 Block 4 Expansion Project – Access Route Map

Table 15-2 Summary of Existing Traffic Conditions

Peak Time & Hours	Total Vehicle/Lane/Hour					
	Weekday		Weekend	Weekday		Weekend
	22-12-2021	23-12-2021	24-12-2021	22-12-2021	23-12-2021	24-12-2021
	Road 5146 to Road 5136			**Road 5136 to Road 5146**		
Morning 7.00 AM to 8.00 AM	14	18	3	22	25	5
Afternoon 1.00 PM to 2.00 PM	10	23	5	18	17	3
Evening 4.00 PM to 7.00 PM	28	32	7	20	21	8
	22-12-2021	**23-12-2021**	**24-12-2021**	**22-12-2021**	**23-12-2021**	**24-12-2021**
	Road 5135 to Road 5141			**Road 5141 to Road 5135**		
Morning 7.00 AM to 8.00 AM	141	126	40	36	27	5
Afternoon 1.00 PM to 2.00 PM	130	121	28	29	33	10
Evening 4.00 PM to 7.00 PM	387	394	62	58	54	15
	08-12-2021	**09-12-2021**	**10-12-2021**	**08-12-2021**	**09-12-2021**	**10-12-2021**
	King Hamad Highway to Askar (5156)			**Askar (5156) to King Hamad Highway**		
Morning 7.00 AM to 8.00 AM	93	87	30	238	263	142
Afternoon 1.00 PM to 2.00 PM	88	82	26	269	296	97
Evening 4.00 PM to 7.00 PM	179	153	43	708	754	237
	08-12-2021	**09-12-2021**	**10-12-2021**	**08-12-2021**	**09-12-2021**	**10-12-2021**
	Road 5156 – Al-Mazara'a Industrial Park (5141)			**Al-Mazara'a Industrial Park (5141) – Road 5156**		
Morning 7.00 AM to 8.00 AM	47	46	19	198	235	92
Afternoon	42	34	16	305	317	69

Peak Time & Hours	Total Vehicle/Lane/Hour					
	Weekday		Weekend	Weekday		Weekend
1.00 PM to 2.00 PM						
Evening 4.00 PM to 7.00 PM	87	53	14	718	695	161
	08-12-2021	**09-12-2021**	**10-12-2021**	**08-12-2021**	**09-12-2021**	**10-12-2021**
	Road 5156 (Bypass) – Road 5141			**Road 5141 – Road 5156 (Bypass)**		
Morning 7.00 AM to 8.00 AM	15	11	2	20	22	10
Afternoon 1.00 PM to 2.00 PM	6	3	2	25	21	4
Evening 4.00 PM to 7.00 PM	17	9	12	87	95	15

Road 5146 is adjacent to the project site and is undivided median lane with 900 PCU per hour capacity. From the traffic assessment study, it was observed that the one-way maximum vehicle / lane during weekday is approximately 32 on road 5146, 394 on road 5135, 754 on road 5156, 718 on road 5141 and 95 on Roads 5141 and 5156 bypass.

Based on above table it can be concluded that Roads 5146, 5135 and 5141 falls under **Level of Service A** and Road 5156 falls under **Level of Service B**.

15.3 Impact Assessment

15.3.1 Construction Phase

15.3.1.1 Impacts on Traffic Conditions

Since the contractor’s method statement is not available at the time of preparation of this document, exact number of vehicles and equipment required during construction phase are unknown. It is anticipated that construction will be undertaken over a three (3) year period. Approximately 1,500 workers will be at site during the peak construction period. During construction period, vehicles ferrying workers to and from site, trucks carrying construction materials to site and waste materials out of site for disposal will be accessing the roads in the area.

Based on the traffic study conducted on the adjacent roads it is anticipated that additional traffic generated will have a **minor adverse** impact on the traffic flow on Roads 5146, 5135, 5136, 5141, 5156 and King Hamad Highway.

15.3.1.1.1 Impacts during Transportation of CCP Components

Khalifa bin Salman Port will be used to bring CCP components. It is anticipated that the materials will be offloaded to a barge and then transport to a Jetty in Askar area. After customs clearance they will be transported to the site via King Hamad Highway, Roads 5156, 5141 and 5146. Considering the existing traffic flow on these roads and the lower number of trips required the significance of impact due to the transport of plant components is consequently regarded as **minor adverse**.

15.3.1.1.2 Impact on Road Sections

Construction related traffic, in addition to the existing traffic volumes, would not exceed the vehicle carrying capacity of the road sections. Hence, the impacts are assessed to be of **insignificant**.

15.3.1.1.3 Impact on Road Intersections

Apart from the road sections, the intersections usually act as bottlenecks in the network that can also experience capacity problems. Based on the traffic volumes, the most critical intersection will be the intersection of King Hamad Highway and Road 5156. The intersection is controlled using traffic signal. The expansion works on the King Hamad Highway is completed.

The construction traffic will have to enter Road 5156 from King Hamad Highway to gain access to the construction site. In addition to this, heavy vehicles carrying construction materials will also move through this intersection during the daytime and can also have an adverse impact. The significance of the impact is **minor adverse**.

15.3.1.2 Impact on Road Infrastructure

Since the construction phase is short compared to the lifetime of the road, the effect of construction traffic on the structural life of the road will be **insignificant**, provided that the roads are well maintained, and heavy vehicles are not overloaded.

15.3.1.3 Impacts on Air Quality and Noise

As described in Section 9.4.1 and 10.4.1, there will be **minor adverse** impact to the local air quality and environmental noise because of traffic generated during construction phase of the project. The existing noise environment in the vicinity of the proposed plot is observed to be typical to that of an industrial area.

15.3.2 Operational Phase

Access and vehicular traffic impacts are not anticipated to be significant during operation as the new block will be utilizing resources from the existing PS 5 facilities. Further, the existing staff at PS 5 will operate Block 4. Additional traffic flow is not expected. Hence, impacts to access and vehicular traffic during operation phase are not anticipated.

15.4 Mitigation Measures

15.4.1 Construction Phase

The following measures shall be implemented during construction phase of the Project:

- Speed limits shall be set for on-site traffic.
- Flagmen should be always present to signal moving machinery and equipment.
- Traffic signs and control signals to direct and control traffic flow, to include:
    - Signs that are reflective or adequately illuminated at night.
    - Warning signs on approach and departure from work site.
    - All other warning and regulatory sign
- Where practical, deliveries should be undertaken outside peak periods in the morning and afternoon.
- Construction material shall be delivered in bulk rather than in small quantities to reduce number of trips.
- Coordinate with relevant authorities and neighboring industries during delivery of heavy and oversized material.
- A traffic management plan shall be developed by the EPC Contractor.
- Appoint a member of the EPC Contractor's Project Team as Transport Coordinator.

To mitigate traffic impacts associated with noise, dust and air emissions, air quality management measures (Section 9.5.1) and noise control measures (Section 10.5.1) shall be implemented.

16 ENVIRONMENTAL MANAGEMENT AND MONITORING PLAN

The framework Environmental Management and Monitoring Program (EMMP) forms part of this ESIA report to provide a mechanism for the development and implementation of mitigation measures against potential adverse environmental impacts from the Project construction and operational activities.

16.1 Objectives

The EMMP provides the framework to facilitate the implementation and monitoring of mitigation measures to eliminate or minimize adverse environmental impacts of the Project to acceptable levels.

Specific objectives of this EMMP are to:

- Provide guidance for the development of the Construction and Operational EMPs.
- Outline mitigation measures and management procedures to be implemented to guide Project design, construction, and operation in accordance with the requirements of relevant environmental legislation, policy and guidelines.
- Provide a mechanism for monitoring and reporting of the various environmental undertakings of the Project, which will include routine liaison with SCE and other regulatory authorities.
- Define roles, responsibilities and accountabilities of parties and individuals, ensuring that all parties and individuals involved in the Project understand and adhere to the environmental management requirements relevant to their line of work.
- Set the requirements for environmental induction and training programs.
- Facilitate continuous improvement of the Project's overall environmental performance through a regular review of specific EMPs and audit of the Project's compliance to the requirements.

16.2 Implementation

This framework EMMP should be employed as a guideline for the design, construction, and operation of the Project. Specific components of this EMMP will be finalized as separate management plans for each stage of the construction and operation phases of the Project. Specific management measures will also be incorporated, where relevant, in the Contractors' work method statements.

Managers and supervisors are responsible for providing assurance that their work unit complies with the requirements in this framework EMMP as translated to

Construction and Operation ESMPs. This can be done via conducting regular inspections, monitoring and audits of the Project management system and / or specific ESMPs.

Audits can be undertaken as regular internal or end of phase 'milestone' checks against regulatory guidelines by internal staff or independent external auditors. A documented auditable trail should be established for verification purposes.

16.3 Environmental and Social Management Plans

A Construction Environmental and Social Management Plan (CESMP) and Operation Environmental and Social Management Plan (OESMP) will be developed for both construction and operation phases of the Project. The CESMP and OESMP will be submitted along with this ESIA report.

16.4 Environmental Monitoring Plan

The formulation of an environmental monitoring plan will provide assurances that the responsible entity will immediately address any adverse impact on the environment aspects during the construction and operation phases of the Project.

16.4.1 Construction Phase

The proposed monitoring plan for the project construction phase is presented in the table below. It includes information on the parameter to be monitored, facility, frequency, and procedure.

Table 16-1 Construction Environmental Monitoring Requirements

Aspect	Requirement
Compliance to Environmental License Terms and CEMP	— Monthly environmental audits on site. — Review meeting with the Environmental Engineer, HSE Officer and Construction team. — Review of environmental license and its availability on site and contractual documents — Review of site inspection and training records — Review of complaints register — Review of accident / incident register — Review of emergency response plan and implementation inspection
Air Quality	— Daily visual inspection of dust levels from construction works and stockpiles. Verification of implementation of mitigation measures during site visit. — Ambient air quality monitoring at site boundary and nearest sensitive receptor location on monthly basis for gaseous pollutants and particulate matter.

Aspect	Requirement
	— Daily visual inspection of adjacent roads.
Noise	— Review of complaints register — Noise monitoring at site boundary and nearest sensitive receptor on monthly basis and shall be on daily basis when rock breakers are operational during excavation activities. — Review of mitigation measures implementation.
Waste Management	— Review of waste logs and disposal records — Inspection of waste storage areas, sanitary facilities, material storage areas and construction areas
Health and Safety	— Review of site induction, training and toolbox talks records — Review of HSE inspection records
Geology, Soil and Groundwater	— Visual inspection daily for presence of soil contamination. — Inspection during dewatering activities and ensure that dewatered water is not disposed into the marine environment.

16.4.2 Operational Phase

16.4.2.1 Initial Performance Test

The initial performance test must be conducted within 60 days after the plant reaches the charge rate at which it will operate, but no later than 180 days after initial start-up.

The initial air pollution control system inspection must be carried out within 60 days after installation of the control system and plant reaches the charge rate at which it will operate, but no later than 180 days after device's initial start-up.

The performance test report must be submitted to the Supreme Council for Environment. Initial performance tests must be conducted using the minimum run duration and test procedure specified in Table 16-2.

Table 16-2 Initial Performance Test Specifications

Pollutant	Method	Averaging Time
Sulphur Dioxide	USEPA Method 6C	3-run average (1-hour minimum sample time per run)
Oxides of Nitrogen	USEPA Method 7E	3-run average (1-hour minimum sample time per run)
Carbon Monoxide	USEPA Method 10	3-run average (1-hour minimum sample time per run)

16.4.2.2 Operational Monitoring

The operational stack emission monitoring shall be carried out monthly during first year of operations and quarterly thereafter. Alba shall appoint an environmental consultant to carry out environmental audits to evaluate the compliance of project activities to the Environmental Management and Monitoring Plan and to submit monthly environmental monitoring reports to the SCE during first year of operation.

In addition to the stack emissions, Alba shall perform the ambient air quality, noise, indoor air quality and occupational noise monitoring during operation phase of the project. The anticipated environmental monitoring program during operational phase of the project is presented in the table below:

Table 16-3 Operational Monitoring Program

Parameter	Frequency / Duration	Location and Method
Stack Emission Monitoring	Monthly stack emission monitoring and submission of reports during first year of operations Quarterly stack emission monitoring and reporting from second year onwards	HRSG Main Stack / Continuous Emission Monitoring System (CEMS)
Acid Gas Monitoring	Biannually	Nearest receptor locations, accommodation, and commercial areas. ISO 9225:2012 €
Noise Monitoring	Quarterly	Four (4) Locations at the plant boundary line
Occupational Noise Monitoring	Annually	Process Areas
Effluents	As per existing practice	Parameters listed in Table 11-2 and Table 11-3

17 REFERENCES

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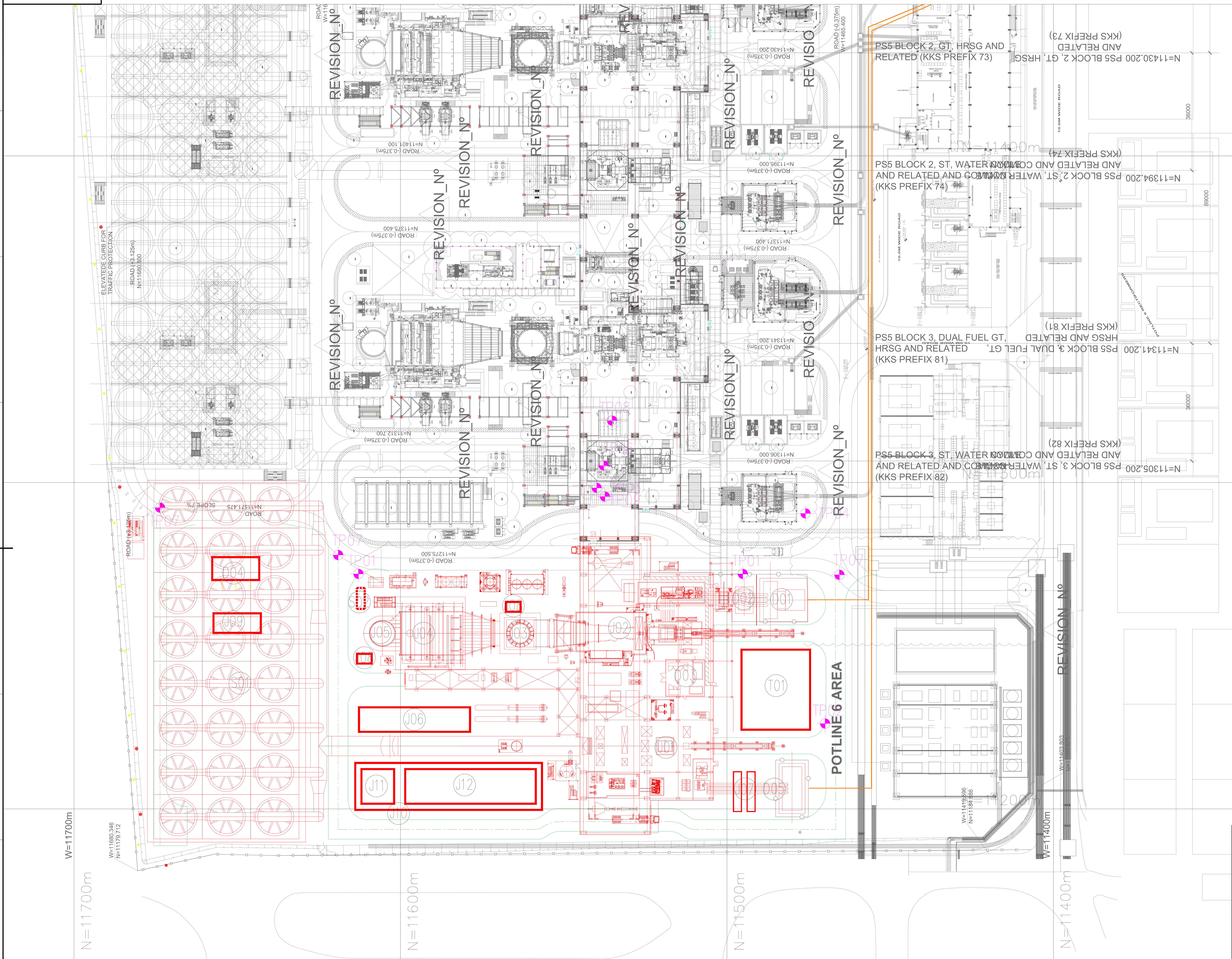
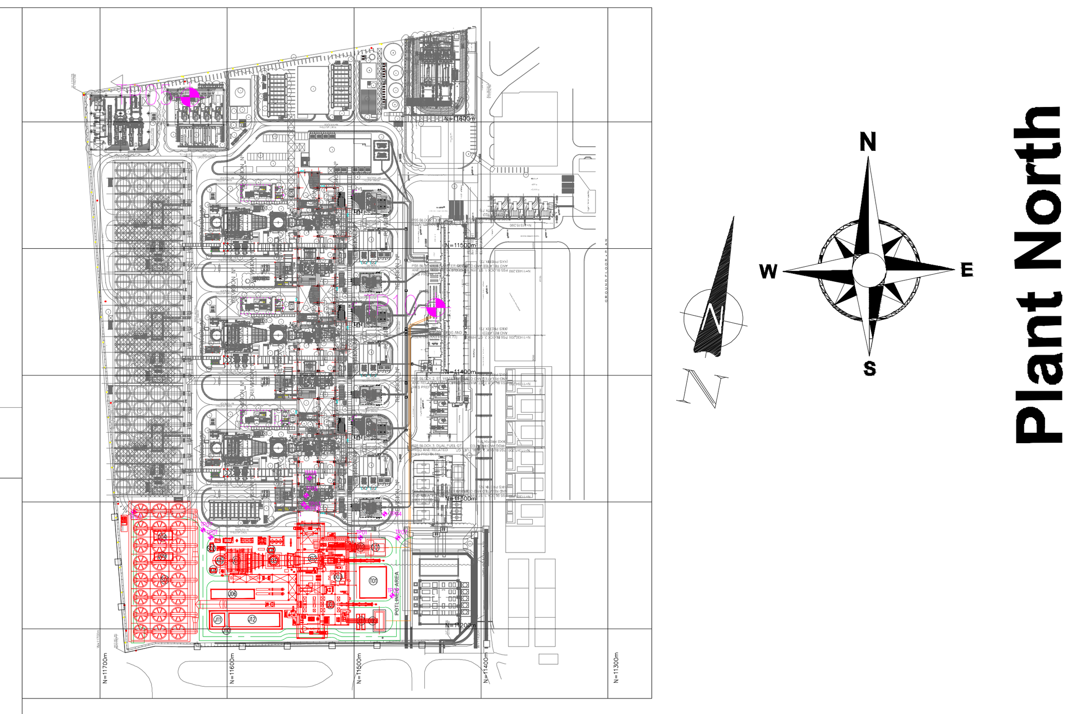
20. Ministry of Municipalities & Agriculture Urban Planning Affairs, Traffic Impact Assessment Guide for Developers

18 APPENDICES

Appendix A: Plant Layout

F0803-53E-LA-PC0103-001





KEY PLAN

LIST OF BUILDINGS AND STRUCTURES

No.	NAME	NOTE	No.	NAME	NOTE
J01	STG HALL		D01	GT GSUT	
J02	GTG HALL		D02	UAT	
J03	BYPASS STACK		D03	GCB	
J04	HRSG		D04	ACC E-ROOM	
J05	MAIN STACK		D05	ST GSUT	
J06	CCW FIN FAN COOLER (ST&BOP)				
J07	EMERGENCY DIESEL GENERATOR		S01	ACC	
J08	CEMS		S02	BOILER BLOW DOWN COOLING POND	
J09	CEP/VACUUM/CONDENSATE RECEIVE TANK				
J10	FUEL GAS COMPRESSOR STATION		T01	CENTRAL CONTROL BUILDING	
J11	FINFAN COOLER FOR FUELGAS COMPRESSOR STATION				
12	FINFAN COOLER FOR GT				

TERMINAL POINT LEGEND

NO.	NAME	NOTE
TP01	INTERFACE POINT OF FIREFIGHTING SYSTEM	
TP02	INTERFACE POINT OF STORM WATER SYSTEM	
TP03	INTERFACE POINT OF POTABLE AND SERVICE WATER SYSTEM	
TP04	INTERFACE POINT OF OILY WASTE WATER SYSTEM	
TP05	INTERFACE POINT OF FUEL GAS	REFER TO KEY PLAN
TP06	PLANT LIQUID EFFLUENT(HRS&ADV BLOWDOWN) TO N-PIT	
TP07	ROAD CONNECTION POINT	
TP08	INTERFACE POINT OF AUXILIARY STEAM	
TP09	INTERFACE POINT OF COMPRESSED AIR	
TP10	EXISTING GIS MODIFICATION	

FOR TENDER PURPOSE ONLY

GENERAL LEGEND

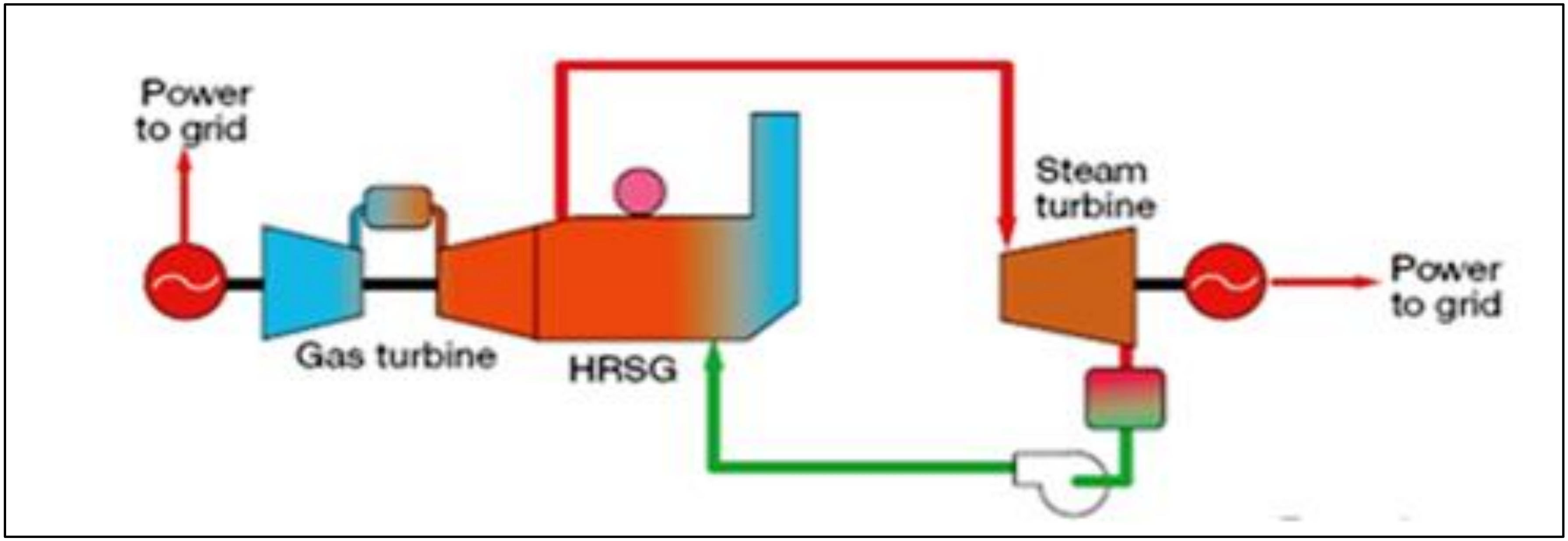
SYMBOL	NAME	NOTE
	BUILDING AND STRUCTURE	
	UNDERGROUND STRUCTURES	
	ROAD	
	INTERNAL FENCE	
	BOUNDARY FENCE	

NOTE:
1. THE DRAWING IS ACCORDING TO THE FILE PROVIDED BY THE OWNER.
2. THE COORDINATE SYSTEM IS ACCORDING TO THE FILE PROVIDED BY THE OWNER.
3. ALL DIMENSIONS ARE IN METERS UNLESS NOTED OTHERWISE.

A1(841X594)

Appendix B: Process Flow Diagrams

PROCESS FLOW DIAGRAM

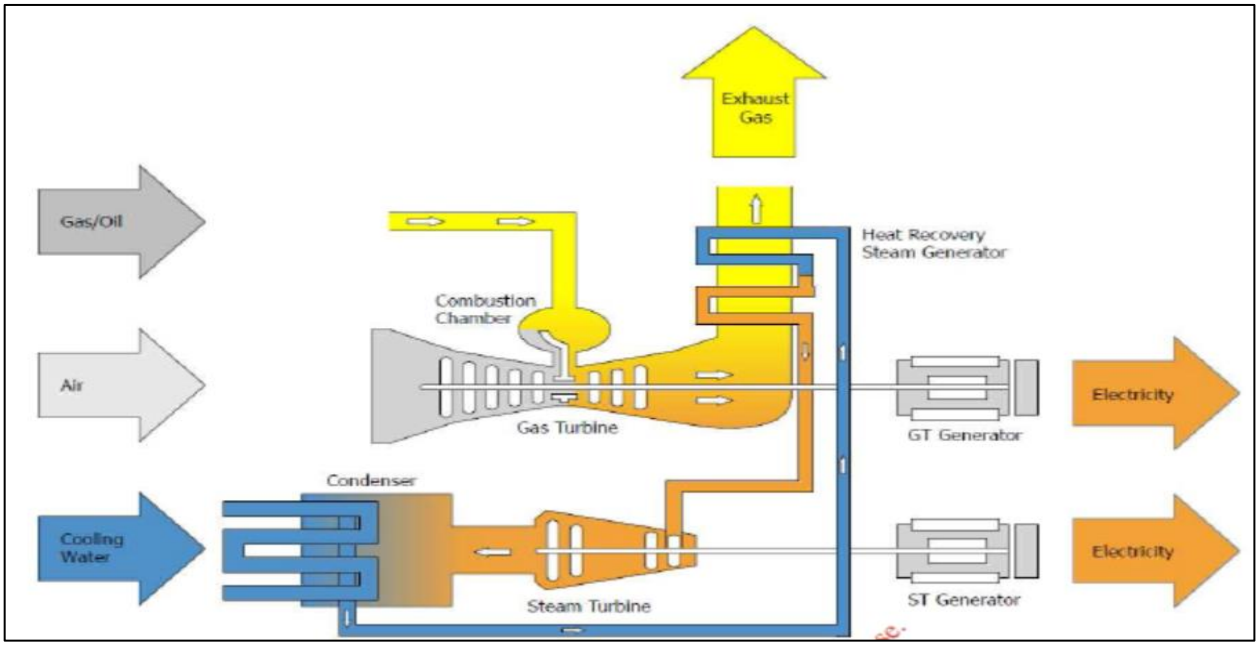


Appendix 3

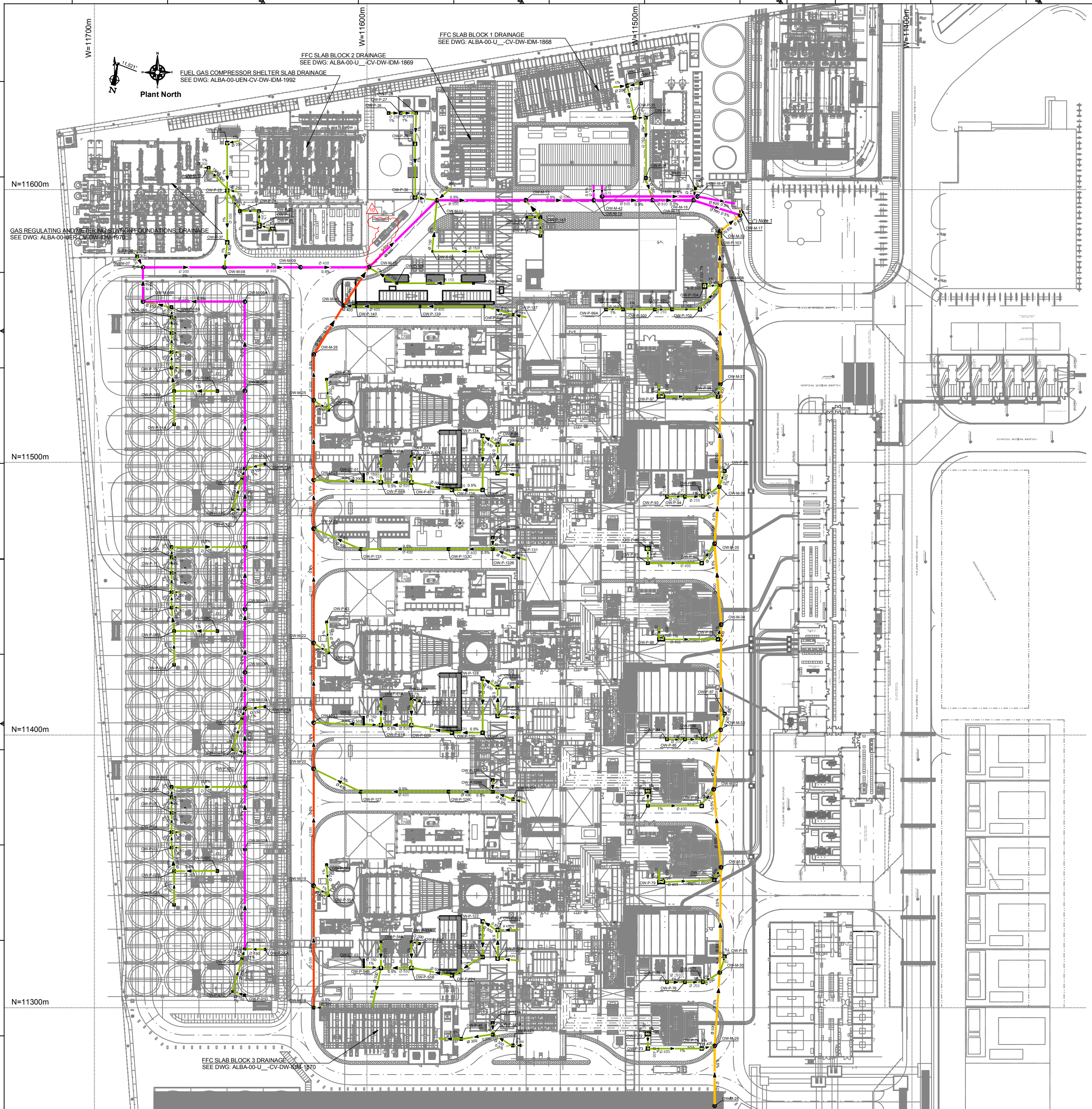
Combined Cycle Process

In combined cycle plant, Natural gas is fired in the combustor, then the hot gas from the combustor passes through the Gas turbine and the electricity is generated. Waste exhaust hot gas leaving the Gas turbine passes through the heat recovery steam Generator (HRSG) and steam is generated. Steam generated in the HRSG is admitted into the steam turbine and the electricity is generated. Steam leaving the steam turbine is cooled in the Air Cooled Condenser (ACC) and the condensate water is send to the HRSG and returned as steam again as water steam cycle as a closed circuit.

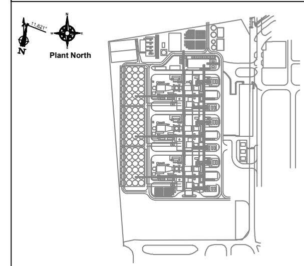
Below, illustrates the combined cycle process.



Appendix C: Oily Water Drainage System Layout



KEY PLAN



GENERAL NOTES

- RELATIVE LEVEL ±0,00 CORRESPONDS TO +24,891 m, PLANT DATUM
- W= 11713,778, N= 11621,766 PLANT COORDINATES CORRESPONDS TO E= 459335, 00, N= 2885989,98 UTM COORDINATES.
- ALL DIMENSION ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
- ALL LEVEL AND COORDINATES ARE IN METERS, UNLESS OTHERWISE NOTED.
- COORDINATE IN THE DRAWING ARE GIVEN IN ALBA LOCAL COORDINATE SYSTEM UNLESS OTHERWISE INDICATED.

DATUM ELEVATION COMPARISON INFORMATION

REFERENCE	NSD	PLANT DATUM
1	24.585 m	25.676 m

NOTES

1. PIPING FROM SEPARATOR TO TERMINAL POINT WILL BE ABOVEGROUND AND CONSIDERED ABOVEGROUND PIPING DRAWING.

LEGEND

- OILY LINE 1
- OILY LINE 2
- OILY LINE 3
- SECONDARY LINES
- OW-M-01 MANHOLE
- OW-P-01 PIT
- OW-S-01 SINKHOLE

REFERENCE DRAWINGS

- ALBA-00-YYY-GN-DW-IDM-0018. GENERAL PLANT LAYOUT
- ALBA-00-UGH-CV-DW-IDM-1044 UNDERGROUND SYSTEM STORM. WATER SYSTEM DRAINAGE PLAN.
- ALBA-00-UZJ-CV-DW-IDM-1003 EARTHWORKS GRADING LEVELS PLAN VIEW I.
- ALBA-00-UZJ-CV-DW-IDM-1004 EARTHWORKS GRADING LEVELS PLAN VIEW II.
- ALBA-00-YYY-CV-DW-IDM-1039 PROJECT GENERAL CIVIL NOTES.
- ALBA-00-UGC-CV-DW-IDM-1049 UNDERGROUND SYSTEMS SEWAGES DRAINAGE PLAN.
- ALBA-00-YYY-CV-DW-IDM-1043 UNDERGROUND NETWORK SYSTEM LAYOUT (CIVIL-MECHANICAL & ELECTRICAL).
- ALBA-00-UGH-CV-DW-IDM-1045 UNDERGROUND SYSTEM STORM.WATER SYSTEM DRAINAGE DETAILS DRAWING 01.
- ALBA-00-UGH-CV-DW-IDM-1046 UNDERGROUND SYSTEM STORM. WATER SYSTEM DRAINAGE DETAILS DRAWING 02.
- ALBA-00-UGH-CV-DW-IDM-1047 UNDERGROUND SYSTEM STORM.WATER SYSTEM DRAINAGE IN-SITU DETAILS 1.
- ALBA-00-UGH-CV-DW-IDM-1048 UNDERGROUND SYSTEM STORM.WATER SYSTEM DRAINAGE IN-SITU DETAILS 2.
- ALBA-00-YYY-CV-DW-IDM-1063 UNDERGROUND SYSTEMS ELECT.&CONT. CABLE WAYS FROM PS5 TO PDS OUTLINE.
- ALBA-00-YYY-CV-DW-IDM-1064 UNDERGROUND SYSTEMS ELECT.&CONT. CABLE WAYS FROM PS5 TO PDS DETAILS.

SCALE 1:500 — 0 5 10 20 30 40 50m

Project: ALBA POWER STATION 5: ALBA LINE 6 EXPANSION

Owner: ALUMINIUM BAHRAIN B.S.C.

Consultant: ESB INTERNATIONAL

EPC Contractor: 7711 GE Global Parts & Products GMBH — GAMA

Reference Number	Revision Number	Functional Location Code
ALBA-00-GMA-CV-DW-IDM-1054	10	01-01-022

Revision History

Rev.	Revision Date	Created by	Checked by	Approved by	Brief Description
0	2017-03-09	L.C.T.	M.P.C.	I.A.G.	
8	2018-06-29	O.M.P.	M.P.C.	I.A.G.	
9	2018-11-21	O.M.P.	M.P.C.	I.A.G.	
10	2019-01-30	O.M.P.	M.P.C.	I.A.G.	

Description current Revision

Cross checked

Department	Name	Date	Signature

Replaces	Derived From	Document Code	
Responsible dept. --	Created by	Checked by	Approved by / Format A0
Originator: Idom	Document Type: DRAWING	Document Status: FOR CONSTRUCTION	
	Title, Subtitle: UNDERGROUND SYSTEM OILY WATER SYSTEM DRAINAGE PLAN	Identification number	Rev. / Date / Lang. / Sheet 1/4

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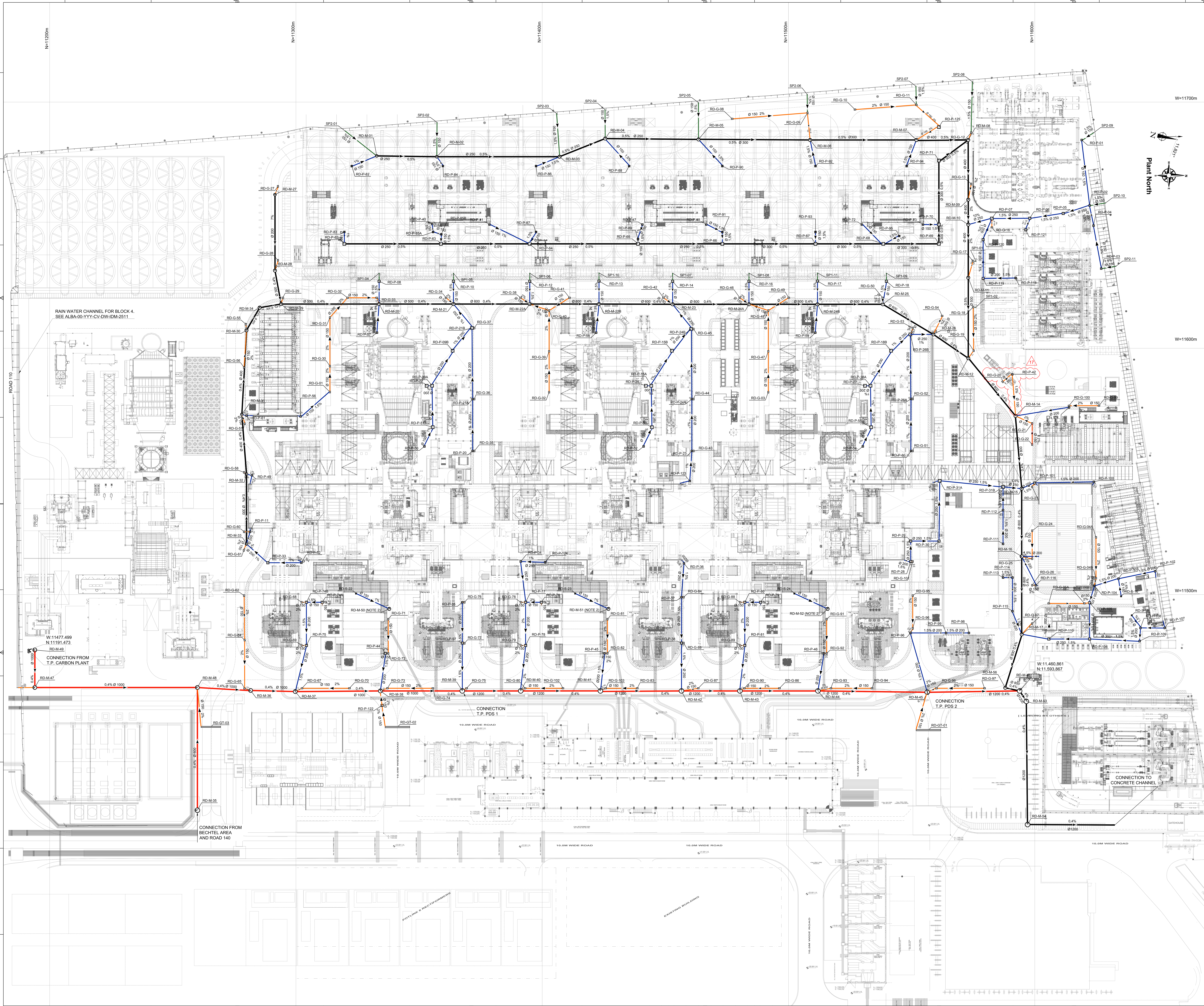
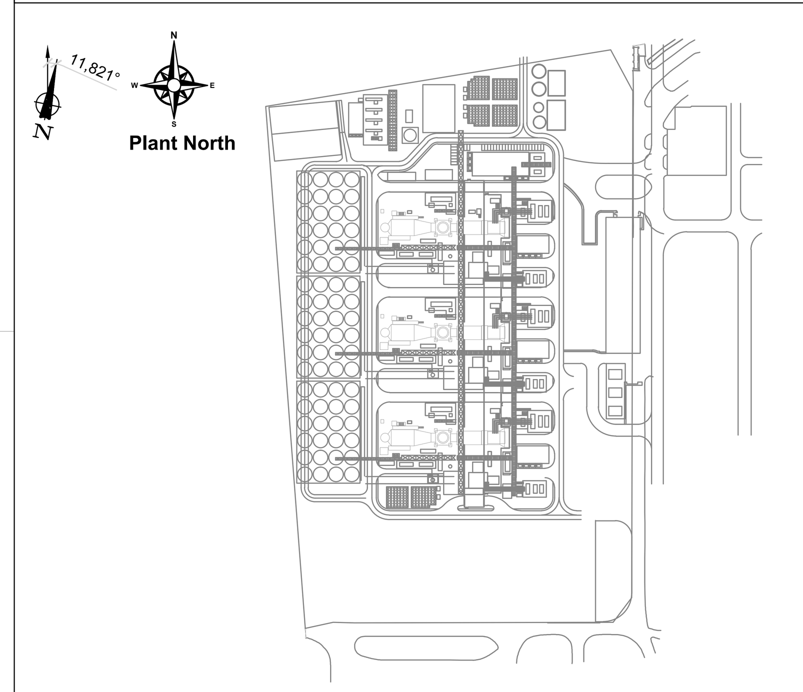
Appendix D: Stormwater Drainage System Layout



KEY PLAN



GENERAL NOTES

- RELATIVE LEVEL ±0.00 CORRESPONDS TO +24,891 m. PLANT DATUM
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- ALL DIMENSION ARE IN MILLIMETERS, UNLESS OTHERWISE NOTED.
- ALL LEVEL AND COORDINATES ARE IN METERS, UNLESS OTHERWISE NOTED.
- COORDINATE IN THE DRAWING ARE GIVEN IN ALBA LOCAL COORDINATE SYSTEM UNLESS OTHERWISE INDICATED.

DATUM ELEVATION COMPARISON INFORMATION

REFERENCE	NSD	PLANT DATUM
1	24.585 m	25.676 m

NOTES

1. IN ROAD LINES WHERE THE DIAMETER AND SLOPE IS NOT SPECIFIED, Ø150 AND 2% SLOPE SHALL BE CONSIDERED.
2. THESE MANHOLES ARE BLIND AND NOT CONNECTED TO NETWORK. DRAINAGES WILL BE DONE BY MOBILE PUMPS IN CASE OF ANY UNEXPECTED LEAKAGE TO CABLE GALLERY.
3. BUILDINGS DOWNPIPES TO BE CONNECTED TO CLOSEST PIT.

LEGEND

- LINE 1
- LINE 2
- LINE 3
- SECONDARY LINES
- ROAD LINES
- STONE PITCHING LINES
- DRAINAGE PIPE
- MANHOLE
- RD-P-01 PIT
- RD-G-01 GULLY (500x300mm)
- RD-GT-01 GUTTER
- RD-S-01 SINKHOLE
- WEST NORTH TERMINAL POINT
- SP1-01 STONE PITCH CONNECTION POINT

REFERENCE DRAWINGS

- ALBA-00-YYY-GN-DW-IDM-0018. GENERAL PLANT LAYOUT
- ALBA-00-UGH-CV-DW-IDM-1045 UNDERGROUND SYSTEM STORM. WATER SYSTEM DRAINAGE DETAILS 1
- ALBA-00-UGH-CV-DW-IDM-1046 UNDERGROUND SYSTEM STORM. WATER SYSTEM DRAINAGE DETAILS 2
- ALBA-00-UZJ-CV-DW-IDM-2509 STONE PITCHING AND DETAILS
- ALBA-00-UZJ-CV-DW-IDM-1003 EARTHWORKS GRADING LEVELS PLAN VIEW I
- ALBA-00-UZJ-CV-DW-IDM-1004 EARTHWORKS GRADING LEVELS PLAN VIEW II
- ALBA-00-YYY-CV-DW-IDM-1039 PROJECT GENERAL CIVIL NOTES
- ALBA-00-YYY-CV-DW-IDM-2511 NEW RAIN WATER CHANNEL FOR BLOCK 4
- ALBA-00-UGH-CV-DW-IDM-1047 UNDERGROUND SYSTEM STORM.WATER SYSTEM DRAINAGE IN-SITU DETAILS 1.
- ALBA-00-UGH-CV-DW-IDM-1048 UNDERGROUND SYSTEM STORM.WATER SYSTEM DRAINAGE IN-SITU DETAILS 2.
- ALBA-00-UGH-CV-DW-IDM-1051 UNDERGROUND SYSTEM STORM.WATER SYSTEM DRAINAGE CONNECTION TO TERMINAL POINT.
- ALBA-00-YYY-CV-DW-IDM-1043 UNDERGROUND NETWORK SYSTEM LAYOUT (CIVIL-MECHANICAL & ELECTRICAL).

SCALE 1:500 — 0 5 10 20 30 40 50m

Project: ALBA POWER STATION 5: ALBA LINE 6 EXPANSION

Owner: ALUMINIUM BAHRAIN B.S.C.

Aluminium for the world — Power

Consultant: ESB INTERNATIONAL

EPC Contractor
7711
GE Global Parts & Products GMBH

GAMA POWER SYSTEMS INC.

Reference Number	Revision Number	Functional Location Code
ALBA-00-UGH-CV-DW-IDM-1044	18	01-01-022

Revision History

Rev.	Revision Date	Created by	Checked by	Approved by	Brief Description
0	2018-07-20	L.C.T.	M.P.C.	I.A.G.	
15	2018-10-04	O.M.P.	M.P.C.	I.A.G.	
16	2018-11-16	O.M.P.	M.P.C.	I.A.G.	
17	2019-01-30	O.M.P.	M.P.C.	I.A.G.	
	Description current Revision				

Cross checked

Department	Name	Date	Signature

Replaces	Derived From	Document Code

Responsible dept.	Created by	Checked by	Approved by	Format
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Originator	Document Type	Document Status
Idom	DRAWING	FOR CONSTRUCTION

Title, Subtitle: UNDERGROUND SYSTEM STORM WATER SYSTEM DRAINAGE PLAN

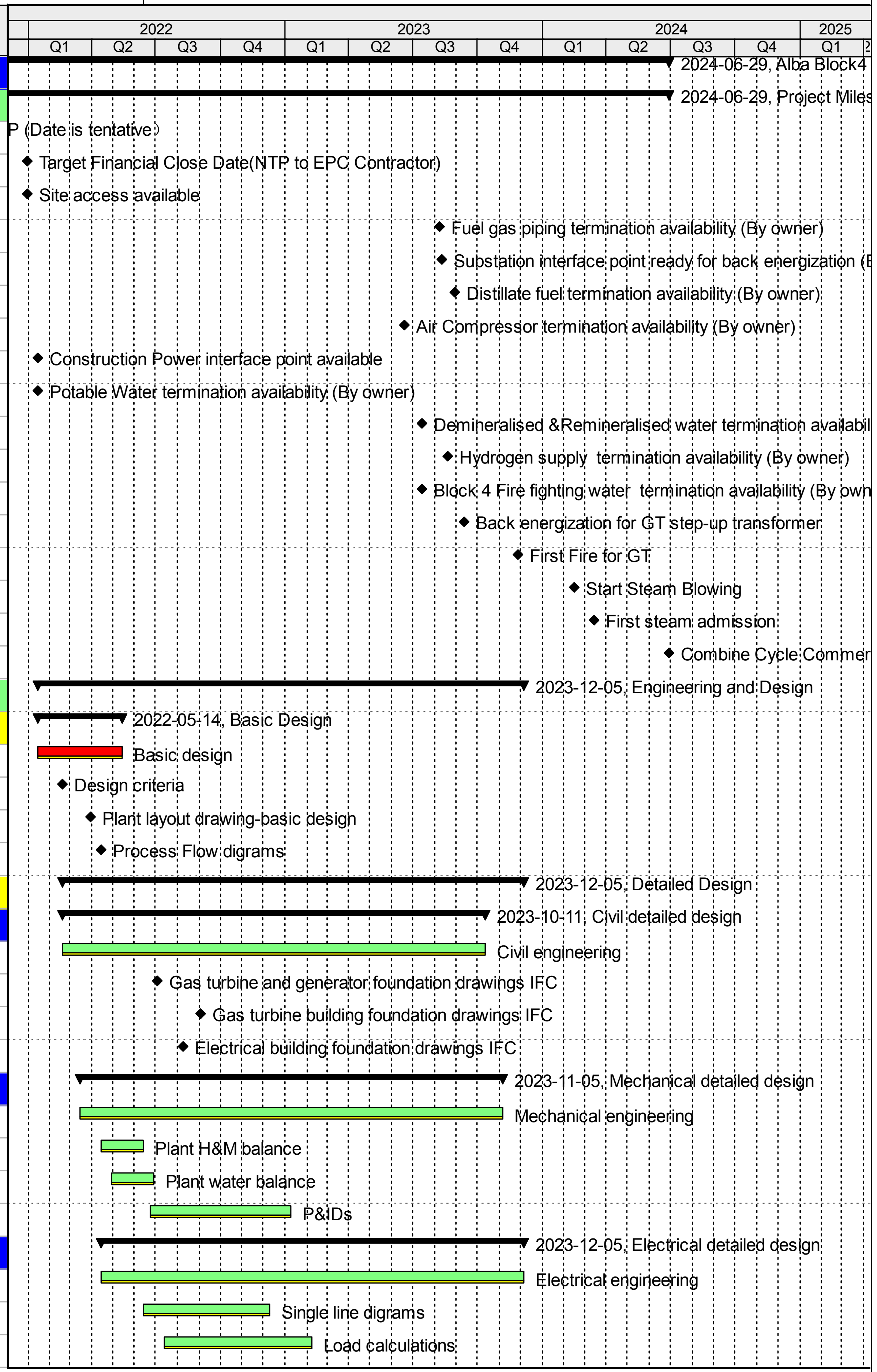
Identification number

Rev.	Date	Lang.	Sheet
			1/4

Appendix E: Construction Schedule

Alba Block4 Project

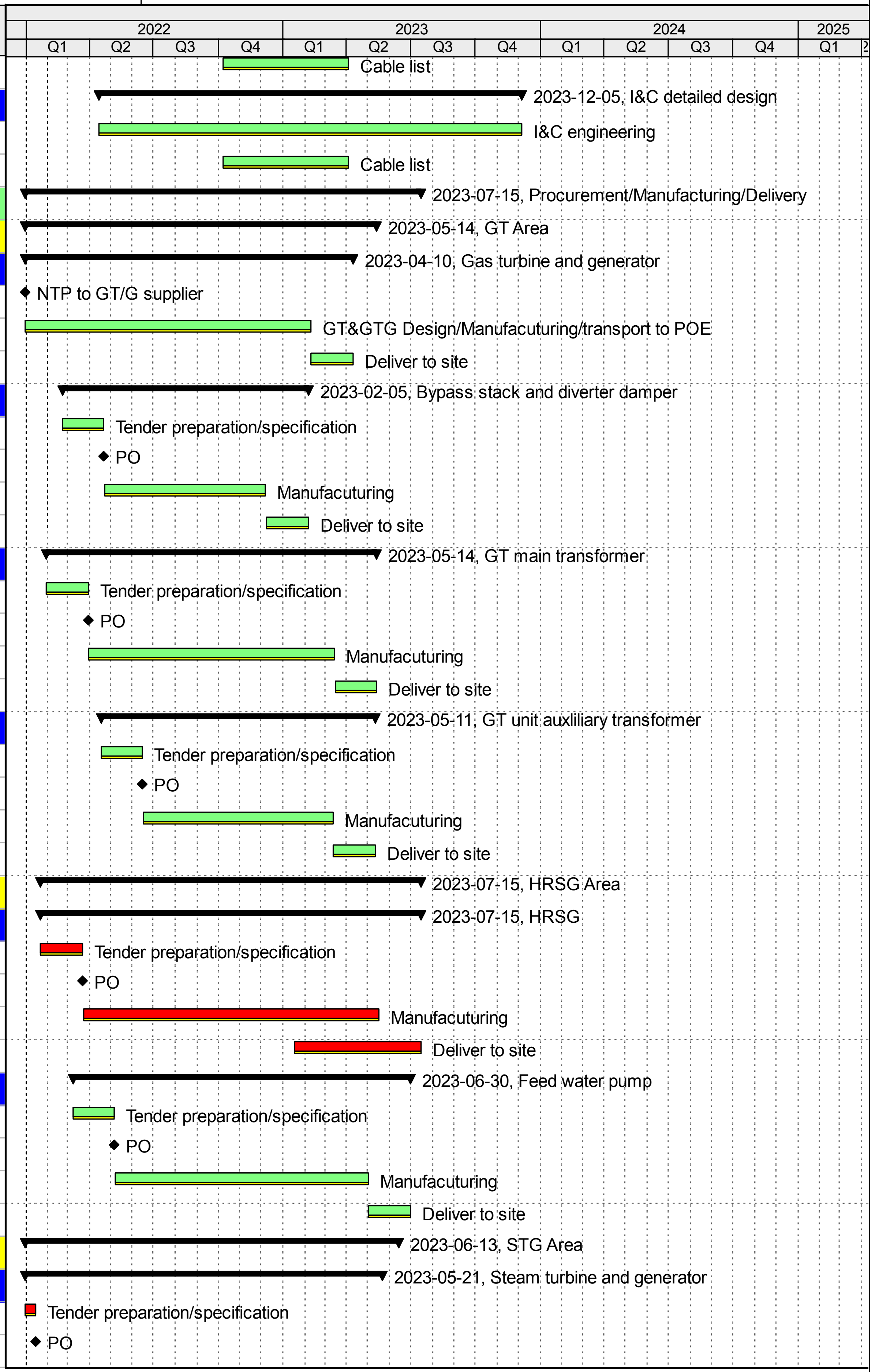
Activity ID	Activity Name	Start	Finish
Alba Block4 Project		2021-09-30	2024-06-29
Project Milestone		2021-09-30	2024-06-29
A0005	LNTP (Date is tentative）	2021-09-30	
A1000	Target Financial Close Date(NTP to EPC Contractor)	2021-12-31	
A1010	Site access available	2021-12-31	
A1020	Fuel gas piping termination availability (By owner)		2023-08-08*
A1030	Substation interface point ready for back energization (By owner)		2023-08-11*
A1040	Distillate fuel termination availability (By owner)		2023-08-29
A1050	Air Compressor termination availability (By owner)		2023-06-18
A1060	Construction Power interface point available		2022-01-14
A1070	Potable Water termination availability (By owner)		2022-01-14
A1080	Demineralised &Remineralised water termination availability (By owner)		2023-07-13
A1090	Hydrogen supply termination availability (By owner)		2023-08-19
A1100	Block 4 Fire fighting water termination availability (By owner)		2023-07-13
A1110	Back energization for GT step-up transformer		2023-09-11
A1120	First Fire for GT		2023-11-27
A1140	Start Steam Blowing	2024-02-16	
A1150	First steam admission		2024-03-15
A1160	Combine Cycle Commercial Operation Date		2024-06-29*
Engineering and Design		2022-01-15	2023-12-05
Basic Design		2022-01-15	2022-05-14
A1170	Basic design	2022-01-15	2022-05-14
A1180	Design criteria		2022-02-19
A1190	Plant layout drawing-basic design		2022-03-31
A1200	Process Flow digrams		2022-04-15
Detailed Design		2022-02-19	2023-12-05
Civil detailed design		2022-02-19	2023-10-11
A1210	Civil engineering	2022-02-19	2023-10-11
A1220	Gas turbine and generator foundation drawings IFC	2022-07-04	
A1230	Gas turbine building foundation drawings IFC	2022-09-02	
A1240	Electrical building foundation drawings IFC	2022-08-08	
Mechanical detailed design		2022-03-16	2023-11-05
A1250	Mechanical engineering	2022-03-16	2023-11-05
A1260	Plant H&M balance	2022-04-15	2022-06-13
A1270	Plant water balance	2022-04-30	2022-06-28
A1280	P&IDs	2022-06-24	2023-01-09
Electrical detailed design		2022-04-15	2023-12-05
A1290	Electrical engineering	2022-04-15	2023-12-05
A1300	Single line digrams	2022-06-14	2022-12-10
A1310	Load calculations	2022-07-14	2023-02-08



Baseline 1 | Actual | Remaining critical path ◆ | ◆ Milestone
Sub Critical | Remaining | Critical path | Summary

TASK filter: All Activities

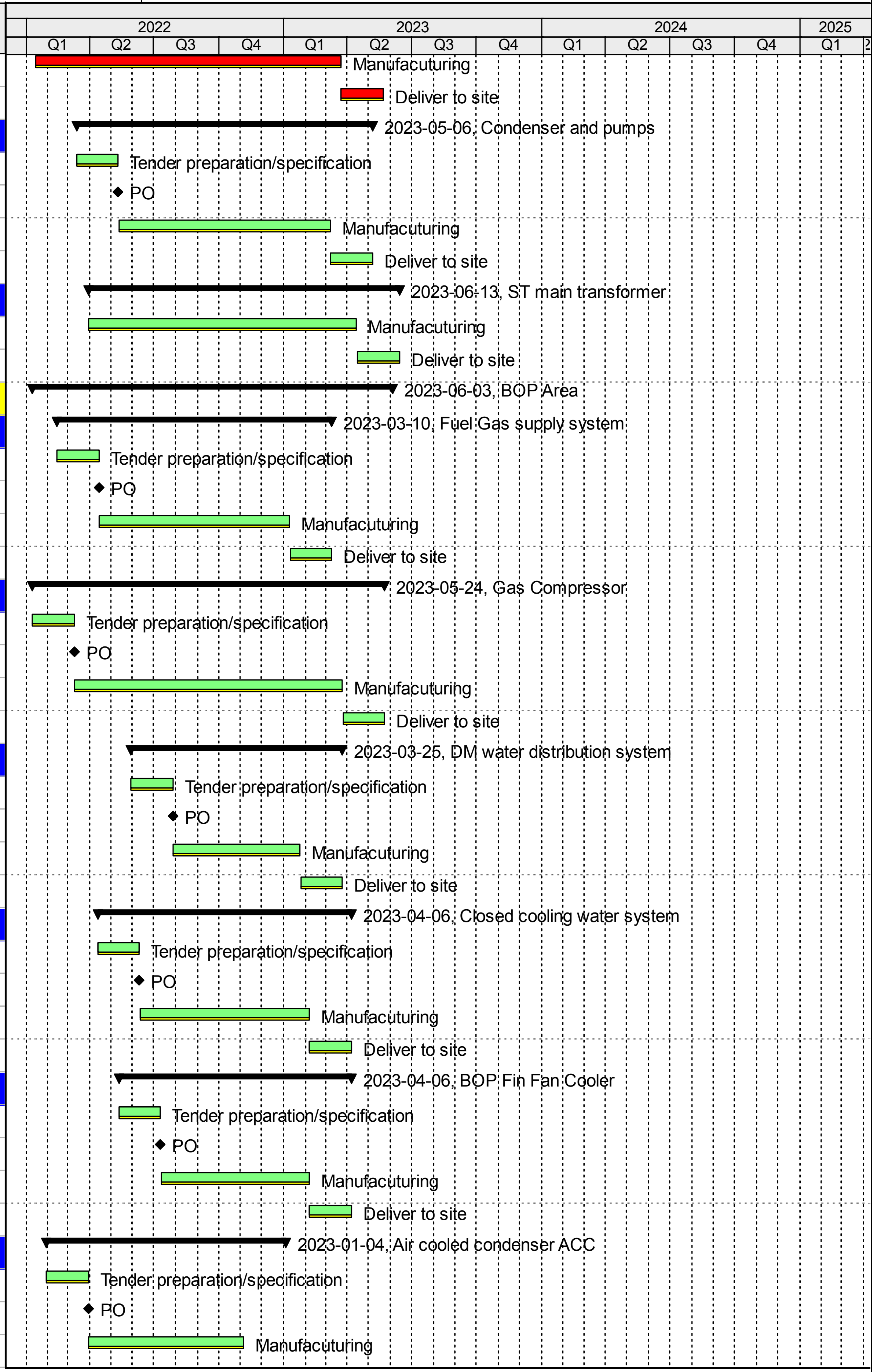
Activity ID	Activity Name	Start	Finish
A1320	Cable list	2022-10-07	2023-04-04
I&C detailed design		2022-04-15	2023-12-05
A1330	I&C engineering	2022-04-15	2023-12-05
A1340	Cable list	2022-10-07	2023-04-04
Procurement/Manufacturing/Delivery		2021-12-31	2023-07-15
GT Area		2021-12-31	2023-05-14
Gas turbine and generator		2021-12-31	2023-04-10
A1350	NTP to GT/G supplier	2021-12-31	
A1360	GT&GTG Design/Manufacuturing/transport to POE	2021-12-31	2023-02-09
A1370	Deliver to site	2023-02-10	2023-04-10
Bypass stack and diverter damper		2022-02-21	2023-02-05
A1380	Tender preparation/specification	2022-02-21	2022-04-21
A1390	PO		2022-04-21
A1400	Manufacuturing	2022-04-22	2022-12-07
A1410	Deliver to site	2022-12-08	2023-02-05
GT main transformer		2022-01-30	2023-05-14
A1460	Tender preparation/specification	2022-01-30	2022-03-30
A1470	PO		2022-03-30
A1480	Manufacuturing	2022-03-31	2023-03-15
A1490	Deliver to site	2023-03-16	2023-05-14
GT unit auxliliary transformer		2022-04-17	2023-05-11
A1500	Tender preparation/specification	2022-04-17	2022-06-15
A1510	PO		2022-06-15
A1520	Manufacuturing	2022-06-16	2023-03-12
A1530	Deliver to site	2023-03-13	2023-05-11
HRSG Area		2022-01-22	2023-07-15
HRSG		2022-01-22	2023-07-15
A1540	Tender preparation/specification	2022-01-22	2022-03-22
A1550	PO		2022-03-22
A1560	Manufacuturing	2022-03-23	2023-05-16
A1570	Deliver to site	2023-01-17	2023-07-15
Feed water pump		2022-03-08	2023-06-30
A1580	Tender preparation/specification	2022-03-08	2022-05-06
A1590	PO		2022-05-06
A1600	Manufacuturing	2022-05-07	2023-05-01
A1610	Deliver to site	2023-05-02	2023-06-30
STG Area		2021-12-31	2023-06-13
Steam turbine and generator		2021-12-31	2023-05-21
A1620	Tender preparation/specification	2021-12-31	2022-01-14
A1630	PO		2022-01-14



Baseline 1 | Actual | Remaining critical path | Milestone
Sub Critical | Remaining | Critical path | Summary

TASK filter: All Activities

Activity ID	Activity Name	Start	Finish
A1640	Manufacuturing	2022-01-15	2023-03-22
A1650	Deliver to site	2023-03-23	2023-05-21
Condenser and pumps		2022-03-13	2023-05-06
A1660	Tender preparation/specification	2022-03-13	2022-05-11
A1670	PO		2022-05-11
A1680	Manufacuturing	2022-05-12	2023-03-07
A1690	Deliver to site	2023-03-08	2023-05-06
ST main transformer		2022-03-31	2023-06-13
A1700	Manufacuturing	2022-03-31	2023-04-14
A1710	Deliver to site	2023-04-15	2023-06-13
BOP Area		2022-01-10	2023-06-03
Fuel Gas supply system		2022-02-14	2023-03-10
A1720	Tender preparation/specification	2022-02-14	2022-04-14
A1730	PO	2022-04-15	
A1740	Manufacuturing	2022-04-15	2023-01-09
A1750	Deliver to site	2023-01-10	2023-03-10
Gas Compressor		2022-01-10	2023-05-24
A2710	Tender preparation/specification	2022-01-10	2022-03-10
A2720	PO	2022-03-11	
A2730	Manufacuturing	2022-03-11	2023-03-25
A2740	Deliver to site	2023-03-26	2023-05-24
DM water distribution system		2022-05-30	2023-03-25
A1760	Tender preparation/specification	2022-05-30	2022-07-28
A1770	PO		2022-07-28
A1780	Manufacuturing	2022-07-29	2023-01-24
A1790	Deliver to site	2023-01-25	2023-03-25
Closed cooling water system		2022-04-12	2023-04-06
A1800	Tender preparation/specification	2022-04-12	2022-06-10
A1810	PO		2022-06-10
A1820	Manufacuturing	2022-06-11	2023-02-05
A1830	Deliver to site	2023-02-06	2023-04-06
BOP Fin Fan Cooler		2022-05-12	2023-04-06
A1420	Tender preparation/specification	2022-05-12	2022-07-10
A1430	PO		2022-07-10
A1440	Manufacuturing	2022-07-11	2023-02-05
A1450	Deliver to site	2023-02-06	2023-04-06
Air cooled condenser ACC		2022-01-30	2023-01-04
A1840	Tender preparation/specification	2022-01-30	2022-03-30
A1850	PO		2022-03-30
A1860	Manufacuturing	2022-03-31	2022-11-05

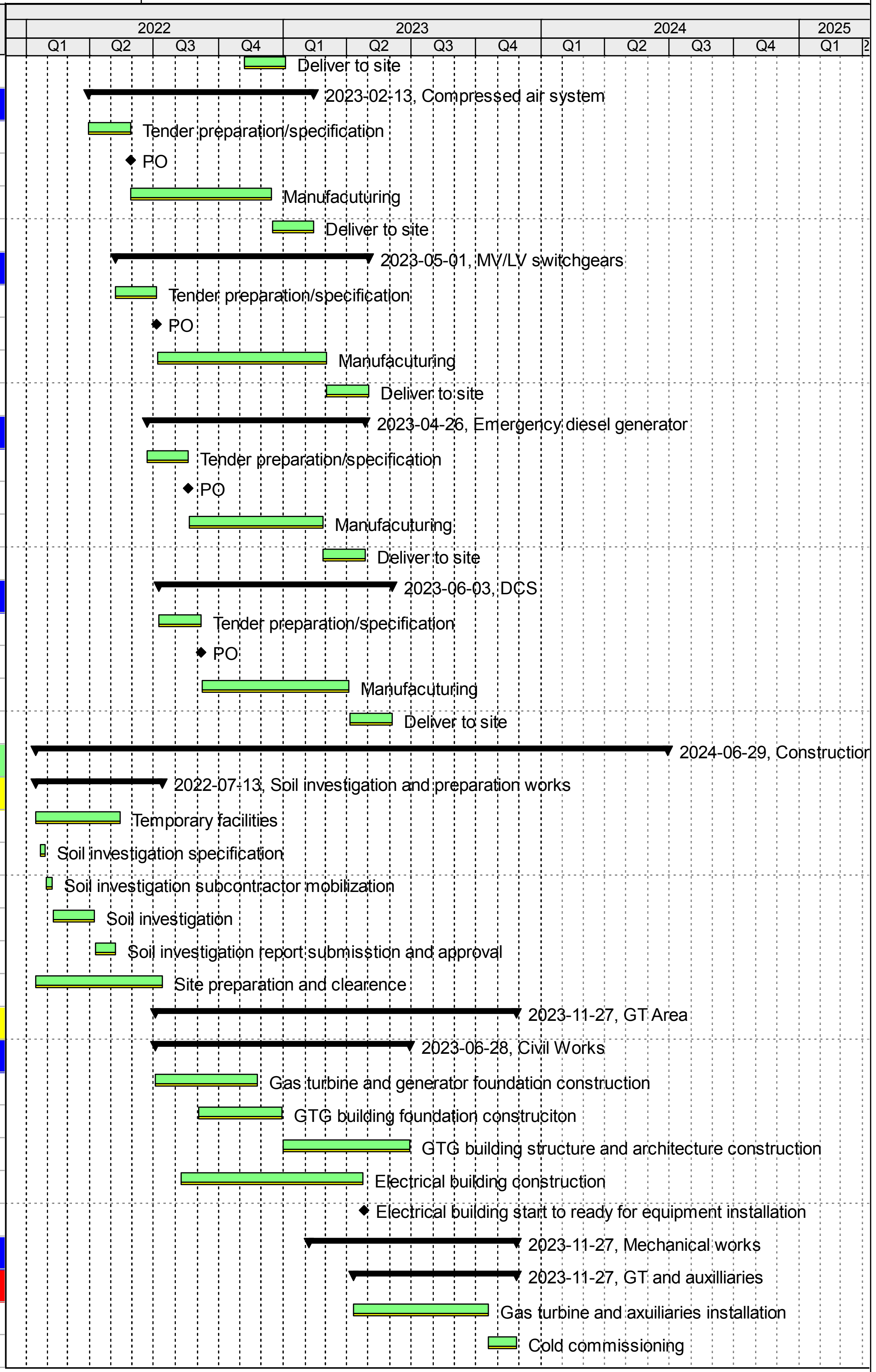


Baseline 1 | Actual | Remaining critical path | Milestone
Sub Critical | Remaining | Critical path | Summary

TASK filter: All Activities

Alba Block4 Project

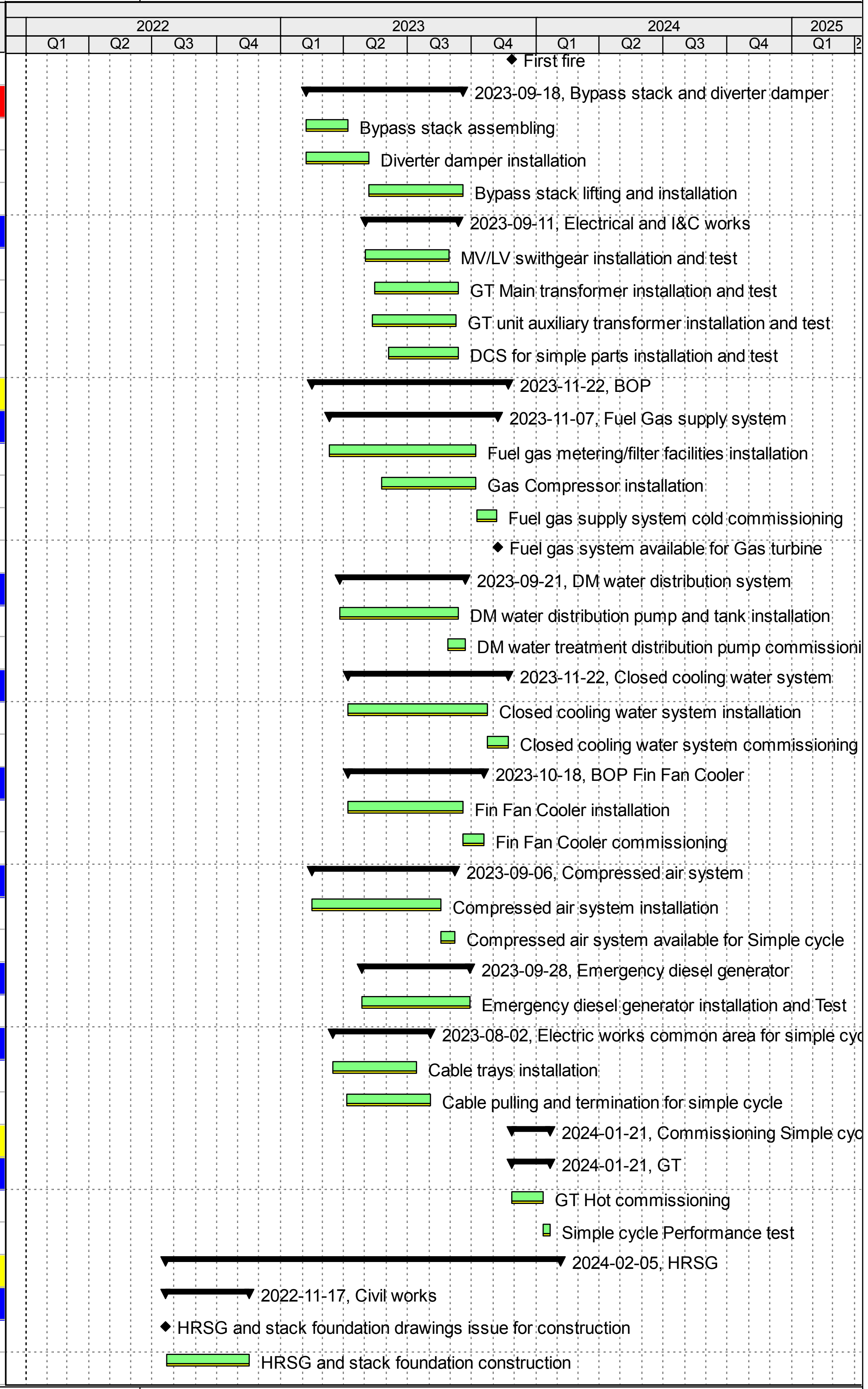
Activity ID	Activity Name	Start	Finish
A1870	Deliver to site	2022-11-06	2023-01-04
Compressed air system		2022-03-31	2023-02-13
A1880	Tender preparation/specification	2022-03-31	2022-05-29
A1890	PO		2022-05-29
A1900	Manufacuturing	2022-05-30	2022-12-15
A1910	Deliver to site	2022-12-16	2023-02-13
MV/LV switchgears		2022-05-07	2023-05-01
A1920	Tender preparation/specification	2022-05-07	2022-07-05
A1930	PO		2022-07-05
A1940	Manufacuturing	2022-07-06	2023-03-02
A1950	Deliver to site	2023-03-03	2023-05-01
Emergency diesel generator		2022-06-21	2023-04-26
A1960	Tender preparation/specification	2022-06-21	2022-08-19
A1970	PO		2022-08-19
A1980	Manufacuturing	2022-08-20	2023-02-25
A1990	Deliver to site	2023-02-26	2023-04-26
DCS		2022-07-09	2023-06-03
A2000	Tender preparation/specification	2022-07-09	2022-09-06
A2010	PO		2022-09-06
A2020	Manufacuturing	2022-09-07	2023-04-04
A2030	Deliver to site	2023-04-05	2023-06-03
Construction and Commissioning		2022-01-15	2024-06-29
Soil investigation and preparation works		2022-01-15	2022-07-13
A2040	Temporary facilities	2022-01-15	2022-05-14
A2050	Soil investigation specification	2022-01-22	2022-01-28
A2060	Soil investigation subcontractor mobilization	2022-01-29	2022-02-07
A2070	Soil investigation	2022-02-08	2022-04-08
A2080	Soil investigation report submisstion and approval	2022-04-09	2022-05-08
A2090	Site preparation and clearence	2022-01-15	2022-07-13
GT Area		2022-07-04	2023-11-27
Civil Works		2022-07-04	2023-06-28
A2100	Gas turbine and generator foundation construction	2022-07-04	2022-11-25
A2110	GTG building foundation construciton	2022-09-02	2022-12-30
A2120	GTG building structure and architecture construction	2022-12-31	2023-06-28
A2130	Electrical building construction	2022-08-08	2023-04-24
A2140	Electrical building start to ready for equipment installation	2023-04-25	
Mechanical works		2023-02-06	2023-11-27
GT and auxilliaries		2023-04-11	2023-11-27
A215	Gas turbine and axuiliaries installation	2023-04-11	2023-10-18
A216	Cold commissioning	2023-10-19	2023-11-27



Baseline 1 | Actual | Remaining critical path | Milestone
Sub Critical | Remaining | Critical path | Summary

TASK filter: All Activities

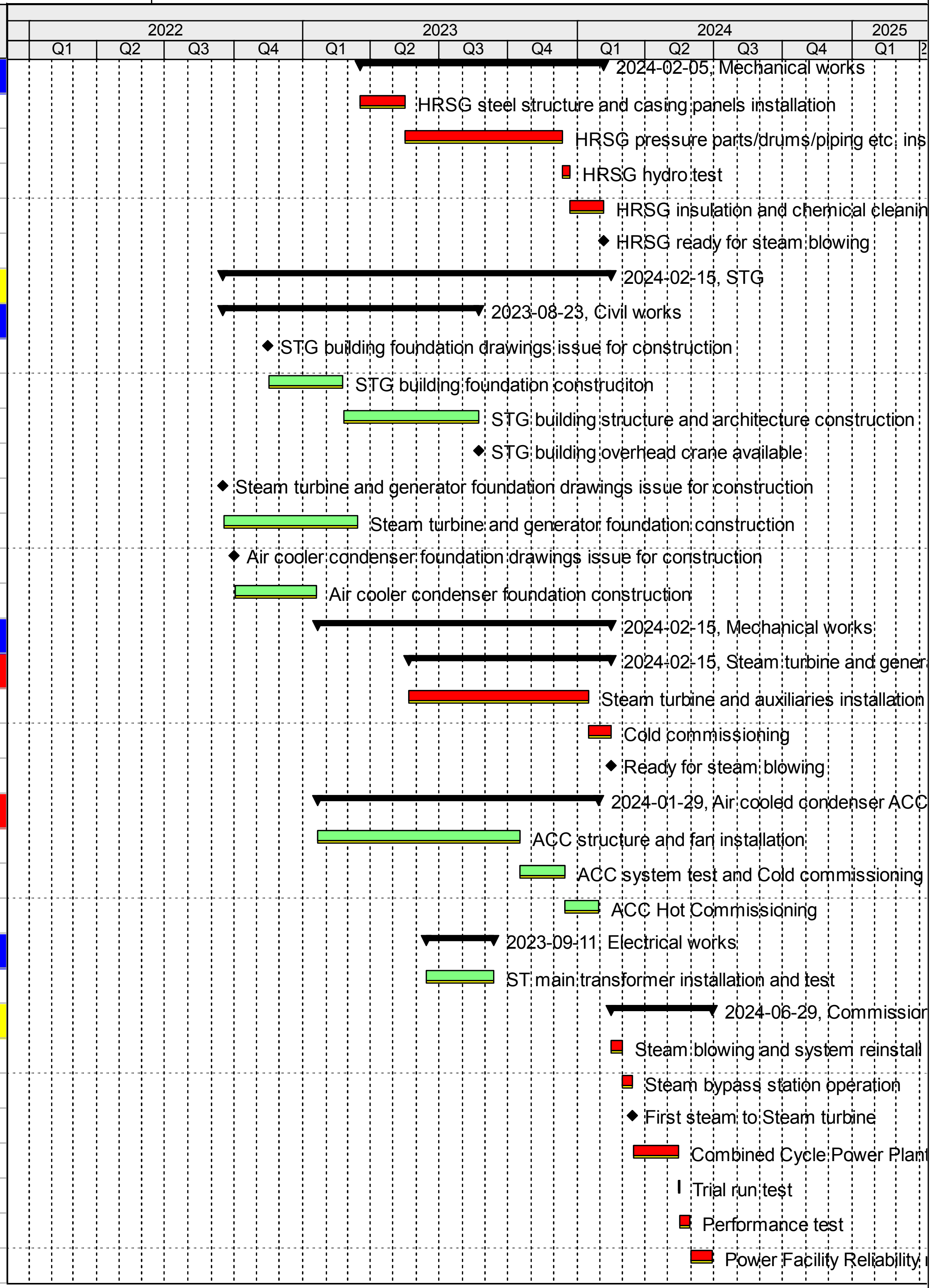
Activity ID	Activity Name	Start	Finish
A217	First fire		2023-11-27
	Bypass stack and diverter damper	2023-02-06	2023-09-18
A220	Bypass stack assembling	2023-02-06	2023-04-06
A221	Diverter damper installation	2023-02-06	2023-05-06
A222	Bypass stack lifting and installation	2023-05-07	2023-09-18
	Electrical and I&C works	2023-05-02	2023-09-11
A2230	MV/LV swithgear installation and test	2023-05-02	2023-08-29
A2240	GT Main transformer installation and test	2023-05-15	2023-09-11
A2250	GT unit auxiliary transformer installation and test	2023-05-12	2023-09-08
A2260	DCS for simple parts installation and test	2023-06-04	2023-09-11
BOP		2023-02-14	2023-11-22
	Fuel Gas supply system	2023-03-12	2023-11-07
A2270	Fuel gas metering/filter facilities installation	2023-03-12	2023-10-07
A2275	Gas Compressor installation	2023-05-25	2023-10-06
A2280	Fuel gas supply system cold commissioning	2023-10-08	2023-11-06
A2290	Fuel gas system available for Gas turbine	2023-11-07	
	DM water distribution system	2023-03-26	2023-09-21
A2300	DM water distribution pump and tank installation	2023-03-26	2023-09-11
A2310	DM water treatment distribution pump commissioning	2023-08-28	2023-09-21
	Closed cooling water system	2023-04-07	2023-11-22
A2320	Closed cooling water system installation	2023-04-07	2023-10-23
A2330	Closed cooling water system commissioning	2023-10-24	2023-11-22
	BOP Fin Fan Cooler	2023-04-07	2023-10-18
A2180	Fin Fan Cooler installation	2023-04-07	2023-09-18
A2190	Fin Fan Cooler commissioning	2023-09-19	2023-10-18
	Compressed air system	2023-02-14	2023-09-06
A2370	Compressed air system installation	2023-02-14	2023-08-17
A2380	Compressed air system available for Simple cycle	2023-08-18	2023-09-06
	Emergency diesel generator	2023-04-27	2023-09-28
A2390	Emergency diesel generator installation and Test	2023-04-27	2023-09-28
	Electric works common area for simple cycle	2023-03-16	2023-08-02
A2400	Cable trays installation	2023-03-16	2023-07-13
A2410	Cable pulling and termination for simple cycle	2023-04-05	2023-08-02
Commissioning Simple cycle		2023-11-28	2024-01-21
	GT	2023-11-28	2024-01-21
A2420	GT Hot commissioning	2023-11-28	2024-01-11
A2430	Simple cycle Performance test	2024-01-12	2024-01-21
HRSG		2022-07-20	2024-02-05
	Civil works	2022-07-20	2022-11-17
A2450	HRSG and stack foundation drawings issue for construction		2022-07-20
A2460	HRSG and stack foundation construction	2022-07-21	2022-11-17



Baseline 1 | Actual | Remaining critical path | Milestone
Sub Critical | Remaining | Critical path | Summary

TASK filter: All Activities

Activity ID	Activity Name	Start	Finish
	Mechanical works	2023-03-18	2024-02-05
A2470	HRSG steel structure and casing panels installation	2023-03-18	2023-05-16
A2480	HRSG pressure parts/drums/piping etc. installation	2023-05-17	2023-12-12
A2490	HRSG hydro test	2023-12-13	2023-12-22
A2500	HRSG insulation and chemical cleaning	2023-12-23	2024-02-05
A2510	HRSG ready for steam blowing		2024-02-05
	STG	2022-09-16	2024-02-15
	Civil works	2022-09-16	2023-08-23
A2520	STG building foundation drawings issue for construction		2022-11-15
A2530	STG building foundation construciton	2022-11-16	2023-02-23
A2540	STG building structure and architecture construction	2023-02-24	2023-08-22
A2550	STG building overhead crane available	2023-08-23	
A2560	Steam turbine and generator foundation drawings issue for construction		2022-09-16
A2570	Steam turbine and generator foundation construction	2022-09-17	2023-03-15
A2610	Air cooler condenser foundation drawings issue for construction		2022-10-01
A2620	Air cooler condenser foundation construction	2022-10-02	2023-01-19
	Mechanical works	2023-01-20	2024-02-15
	Steam turbine and generator	2023-05-22	2024-02-15
A258	Steam turbine and auxiliaries installation	2023-05-22	2024-01-16
A259	Cold commissioning	2024-01-17	2024-02-15
A260	Ready for steam blowing		2024-02-15
	Air cooled condenser ACC	2023-01-20	2024-01-29
A234	ACC structure and fan installation	2023-01-20	2023-10-16
A235	ACC system test and Cold commissioning	2023-10-17	2023-12-15
A236	ACC Hot Commissioning	2023-12-16	2024-01-29
	Electrical works	2023-06-14	2023-09-11
A2630	ST main transformer installation and test	2023-06-14	2023-09-11
	Commissionig Combined cycle	2024-02-16	2024-06-29
A2640	Steam blowing and system reinstall	2024-02-16	2024-03-01
A2650	Steam bypass station operation	2024-03-02	2024-03-15
A2660	First steam to Steam turbine		2024-03-15
A2670	Combined Cycle Power Plant start up tests and function tests	2024-03-16	2024-05-14
A2680	Trial run test	2024-05-15	2024-05-16
A2690	Performance test	2024-05-17	2024-05-30
A2700	Power Facility Reliability run test	2024-05-31	2024-06-29



Baseline 1 | Actual | Remaining critical path | Milestone
Sub Critical | Remaining | Critical path | Summary

TASK filter: All Activities

Appendix F: Material Safety Data Sheets

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 6.2
Revision Date 24.10.2019
Print Date 17.08.2021
GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name	:	Carbohydrazide
Product Number	:	C11006
Brand	:	Aldrich
REACH No.	:	A registration number is not available for this substance as the substance or its uses are exempted from registration, the annual tonnage does not require a registration or the registration is envisaged for a later registration deadline.
CAS-No.	:	497-18-7

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses	:	Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company	:	Sigma-Aldrich Chemie GmbH Eschenstrasse 5 D-82024 TAUFKIRCHEN
Telephone	:	+49 (0)89 6513-1130
Fax	:	+49 (0)89 6513-1161
E-mail address	:	technischerservice@merckgroup.com

1.4 Emergency telephone number

Emergency Phone #	:	0800 181 7059 (CHEMTREC Deutschland) +49 (0)696 43508409 (CHEMTREC weltweit)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008
Acute toxicity, Oral (Category 4), H302
Skin irritation (Category 2), H315
Skin sensitisation (Category 1), H317
Long-term (chronic) aquatic hazard (Category 2), H411

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008

Pictogram 

Signal word Warning

Hazard statement(s)

H302	Harmful if swallowed.
H315	Causes skin irritation.
H317	May cause an allergic skin reaction.
H411	Toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P273	Avoid release to the environment.
P280	Wear protective gloves.
P301 + P312 + P330	IF SWALLOWED: Call a POISON CENTER/doctor if you feel unwell. Rinse mouth.
P302 + P352	IF ON SKIN: Wash with plenty of water.

Supplemental Hazard information (EU)

EUH044	Risk of explosion if heated under confinement.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula	:	CH_6N_4O
Molecular weight	:	90,08 g/mol
CAS-No.	:	497-18-7
EC-No.	:	207-837-2

Component	Classification	Concentration
Carbonohydrazide		
	Acute Tox. 4; Skin Irrit. 2; Skin Sens. 1; Aquatic Chronic 2; H302, H315, H317, H411	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice

Consult a physician. Show this safety data sheet to the doctor in attendance.

If inhaled

If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact

Wash off with soap and plenty of water. Consult a physician.

In case of eye contact
Flush eyes with water as a precaution.

If swallowed
Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Carbon oxides, Nitrogen oxides (NOx)

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
No data available

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Use personal protective equipment. Avoid dust formation. Avoid breathing vapours, mist or gas. Ensure adequate ventilation. Avoid breathing dust.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.
Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Pick up and arrange disposal without creating dust. Sweep up and shovel. Keep in suitable, closed containers for disposal.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling
Avoid contact with skin and eyes. Avoid formation of dust and aerosols.
Provide appropriate exhaust ventilation at places where dust is formed.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Keep container tightly closed in a dry and well-ventilated place. Store in cool place.

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Components with workplace control parameters

8.2 Exposure controls

Appropriate engineering controls
Handle in accordance with good industrial hygiene and safety practice. Wash hands before breaks and at the end of workday.

Personal protective equipment

Eye/face protection
Face shield and safety glasses Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of Regulation (EU) 2016/425 and the standard EN 374 derived from it.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
For nuisance exposures use type P95 (US) or type P1 (EU EN 143) particle respirator.For higher level protection use type OV/AG/P99 (US) or type ABEK-P2 (EU EN 143) respirator cartridges. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: crystalline Colour: white
b)	Odour	odourless
c)	Odour Threshold	No data available
d)	pH	6,7 - 8,3
e)	Melting	Melting point/range: 150 - 153 °C - lit.

	point/freezing point	
f)	Initial boiling point and boiling range	No data available
g)	Flash point	No data available
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapour pressure	16 hPa at 20 °C
l)	Vapour density	No data available
m)	Relative density	1,020 g/cm3 at 20 °C
n)	Water solubility	soluble
o)	Partition coefficient: n-octanol/water	No data available
p)	Auto-ignition temperature	No data available
q)	Decomposition temperature	No data available
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
Strong oxidizing agents, Strong acids, Copper, Zinc, Nickel, Lead, Brass

10.6 Hazardous decomposition products
Hazardous decomposition products formed under fire conditions. - Carbon oxides, Nitrogen oxides (NOx)
Other decomposition products - No data available
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - female - 311 mg/kg

Skin corrosion/irritation
No data available

Serious eye damage/eye irritation
No data available

Respiratory or skin sensitisation
No data available

Germ cell mutagenicity
No data available
Result: negative
Histidine reversion (Ames)

Carcinogenicity

IARC: No component of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: FF2625000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	LC50 - Lepomis macrochirus (Bluegill) - 190,0 mg/l - 96,0 h
Toxicity to daphnia and other aquatic invertebrates	LC50 - Daphnia magna (Water flea) - 96 mg/l - 48 h
Toxicity to algae	EC50 - Desmodesmus subspicatus (green algae) - 9,5 mg/l - 72 h

12.2 Persistence and degradability

Biodegradability	Result: - Not readily biodegradable.

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

Toxic to aquatic life with long lasting effects.
No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Offer surplus and non-recyclable solutions to a licensed disposal company. Dissolve or mix the material with a combustible solvent and burn in a chemical incinerator equipped with an afterburner and scrubber. Waste material must be disposed of in accordance with the Directive on waste 2008/98/EC as well as other national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself.

Contaminated packaging

Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number

ADR/RID: 3077	IMDG: 3077	IATA: 3077

14.2 UN proper shipping name

ADR/RID:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Carbonohydrazide)
IMDG:	ENVIRONMENTALLY HAZARDOUS SUBSTANCE, SOLID, N.O.S. (Carbonohydrazide)
IATA:	Environmentally hazardous substance, solid, n.o.s. (Carbonohydrazide)

14.3 Transport hazard class(es)

ADR/RID: 9	IMDG: 9	IATA: 9

14.4 Packaging group

ADR/RID: III	IMDG: III	IATA: III

14.5 Environmental hazards

ADR/RID: yes	IMDG Marine pollutant: yes	IATA: yes

14.6 Special precautions for user

Further information

EHS-Mark required (ADR 2.2.9.1.10, IMDG code 2.10.3) for single packagings and combination packagings containing inner packagings with Dangerous Goods > 5L for liquids or > 5kg for solids.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

This safety datasheet complies with the requirements of Regulation (EC) No. 1907/2006.

15.2 Chemical safety assessment

For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

EUH044	Risk of explosion if heated under confinement.
H302	Harmful if swallowed.
H315	Causes skin irritation.
H317	May cause an allergic skin reaction.
H411	Toxic to aquatic life with long lasting effects.

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 7.1
Revision Date 18.04.2021
Print Date 17.08.2021
GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name	:	Ammonia
Product Number	:	294993
Brand	:	Aldrich
Index-No.	:	007-001-00-5
REACH No.	:	01-2119488876-14-XXXX
CAS-No.	:	7664-41-7

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company	:	Sigma-Aldrich Chemie GmbH Eschenstrasse 5 D-82024 TAUFKIRCHEN
Telephone	:	+49 (0)89 6513-1130
Fax	:	+49 (0)89 6513-1161
E-mail address	:	technischerservice@merckgroup.com

1.4 Emergency telephone

Emergency Phone # : 0800 181 7059 (CHEMTREC Deutschland)
+49 (0)696 43508409 (CHEMTREC weltweit)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008

Gases under pressure (Liquefied gas), H280
Acute toxicity, Inhalation (Category 3), H331
Skin corrosion (Sub-category 1B), H314
Serious eye damage (Category 1), H318
Short-term (acute) aquatic hazard (Category 1), H400
Long-term (chronic) aquatic hazard (Category 2), H411

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008

Pictogram

Signal word	Danger

Hazard statement(s)

H280	Contains gas under pressure; may explode if heated.
H314	Causes severe skin burns and eye damage.
H331	Toxic if inhaled.
H410	Very toxic to aquatic life with long lasting effects.

Precautionary statement(s)

P260	Do not breathe gas.
P273	Avoid release to the environment.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water.
P304 + P340 + P311	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/ doctor.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER/ doctor.

Supplemental Hazard information (EU)

EUH071	Corrosive to the respiratory tract.

Reduced Labeling (<= 125 ml)

Pictogram

Signal word	Danger

Hazard statement(s)

H331	Toxic if inhaled.
H314	Causes severe skin burns and eye damage.

Precautionary statement(s)

P260	Do not breathe gas.
P280	Wear protective gloves/ protective clothing/ eye protection/ face protection.
P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water.
P304 + P340 + P311	IF INHALED: Remove person to fresh air and keep comfortable for breathing. Call a POISON CENTER/ doctor.
P305 + P351 + P338 + P310	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Immediately call a POISON CENTER/ doctor.

Supplemental Hazard information (EU)

EUH071	Corrosive to the respiratory tract.

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.1 Substances

Formula	:	H_3N
Molecular weight	:	17,03 g/mol
CAS-No.	:	7664-41-7
EC-No.	:	231-635-3
Index-No.	:	007-001-00-5

Component		Classification	Concentration
ammonia anhydrous			
CAS-No. EC-No. Index-No.	7664-41-7 231-635-3 007-001-00-5	Flam. Gas 2; Press. Gas Liquefied gas; Acute Tox. 3; Skin Corr. 1B; Eye Dam. 1; Aquatic Acute 1; Aquatic Chronic 2; H221, H280, H331, H314, H318, H400, H411 M-Factor - Aquatic Acute: 10	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice
Consult a physician. Show this material safety data sheet to the doctor in attendance.

If inhaled
If breathed in, move person into fresh air. If not breathing, give artificial respiration. Consult a physician.

In case of skin contact
Take off contaminated clothing and shoes immediately. Wash off with soap and plenty of water. Take victim immediately to hospital. Consult a physician.

In case of eye contact
Rinse thoroughly with plenty of water for at least 15 minutes and consult a physician.

If swallowed
Do NOT induce vomiting. Never give anything by mouth to an unconscious person. Rinse mouth with water. Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Nitrogen oxides (NOx)
Not combustible.

5.3 Advice for firefighters
Wear self-contained breathing apparatus for firefighting if necessary.

5.4 Further information
Use water spray to cool unopened containers.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Wear respiratory protection. Avoid breathing vapors, mist or gas. Ensure adequate ventilation. Evacuate personnel to safe areas.
For personal protection see section 8.

6.2 Environmental precautions
Prevent further leakage or spillage if safe to do so. Do not let product enter drains.
Discharge into the environment must be avoided.

6.3 Methods and materials for containment and cleaning up
Clean up promptly by sweeping or vacuum.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on safe handling
Avoid contact with skin and eyes. Avoid inhalation of vapor or mist.

Hygiene measures
Avoid contact with skin, eyes and clothing. Wash hands before breaks and immediately after handling the product.
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions
Keep container tightly closed in a dry and well-ventilated place. Store in cool place.

Contents under pressure.

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

8.2 Exposure controls

Personal protective equipment

Eye/face protection
Tightly fitting safety goggles. Faceshield (8-inch minimum). Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU).

Skin protection
Handle with gloves. Gloves must be inspected prior to use. Use proper glove removal technique (without touching glove's outer surface) to avoid skin contact with this product. Dispose of contaminated gloves after use in accordance with applicable laws and good laboratory practices. Wash and dry hands.

The selected protective gloves have to satisfy the specifications of Regulation (EU) 2016/425 and the standard EN 374 derived from it.

Full contact
Material: butyl-rubber
Minimum layer thickness: 0,3 mm
Break through time: 480 min
Material tested:Butoject® (KCL 897 / Aldrich Z677647, Size M)

Splash contact
Material: butyl-rubber
Minimum layer thickness: 0,3 mm
Break through time: 480 min
Material tested:Butoject® (KCL 897 / Aldrich Z677647, Size M)

data source: KCL GmbH, D-36124 Eichenzell, phone +49 (0)6659 87300, e-mail sales@kcl.de, test method: EN374
If used in solution, or mixed with other substances, and under conditions which differ from EN 374, contact the supplier of the EC approved gloves. This recommendation is advisory only and must be evaluated by an industrial hygienist and safety officer familiar with the specific situation of anticipated use by our customers. It should not be construed as offering an approval for any specific use scenario.

Body Protection
Complete suit protecting against chemicals, The type of protective equipment must be selected according to the concentration and amount of the dangerous substance at the specific workplace.

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face respirator with multi-purpose combination (US) or type AXBEK (EN 14387) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Prevent further leakage or spillage if safe to do so. Do not let product enter drains. Discharge into the environment must be avoided.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: Liquefied gas Color: colorless
b)	Odor	stinging, Do not attempt to smell the product as it is hazardous.
c)	Odor Threshold	No data available
d)	pH	ca.10 - 12 at 50 g/l at 20 °C
e)	Melting point/freezing point	Melting point/range: -78 °C - lit.
f)	Initial boiling point and boiling range	-33 °C - lit.
g)	Flash point	Not applicable
h)	Evaporation rate	Not applicable
i)	Flammability (solid, gas)	The product is not flammable.
j)	Upper/lower flammability or explosive limits	Upper explosion limit: 25 %(V) Lower explosion limit: 16 %(V)
k)	Vapor pressure	8.600 hPa at 20 °C
l)	Vapor density	0,6 - (Air = 1.0)
m)	Relative density	No data available
n)	Water solubility	531 g/l at 20 °C - OECD Test Guideline 105
o)	Partition coefficient: n-octanol/water	Not applicable for inorganic substances
p)	Autoignition temperature	651 °C
q)	Decomposition temperature	> 450 °C -
r)	Viscosity	Viscosity, kinematic: No data available Viscosity, dynamic: No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information

Dissociation constant	9,25 at 25 °C
Relative vapor density	0,6 - (Air = 1.0)

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
No data available

10.5 Incompatible materials
No data available

10.6 Hazardous decomposition products
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
No data available

LC50 Inhalation - Rat - male - 4 h - 4,93 mg/l
Remarks: (ECHA)

Skin corrosion/irritation
Skin - Rabbit
Result: Corrosive - 4 h
(OECD Test Guideline 404)
Remarks: (Regulation (EC) No 1272/2008, Annex VI)

Serious eye damage/eye irritation
Causes serious eye damage.

Respiratory or skin sensitization
No data available

Germ cell mutagenicity

Test Type: Ames test
Test system: Escherichia coli/Salmonella typhimurium
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 471
Result: negative

Test Type: Micronucleus test
Species: Mouse
Cell type: Bone marrow
Application Route: Intraperitoneal
Method: OECD Test Guideline 474

Result: negative
Remarks: (in analogy to similar products)
The value is given in analogy to the following substances: ammonium chloride

Carcinogenicity
No data available

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
No data available

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

11.2 Additional Information

Repeated dose toxicity - Rat - male and female - Oral - 35 Days - NOAEL (No observed adverse effect level) - 250 mg/kg - LOAEL (Lowest observed adverse effect level) - 750 mg/kgRemarks:
(in analogy to similar products)
The value is given in analogy to the following substances: diammonium hydrogenphosphate

RTECS: BO0875000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

Liver - Irregularities - Based on Human Evidence

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	flow-through test LC50 - Pimephales promelas (fathead minnow) - 0,068 mg/l - 96 h Remarks: (in analogy to similar products) (ECHA) The value is given in analogy to the following substances: ammonium sulphate
Toxicity to daphnia and other aquatic invertebrates	static test LC50 - Daphnia magna (Water flea) - 101 mg/l - 48 h Remarks: (ECHA)
	EC50 - Daphnia pulicaria - 1,16 mg/l - 48 h Remarks: (Lit.)

12.2 Persistence and degradability

Biodegradability	Result: - rapidly biodegradable Remarks: Readily biodegradable.

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment
This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects
Very toxic to aquatic life.
No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product
Offer surplus and non-recyclable solutions to a licensed disposal company. Waste material must be disposed of in accordance with the Directive on waste 2008/98/EC as well as other national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself.

Contaminated packaging
Dispose of as unused product.

SECTION 14: Transport information

14.1 UN number

ADR/RID: 1005	IMDG: 1005	IATA: 1005

14.2 UN proper shipping name
ADR/RID: AMMONIA, ANHYDROUS
IMDG: AMMONIA, ANHYDROUS
IATA: Ammonia, anhydrous
Passenger Aircraft: Not permitted for transport
Cargo Aircraft: Not permitted for transport

14.3 Transport hazard class(es)

ADR/RID: 2.3 (8)	IMDG: 2.3 (8)	IATA: 2.3 (8)

14.4 Packaging group

ADR/RID: -	IMDG: -	IATA: -

14.5 Environmental hazards

ADR/RID: yes	IMDG Marine pollutant: yes	IATA: no

14.6 Special precautions for user
No data available

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006.

National legislation

Seveso III: Directive 2012/18/EU of the European Parliament and of the Council on the control of major-accident hazards involving dangerous substances.	: ACUTE TOXIC
	: ENVIRONMENTAL HAZARDS
	: Anhydrous Ammonia

15.2 Chemical Safety Assessment

For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

EUH071	Corrosive to the respiratory tract.
H221	Flammable gas.
H280	Contains gas under pressure; may explode if heated.
H314	Causes severe skin burns and eye damage.
H318	Causes serious eye damage.
H331	Toxic if inhaled.
H400	Very toxic to aquatic life.
H410	Very toxic to aquatic life with long lasting effects.
H411	Toxic to aquatic life with long lasting effects.

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

The branding on the header and/or footer of this document may temporarily not visually match the product purchased as we transition our branding. However, all of the information in the document regarding the product remains unchanged and matches the product ordered. For further information please contact mlsbranding@sial.com.

SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 6.6
Revision Date 07.10.2020
Print Date 17.08.2021
GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name	:	Sodium phosphate
Product Number	:	342483
Brand	:	Aldrich
REACH No.	:	01-2119489800-32-XXXX
CAS-No.	:	7601-54-9

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses	:	Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company	:	Sigma-Aldrich Chemie GmbH Eschenstrasse 5 D-82024 TAUFKIRCHEN
Telephone	:	+49 (0)89 6513-1130
Fax	:	+49 (0)89 6513-1161
E-mail address	:	technischerservice@merckgroup.com

1.4 Emergency telephone

Emergency Phone #	:	0800 181 7059 (CHEMTREC Deutschland) +49 (0)696 43508409 (CHEMTREC weltweit)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008
Skin irritation (Category 2), H315
Eye irritation (Category 2), H319
Specific target organ toxicity - single exposure (Category 3), Respiratory system, H335

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 Label elements

Labelling according Regulation (EC) No 1272/2008

Pictogram

Signal word Warning

Hazard statement(s)

H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.

Precautionary statement(s)

P261	Avoid breathing dust/ fume/ gas/ mist/ vapors/ spray.
P264	Wash skin thoroughly after handling.
P271	Use only outdoors or in a well-ventilated area.
P280	Wear protective gloves/ eye protection/ face protection.
P302 + P352	IF ON SKIN: Wash with plenty of water.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Supplemental Hazard Statements none

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms : Trisodium phosphate

Formula : Na_3O_4P

Molecular weight : 163,94 g/mol

CAS-No. : 7601-54-9

EC-No. : 231-509-8

Component	Classification	Concentration
tri-sodium phosphate		
	Skin Irrit. 2; Eye Irrit. 2; STOT SE 3; H315, H319, H335	<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice

Show this material safety data sheet to the doctor in attendance.

If inhaled

After inhalation: fresh air.

In case of skin contact

In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower.

In case of eye contact
After eye contact: rinse out with plenty of water. Call in ophthalmologist. Remove contact lenses.

If swallowed
After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed
The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed
No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Use water spray, alcohol-resistant foam, dry chemical or carbon dioxide.

5.2 Special hazards arising from the substance or mixture
Oxides of phosphorus, Sodium oxides
Not combustible.
Ambient fire may liberate hazardous vapours.

5.3 Advice for firefighters
Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information
Suppress (knock down) gases/vapors/mists with a water spray jet. Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures
Advice for non-emergency personnel: Avoid inhalation of dusts. Avoid substance contact. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions
Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up
Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up dry. Dispose of properly. Clean up affected area. Avoid generation of dusts.

6.4 Reference to other sections
For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling
For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities
Tightly closed. Dry.

Moisture sensitive.

7.3 Specific end use(s)
Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

8.2 Exposure controls

Appropriate engineering controls
Immediately change contaminated clothing. Apply preventive skin protection. Wash hands and face after working with substance.

Personal protective equipment

Eye/face protection
Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Safety glasses

Skin protection
This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Full contact
Material: Nitrile rubber
Minimum layer thickness: 0,11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).
Splash contact
Material: Nitrile rubber
Minimum layer thickness: 0,11 mm
Break through time: 480 min
Material tested:KCL 741 Dermatril® L

Body Protection
protective clothing

Respiratory protection
Where risk assessment shows air-purifying respirators are appropriate use a full-face particle respirator type N100 (US) or type P3 (EN 143) respirator cartridges as a backup to engineering controls. If the respirator is the sole means of protection, use a full-face supplied air respirator. Use respirators and components tested and approved under appropriate government standards such as NIOSH (US) or CEN (EU).

Control of environmental exposure
Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a)	Appearance	Form: solid Color: white
b)	Odor	No data available
c)	Odor Threshold	No data available
d)	pH	11 at 20 °C
e)	Melting point/freezing point	Melting point: 75 °C - Decomposes before melting.
f)	Initial boiling point and boiling range	No data available
g)	Flash point	Not applicable
h)	Evaporation rate	No data available
i)	Flammability (solid, gas)	No data available
j)	Upper/lower flammability or explosive limits	No data available
k)	Vapor pressure	No data available
l)	Vapor density	No data available
m)	Relative density	2,53 g/cm3 at 17,5 °C
n)	Water solubility	121 g/l at 20 °C
o)	Partition coefficient: n-octanol/water	Not applicable for inorganic substances
p)	Autoignition temperature	No data available
q)	Decomposition temperature	75 °C - Decomposes before melting.
r)	Viscosity	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	No data available

9.2 Other safety information
No data available

SECTION 10: Stability and reactivity

10.1 Reactivity
No data available

10.2 Chemical stability
The product is chemically stable under standard ambient conditions (room temperature) .
Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions
No data available

10.4 Conditions to avoid
no information available

10.5 Incompatible materials
Strong acids

10.6 Hazardous decomposition products
Other decomposition products - No data available
Hazardous decomposition products formed under fire conditions. - Oxides of phosphorus, Sodium oxides
In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity
LD50 Oral - Rat - female - > 2.000 mg/kg
(OECD Test Guideline 420)
LC50 Inhalation - Rat - male and female - 4 h - > 0,83 mg/l
(OECD Test Guideline 403)
Remarks: (in analogy to similar products)
LD50 Dermal - Rat - male and female - > 2.000 mg/kg
(OECD Test Guideline 402)

Skin corrosion/irritation
Irritating to skin.
(ECHA)

Serious eye damage/eye irritation
Eyes - Rabbit
Result: Causes serious eye irritation.
(US-EPA)
(ECHA)

Respiratory or skin sensitization
Local lymph node assay (LLNA) - Mouse
Result: negative
(OECD Test Guideline 429)

Germ cell mutagenicity
In vitro mammalian cell gene mutation test

mouse lymphoma cells
Result: negative
Micronucleus test
Human lymphocytes
Result: negative

Carcinogenicity

IARC: No ingredient of this product present at levels greater than or equal to 0.1% is identified as probable, possible or confirmed human carcinogen by IARC.

Reproductive toxicity
No data available

Specific target organ toxicity - single exposure
Inhalation - May cause respiratory irritation.

Specific target organ toxicity - repeated exposure
No data available

Aspiration hazard
No data available

Additional Information
RTECS: TC9490000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	semi-static test LC50 - Oncorhynchus mykiss (rainbow trout) - > 100 mg/l - 96 h (OECD Test Guideline 203)
Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Daphnia magna (Water flea) - > 100 mg/l - 48 h (OECD Test Guideline 202)
Toxicity to algae	static test ErC50 - Desmodesmus subspicatus (green algae) - > 100 mg/l - 72 h (OECD Test Guideline 201)
Toxicity to bacteria	static test EC50 - activated sludge - > 1.000 mg/l - 3 h (OECD Test Guideline 209) Remarks: (in analogy to similar products)

12.2 Persistence and degradability
The methods for determining the biological degradability are not applicable to inorganic substances.

12.3 Bioaccumulative potential
No data available

12.4 Mobility in soil
No data available

12.5 Results of PBT and vPvB assessment

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

12.6 Other adverse effects

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

See www.retrologistik.com for processes regarding the return of chemicals and containers, or contact us there if you have further questions.

SECTION 14: Transport information

14.1 UN number

ADR/RID: -	IMDG: -	IATA: -

14.2 UN proper shipping name

ADR/RID: Not dangerous goods
IMDG: Not dangerous goods
IATA: Not dangerous goods

14.3 Transport hazard class(es)

ADR/RID: -	IMDG: -	IATA: -

14.4 Packaging group

ADR/RID: -	IMDG: -	IATA: -

14.5 Environmental hazards

ADR/RID: no	IMDG Marine pollutant: no	IATA: no

14.6 Special precautions for user

Further information

Not classified as dangerous in the meaning of transport regulations.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006.

Other regulations

Take note of Dir 94/33/EC on the protection of young people at work.

15.2 Chemical Safety Assessment

For this product a chemical safety assessment was not carried out

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H315	Causes skin irritation.
H319	Causes serious eye irritation.
H335	May cause respiratory irritation.

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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Appendix G: Passive Sampler Laboratory Analysis Reports

Test Report Air Pollution Measurement

passam ag

air quality monitoring

CO Carbon monoxide measurement means of passive sampler

customer information
customer: Newtech International W.L.L
customer ID: UKB
contact person: Rajith Chandran
project: Alba Power Station 5 - Block 4
reference:

passive samplers
date received: 11.12.2020
type: badge
pollutant: CO
sampling rate: 1 [ml/min]

analysis
method: SP23 photometer
analyte: CO
date: 17.12.2020
place: passam ag

test report
created on: 18.12.2020
created by: U. Kunz
checked on: 21.12.2020
checked by: C. Panier
file name: UKB232002
pages: 1

note: applies to the sample as received; for information on the uncertainty of measurement and detection limit see data sheet: www.passam.ch; concentration calculated assuming: T = 20°C; p = 1013 hPa; this method is accredited to ISO 17025

measuring site	passive sampler label	passive sampler lot no.	measuring period start date	start time	end date	end time	exp. time [h]	measurement blank [ABS]	sample dilution	sample value [ABS]	result m analyte/ sampler [ug]	result C CO [ug/m3]	Comment on the analysis
Pricness Sabeeka Oasis	UKB 14	44118	08/11/2020	11:22	06/12/2020	11:40	672.3	0.008	-	0.102	-	590.0	specs not met: exp. time;
Pricness Sabeeka Oasis	UKB 15	44118	08/11/2020	11:22	06/12/2020	11:40	672.3	0.008	-	0.120	-	703.0	specs not met: exp. time;
Block 4 site	UKB 16	44118	08/11/2020	11:47	06/12/2020	11:57	672.2	0.008	-	0.060	-	< 500	specs not met: exp. time;
Block 4 site	UKB 17	44118	08/11/2020	11:47	06/12/2020	11:57	672.2	0.008	-	0.086	-	< 500	specs not met: exp. time;
L'Hassay Accomodation camp	UKB 23	44118	08/11/2020	9:26	06/12/2020	11:12	673.8	0.008	-	0.091	-	520.0	specs not met: exp. time;
L'Hassay Accomodation camp	UKB 24	44118	08/11/2020	9:26	06/12/2020	11:12	673.8	0.008	-	0.075	-	< 500	specs not met: exp. time;
Westpoint Home	UKB 21	44118	08/11/2020	10:09	06/12/2020	12:21	674.2	0.008	-	0.078	-	< 500	specs not met: exp. time;
Westpoint Home	UKB 22	44118	08/11/2020	10:09	06/12/2020	12:21	674.2	0.008	-	0.091	-	520.0	specs not met: exp. time;
BSPCA	UKB 19	44118	08/11/2020	9:55	06/12/2020	12:32	674.6	0.008	-	0.094	-	538.0	specs not met: exp. time;
BSPCA	UKB 20	44118	08/11/2020	9:55	06/12/2020	12:32	674.6	0.008	-	0.096	-	550.0	specs not met: exp. time;
Askar village	UKB 13	44118	08/11/2020	10:33	06/12/2020	12:43	674.2	0.008	-	0.054	-	< 500	specs not met: exp. time;
Askar village	UKB 18	44118	08/11/2020	10:33	06/12/2020	12:43	674.2	0.008	-	0.067	-	< 500	specs not met: exp. time;
Blank-1	B-1	44118						0.008	-	0.004	-		

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UQAS
ISO/IEC 17025:2017
Certificate No. TL/200 2006

DETERMINATION OF CARBON MONOXIDE - PASSIVE DIFFUSION TUBE ANALYSIS REPORT

REPORT NUMBER	ENV-RJC-20/00070-CO
PROJECT	Aluminium Bahrain B.S.C - PS5 Block 4 Expansion ESIA
SAMPLING PERIOD	08-11-2020 to 06-12-2020
JOB NUMBER	S/45229740

Location	Accommodation Area	Near West Point Home	Princess Sabeeka Oasis	BSPCA	Askar Village	PS5 - Block 4 Site
Unit	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
Monthly Exposure	520.00	< 500	590.00	538.00	< 500	< 500
Duplicate	< 500	520.00	703.00	550.00	< 500	< 500
Average	**520.00**	**520.00**	**646.50**	**544.00**		
Standard Deviation			**79.90**	**8.49**		
Coefficient of Variation			**12.36%**	**1.56%**		

$\mu g/m^3$ Micrograms per Cubic Metre

Comment: Results are blank subtracted, Laboratory Blank - 0.004

This report (including any enclosures or appendices) are prepared for the exclusive use of the Customer(s) named in the report . Installation and replacement of diffusion tubes was carried out based on our standard operating procedure (ENV-MSOP-AAQM-19/0001) for ambient air quality monitoring. Sample analysis has been carried out at passam ag by SP23 Photometer.

Envirotech Consultancy S.P.C's quality system complies with the applicable requirements of ISO/IEC 17025:2017.

Prepared By:	Checked By:	Approved By:
Sweeja .S		
Sweeja Sukumaran	**Minhajuddin Ahmed Faruqi**	**Rajith Chandran**

Test Report Air Pollution Measurement

passam ag

air quality monitoring

NOx (NO+NO2) Nitrogen oxides measurement by means of passive sampler

customer information
customer: Newtech International W.L.L
customer ID: UKB
contact person: Rajith Chandran
project: Alba Power Station 5 - Block 4
reference:

passive samplers
date received: 11.12.2020
type: tube (Palms)
pollutant: NOx (NO+NO2)
protective filter: yes

analysis
method: SP12-S photometer, Salzmann
analyte: [NO]-
date: 17.12.2020
place: passam ag

test report
created on: 21.12.2020
created by: U. Kunz
checked on: 22.12.2020
checked by: S. Huber
file name: UKB12-S-2001
pages: 1

SWISS ACCREDITATION sas.admin.ch STS 0149

note: applies to the sample as received; for information on measurement uncertainty, detection limit and sampling rates, see data sheet: www.passam.ch
concentration calculated assuming: T = 20°C; p = 1013 hPa; this method is accredited to ISO 17025

measuring site	passive sampler				measuring period			result						Comment on the analysis
	label		lot no.		start		exp. time	m / sampler			Conc			
								NO	NO2	NOx	NO	NO2	NOx	
	NO2	NOx	NO2	NOx	date	time	h	ug	ug	ug	ug/m3	ug/m3	ug/m3	*Comment on sampling*
Pricness Sabeeka Oasis	7	7	44082	44105	08/11/2020	11:22	672.3	0.06	1.26	1.31	1.5	42.4	43.9	
Pricness Sabeeka Oasis	8	8	44082	44105	08/11/2020	11:22	672.3	< 0.04	1.22	1.22	< 1	41.1	41.1	
Block 4 site	9	9	44082	44105	08/11/2020	11:47	672.2	< 0.04	0.98	0.98	< 1	33.1	33.1	
Block 4 site	10	10	44082	44105	08/11/2020	11:47	672.2	< 0.04	0.88	0.88	< 1	29.7	29.7	
L'Hassay Accomodation camp	1	1	44082	44105	08/11/2020	9:26	673.8	0.18	1.13	1.31	4.6	38.1	42.7	
L'Hassay Accomodation camp	2	2	44082	44105	08/11/2020	9:26	673.8	< 0.04	1.10	1.10	< 1	37.2	37.2	
Westpoint Home	3	3	44082	44105	08/11/2020	10:09	674.2	< 0.04	1.16	1.16	< 1	39.0	39.0	
Westpoint Home	4	4	44082	44105	08/11/2020	10:09	674.2	< 0.04	1.22	1.22	< 1	41.1	41.1	
BSPCA	5	5	44082	44105	08/11/2020	9:55	674.6	0.15	1.22	1.37	3.8	41.1	44.9	
BSPCA	6	6	44082	44105	08/11/2020	9:55	674.6	< 0.04	1.24	1.24	< 1	41.7	41.7	
Askar village	11	11	44082	44105	08/11/2020	10:33	674.2	0.17	0.89	1.06	4.5	30.0	34.5	
Askar village	12	12	44082	44105	08/11/2020	10:33	674.2	0.08	0.94	1.02	2.0	31.8	33.8	

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Certificate No. TL/200 2006

DETERMINATION OF OXIDES OF NITROGEN - PASSIVE DIFFUSION TUBE ANALYSIS REPORT

REPORT NUMBER	ENV-RJC-20/00070-NOx
PROJECT	Aluminium Bahrain B.S.C - PS5 Block 4 Expansion ESIA
SAMPLING PERIOD	08-11-2020 to 06-12-2020
JOB NUMBER	S/45229740

Location	Accommodation Area	Near West Point Home	Princess Sabeeka Oasis	BSPCA	Askar Village	PS5 - Block 4 Site
Unit	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³
Monthly Exposure	42.70	39.00	43.90	44.90	34.50	33.10
Duplicate	37.20	41.10	41.10	41.70	33.80	29.70
Average	**39.95**	**40.05**	**42.50**	**43.30**	**34.15**	**31.40**
Standard Deviation	**3.89**	**1.48**	**1.98**	**2.26**	**0.49**	**2.40**
Coefficient of Variation	**9.73%**	**3.71%**	**4.66%**	**5.23%**	**1.45%**	**7.66%**

μg/m³	Micrograms per Cubic Metre

Comment: Results are blank subtracted, Laboratory Blank - <0.1

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Envirotech Consultancy S.P.C's quality system complies with the applicable requirements of ISO/IEC 17025:2017.

Prepared By:	**Checked By:**	**Approved By:**
Sweeja. S		
Sweeja Sukumaran	**Minhajuddin Ahmed Faruqi**	**Rajith Chandran**

Test Report Air Pollution Measurement

passam ag

air quality monitoring

SO2 Sulfur dioxide measurement by means of passive sampler

customer information

customer: Envirotech Cosultancy SPC
customer ID: UKB
contact person: Rajith Chandran
project: Alba Power Station 5 - Block 4
reference:

passive samplers

date received: 11.12.2020
type: badge
pollutant: SO2
sampling rate: 11.9 [ml/min]

analysis

method: SP10 ion chromatography
analyte: SO2
date: 21.12.2020
place: passam ag

test report

created on: 04.01.2021
created by: C. Panier
checked on: 04.01.2021
checked by: B. Michen
file name: UKB102002
pages: 1

note: applies to the sample as received; for information on the uncertainty of measurement and detection limit see data sheet: www.passam.ch; concentration calculated assuming: T = 20°C; p = 1013 hPa; this method is accredited to ISO 17025

measuring site	passive sampler		measuring period					measurement			result		Comment on the analysis
	label	lot no.	start date	start time	end date	end time	exp. time [h]	blank [ppm]	sample dilution	sample value [ppm]	m analyte/ sampler [ug]	C SO2 [ug/m3]	
Pricness Sabeeka Oasis	UKB 14	44026	08/11/2020	11:22	06/12/2020	11:40	672.3	0.368	-	15.778	41.11	85.6	
Pricness Sabeeka Oasis	UKB 15	44026	08/11/2020	11:22	06/12/2020	11:40	672.3	0.368	-	12.390	32.07	66.8	
Block 4 site	UKB 16	44026	08/11/2020	11:47	06/12/2020	11:57	672.2	0.368	-	19.519	51.09	106.5	
Block 4 site	UKB 17	44026	08/11/2020	11:47	06/12/2020	11:57	672.2	0.368	-	18.409	48.13	100.3	
L'Hassay Accomodation camp	UKB 23	44026	08/11/2020	9:26	06/12/2020	11:12	673.8	0.368	-	21.595	56.63	117.7	
L'Hassay Accomodation camp	UKB 24	44026	08/11/2020	9:26	06/12/2020	11:12	673.8	0.368	-	23.188	60.88	126.6	
Westpoint Home	UKB 21	44026	08/11/2020	10:09	06/12/2020	12:21	674.2	0.368	-	15.002	39.04	81.1	
Westpoint Home	UKB 22	44026	08/11/2020	10:09	06/12/2020	12:21	674.2	0.368	-	13.435	34.86	72.4	
BSPCA	UKB 19	44026	08/11/2020	9:55	06/12/2020	12:32	674.6	0.368	-	8.713	22.26	46.2	
BSPCA	UKB 20	44026	08/11/2020	9:55	06/12/2020	12:32	674.6	0.368	-	8.230	20.98	43.5	
Askar village	UKB 13	44026	08/11/2020	10:33	06/12/2020	12:43	674.2	0.368	-	5.079	12.57	26.1	
Askar village	UKB 18	44026	08/11/2020	10:33	06/12/2020	12:43	674.2	0.368	-	5.702	14.23	29.6	
	Blank-1	44026						0.368	-	0.166	< 0.1		

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ISO/IEC 17025:2017
Certificate No. TL/200 2006

DETERMINATION OF SULPHUR DIOXIDE - PASSIVE DIFFUSION TUBE ANALYSIS REPORT

REPORT NUMBER	ENV-RJC-20/00070-SO_2
PROJECT	Aluminium Bahrain B.S.C - PS5 Block 4 Expansion ESIA
SAMPLING PERIOD	08-11-2020 to 06-12-2020
JOB NUMBER	S/45229740

Location	Accommodation Area	Near West Point Home	Princess Sabeeka Oasis	BSPCA	Askar Village	PS5 - Block 4 Site
Unit	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
Monthly Exposure	117.70	81.10	85.60	46.20	26.10	106.50
Duplicate	126.60	72.40	66.80	43.50	29.60	100.30
Average	**122.15**	**76.75**	**76.20**	**44.85**	**27.85**	**103.40**
Standard Deviation	**6.29**	**6.15**	**13.29**	**1.91**	**2.47**	**4.38**
Coefficient of Variation	**5.15%**	**8.02%**	**17.45%**	**4.26%**	**8.89%**	**4.24%**

$\mu g/m^3$ Micrograms per Cubic Metre

Comment: Results are blank subtracted, Laboratory Blank - <0.1

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Envirotech Consultancy S.P.C's quality system complies with the applicable requirements of ISO/IEC 17025:2017.

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Prepared By:	Checked By:	Approved By:
Sweeja.S		
Sweeja Sukumaran	Minhajuddin Ahmed Faruqi	Rajith Chandran

Appendix H: Continuous Ambient Air Quality Monitoring Results

Project	: ALBA (Baseline Ambient Air Quality Monitoring Campaign, August 2021)
Monitoring Date	: 22/08/2021
Monitoring Location	: ALBA
Intrument Serial No.	: SL031906
Monitoring Period	: Day & Night

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM								
2:00 AM								
3:00 AM								
4:00 AM								
5:00 AM								
6:00 AM								
7:00 AM								
8:00 AM								
9:00 AM								
10:00 AM								
11:00 AM								
12:00 PM	0.25	85.3	122.6	94.1	59.6	55.8	43.8	44.4
1:00 PM	1.22	81.6	109.4	103.2	61.0	57.5	44.2	44.0
2:00 PM	2.44	112.2	130.9	136.9	61.5	59.1	43.5	44.4
3:00 PM	1.70	108.6	125.3	98.5	47.2	45.0	43.8	45.6
4:00 PM	1.31	95.8	115.2	103.9	46.7	44.4	43.0	40.1
5:00 PM	0.60	107.2	128.8	93.5	44.0	42.0	43.0	37.2
6:00 PM	0.59	110.5	136.2	81.5	37.4	35.7	41.1	40.8
7:00 PM	0.30	102.4	125.4	59.1	30.0	28.3	38.9	46.0
8:00 PM	1.53	83.8	96.0	105.0	48.4	46.3	39.1	41.9
9:00 PM	0.97	66.9	81.1	95.2	40.2	38.2	38.0	45.5
10:00 PM	1.90	52.2	65.5	128.5	41.3	39.2	42.3	41.9
11:00 PM	1.02	57.9	67.9	103.3	41.5	39.3	39.1	36.0
12:00 AM	0.27	50.2	60.6	61.2	45.2	43.0	36.0	55.6
Min	**0.25**	**50.2**	**60.6**	**59.1**	**30.0**	**28.3**	**36.0**	**36.0**
Max	**2.44**	**112.2**	**136.2**	**136.9**	**61.5**	**59.1**	**44.2**	**55.6**
Avg	**1.08**	**85.7**	**105.0**	**97.2**	**46.5**	**44.1**	**41.2**	**43.3**

Project : ALBA (Baseline Ambient Air Quality Monitoring Campaign, August 2021)
Monitoring Date : 23/08/2021
Monitoring Location : ALBA
Instrument Serial No. : SL031906
Monitoring Period : Day & Night

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 (µg/m^3)	PM2.5 (µg/m^3)	Temperature (°C)	Humidity (%)
1:00 AM	0.21	51.80	60.56	61.33	44.64	42.46	35.61	58.53
2:00 AM	0.15	53.35	62.39	54.04	43.46	41.42	35.36	58.10
3:00 AM	0.15	41.09	48.20	63.47	38.58	36.60	34.94	65.34
4:00 AM	0.09	39.17	45.00	60.22	49.90	47.88	33.84	68.77
5:00 AM	0.09	31.17	33.80	78.93	47.61	43.95	35.09	56.51
6:00 AM	0.17	40.74	41.83	74.13	50.46	46.49	35.06	56.95
7:00 AM	1.19	58.61	62.54	113.26	59.48	56.45	35.72	56.27
8:00 AM	1.00	35.76	41.41	151.78	58.99	55.21	36.24	54.52
9:00 AM	0.09	40.05	46.23	92.32	55.31	52.17	36.57	51.62
10:00 AM	0.00	38.23	48.29	81.77	61.81	57.95	38.36	50.92
11:00 AM	0.25	49.73	48.38	63.60	52.32	50.29	35.97	65.48
12:00 PM	0.09	39.17	45.00	60.22	49.90	47.88	33.84	68.77
1:00 PM	1.64	79.02	98.96	71.20	54.22	50.66	47.75	26.61
2:00 PM	1.08	72.39	107.25	78.94	51.64	48.09	47.71	20.30
3:00 PM	1.27	71.57	104.09	116.43	50.03	46.53	45.78	23.16
4:00 PM	1.29	73.80	103.31	116.20	43.97	40.40	45.03	23.42
5:00 PM	1.80	85.17	115.40	125.98	44.76	41.73	43.24	33.42
6:00 PM	1.56	83.59	108.52	98.35	56.41	53.10	41.52	41.06
7:00 PM	2.06	72.88	96.40	117.35	43.13	41.08	39.24	47.75
8:00 PM	1.90	62.98	72.81	121.15	49.88	47.88	37.98	50.50
9:00 PM	1.61	53.04	58.43	110.11	54.25	52.13	37.54	52.50
10:00 PM	0.60	53.19	56.91	69.98	49.15	47.05	36.65	60.12
11:00 PM	0.29	53.92	55.58	58.10	46.44	44.44	36.49	61.61
12:00 AM	0.06	46.21	48.85	50.53	44.29	42.27	35.98	69.56
Min	**0.00**	**31.17**	**33.80**	**50.53**	**38.58**	**36.60**	**33.84**	**20.30**
Max	**2.06**	**85.17**	**115.40**	**151.78**	**61.81**	**57.95**	**47.75**	**69.56**
Avg	**0.78**	**55.28**	**67.09**	**87.06**	**50.03**	**47.25**	**38.40**	**50.91**

Project	**: ALBA (Ambient Air Quality Monitoring Campaign, August 2021)**
Monitoring Date	**: 24/08/2021**
Monitoring Location	**: Manufacture of aluminium alloys**
Intrument Serial No.	**: SL031906**
Monitoring Period	**: Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 (µg/m^3)	PM2.5 (µg/m^3)	Temperature (°C)	Humidity (%)
1:00 AM	0.41	40.04	38.14	84.86	60.51	58.52	36.10	65.98
2:00 AM	0.44	40.49	36.70	91.00	63.39	61.35	35.94	64.78
3:00 AM	0.16	34.65	31.44	71.40	68.16	66.12	35.05	68.53
4:00 AM	0.07	33.81	26.06	56.62	77.97	75.93	34.02	71.29
5:00 AM	0.12	33.46	27.27	53.58	74.36	72.26	33.75	68.31
6:00 AM	0.14	35.74	24.22	56.91	68.68	66.54	34.24	66.46
7:00 AM	0.85	32.15	24.29	91.83	61.30	59.14	36.80	58.57
8:00 AM	0.75	29.09	19.32	99.89	64.90	62.72	38.52	57.38
9:00 AM	0.74	41.36	30.72	101.72	62.09	59.70	40.29	47.22
10:00 AM	0.70	49.20	43.75	79.78	54.30	52.23	42.94	39.75
11:00 AM	0.08	53.65	52.17	53.67	56.93	54.04	43.97	38.71
12:00 PM	0.31	61.68	72.66	77.15	59.97	56.71	46.13	32.62
1:00 PM	1.38	67.79	118.83	79.40	52.49	49.07	48.19	24.88
2:00 PM	1.90	70.39	168.43	99.22	44.81	41.61	48.25	17.51
3:00 PM	1.96	71.52	158.56	151.67	49.58	46.29	47.24	20.95
4:00 PM	0.96	67.04	127.21	108.67	60.87	57.42	44.02	34.37
5:00 PM	0.11	71.88	117.45	72.35	56.87	54.20	42.75	41.91
6:00 PM	0.16	80.21	108.17	73.94	51.03	48.58	41.04	42.57
7:00 PM	0.25	71.27	87.67	76.38	44.28	42.44	38.69	49.36
8:00 PM	2.34	47.04	55.90	143.81	80.36	78.25	38.04	56.20
9:00 PM	1.82	45.63	50.21	116.92	81.01	78.77	37.35	56.18
10:00 PM	0.31	41.91	41.41	67.13	81.36	79.21	36.18	61.13
11:00 PM	0.10	37.55	39.71	62.37	89.00	86.86	35.64	63.94
12:00 AM	0.00	31.44	31.19	62.33	88.16	86.11	35.07	67.46
Min	**0.00**	**29.09**	**19.32**	**53.58**	**44.28**	**41.61**	**33.75**	**17.51**
Max	**2.34**	**80.21**	**168.43**	**151.67**	**89.00**	**86.86**	**48.25**	**71.29**
Avg	**0.67**	**49.54**	**63.81**	**84.69**	**64.68**	**62.25**	**39.59**	**50.67**

Project	**: ALBA (Ambient Air Quality Monitoring Campaign, August 2021)**
Monitoring Date	**: 25/08/2021**
Monitoring Location	**: Manufacture of aluminium alloys**
Intrument Serial No.	**: SL031906**
Monitoring Period	**: Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 (μg/m^3)	PM2.5 (μg/m^3)	Temperature (°C)	Humidity (%)
1:00 AM	0.02	31.50	29.57	56.91	89.38	87.38	34.23	68.87
2:00 AM	0.08	31.53	28.45	56.16	81.94	79.96	33.63	71.61
3:00 AM	0.18	27.27	24.09	63.16	83.74	81.67	33.35	69.74
4:00 AM	0.16	30.56	24.94	61.58	87.20	85.14	33.05	69.15
5:00 AM	0.22	34.38	26.35	59.81	96.30	94.13	33.11	70.91
6:00 AM	0.27	40.90	30.81	55.13	98.09	95.91	33.51	69.90
7:00 AM	0.35	37.72	28.35	60.59	88.03	85.90	35.09	67.89
8:00 AM	0.52	42.40	35.19	63.52	60.41	58.39	38.09	58.31
9:00 AM	0.44	58.81	52.68	57.57	52.46	50.43	40.74	45.61
10:00 AM	0.89	61.62	58.17	73.94	71.03	68.70	42.24	46.87
11:00 AM	0.74	83.79	84.17	63.88	71.29	68.95	42.52	46.00
12:00 PM	0.59	116.90	139.38	57.71	70.64	66.92	45.54	39.79
1:00 PM	0.93	127.13	182.04	34.31	64.77	60.99	47.32	35.74
2:00 PM	0.10	91.83	177.60	48.30	40.16	36.66	48.17	20.24
3:00 PM	0.00	85.04	178.76	91.24	38.06	34.68	47.80	17.74
4:00 PM	0.00	80.44	169.75	84.23	38.84	35.79	46.97	18.74
5:00 PM	0.00	73.41	140.65	70.11	41.72	38.05	45.10	22.62
6:00 PM	0.00	60.18	109.27	74.22	43.40	40.42	42.38	29.74
7:00 PM	0.00	54.43	84.89	64.54	38.12	36.02	40.09	36.35
8:00 PM	0.01	56.81	72.42	59.88	36.70	34.77	40.48	34.10
9:00 PM	0.09	58.60	70.91	56.66	46.47	44.36	40.30	31.35
10:00 PM	0.47	48.60	60.09	60.00	55.50	53.39	37.37	39.72
11:00 PM	0.66	45.15	53.00	70.00	57.70	55.68	36.27	42.89
12:00 AM	0.55	36.89	44.60	61.96	58.55	56.53	35.15	52.53
Min	**0.00**	**27.27**	**24.09**	**34.31**	**36.70**	**34.68**	**33.05**	**17.74**
Max	**0.93**	**127.13**	**182.04**	**91.24**	**98.09**	**95.91**	**48.17**	**71.61**
Avg	**0.30**	**59.00**	**79.42**	**62.73**	**62.94**	**60.45**	**39.69**	**46.10**

Project	**: ALBA (Ambient Air Quality Monitoring Campaign, August 2021)**
Monitoring Date	**: 26/08/2021**
Monitoring Location	**: Manufacture of aluminium alloys**
Intrument Serial No.	**: SL031906**
Monitoring Period	**: Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.52	54.35	60.26	58.63	61.20	59.14	36.39	48.79
2:00 AM	0.37	54.25	58.46	51.77	74.25	72.11	36.30	53.30
3:00 AM	0.16	51.34	55.15	54.11	72.58	70.57	35.68	57.77
4:00 AM	0.07	49.98	54.59	50.14	60.46	58.44	35.42	59.79
5:00 AM	0.12	39.13	40.83	54.63	60.08	58.03	34.37	62.80
6:00 AM	0.33	48.37	47.88	50.96	65.15	63.03	34.49	60.50
7:00 AM	0.39	47.30	47.30	54.96	54.53	52.45	35.53	55.79
8:00 AM	0.34	66.19	64.10	49.27	45.22	43.14	38.35	43.84
9:00 AM	0.32	84.79	85.06	37.23	43.19	41.22	41.69	36.41
10:00 AM	0.19	86.06	96.23	33.38	53.91	50.98	44.71	30.14
11:00 AM	0.14	94.23	125.42	42.90	49.75	46.79	45.97	27.85
12:00 PM	0.12	108.50	174.56	63.42	57.28	53.85	47.47	25.12
1:00 PM	0.18	155.56	238.96	60.96	66.66	62.78	47.61	25.83
2:00 PM	0.04	134.64	220.11	65.21	61.66	57.74	47.72	24.48
3:00 PM	0.00	97.35	195.56	84.90	55.69	52.33	47.63	22.08
4:00 PM	0.00	89.17	182.17	85.43	54.59	51.04	46.89	23.32
5:00 PM	0.00	74.10	142.29	76.14	53.69	49.88	45.47	24.93
6:00 PM	0.00	71.96	125.40	61.72	50.21	47.11	43.23	26.79
7:00 PM	0.01	64.94	99.84	50.92	48.26	45.57	41.74	27.88
8:00 PM	0.20	70.27	90.18	41.82	58.48	55.85	40.77	28.41
9:00 PM	0.48	69.29	80.51	39.78	61.74	59.61	38.51	34.38
10:00 PM	0.35	78.59	85.43	41.93	62.24	59.98	38.72	36.67
11:00 PM	0.44	60.46	70.19	48.25	69.35	67.23	36.95	43.12
12:00 AM	0.49	59.10	66.94	53.04	72.36	70.03	35.79	48.01
Min	**0.00**	**39.13**	**40.83**	**33.38**	**43.19**	**41.22**	**34.37**	**22.08**
Max	**0.52**	**155.56**	**238.96**	**85.43**	**74.25**	**72.11**	**47.72**	**62.80**
Avg	**0.22**	**75.41**	**104.48**	**54.65**	**58.86**	**56.20**	**40.73**	**38.67**

Project	**: ALBA (Baseline Ambient Air Quality Monitoring Campaign, August 2021)**
Monitoring Date	**: 27/08/2021**
Monitoring Location	**: Manufacture of aluminium alloys**
Intrument Serial No.	**: SL031906**
Monitoring Period	**: Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (ºC)	Humidity (%)
1:00 AM	0.25	53.28	61.83	53.51	72.98	70.81	34.92	51.43
2:00 AM	0.26	42.27	48.00	51.98	70.67	68.58	33.90	58.78
3:00 AM	0.24	38.96	42.80	49.14	69.05	66.94	33.74	62.04
4:00 AM	0.22	36.81	40.77	51.67	60.50	58.50	33.54	62.19
5:00 AM	0.27	47.06	47.92	48.65	56.22	54.16	33.82	54.28
6:00 AM	0.22	48.04	47.36	48.70	44.20	42.12	33.93	47.84
7:00 AM	0.27	45.58	42.38	46.92	38.45	36.32	35.40	47.87
8:00 AM	0.32	48.46	45.71	40.96	27.21	25.58	38.62	48.36
9:00 AM	0.03	47.77	43.92	48.58	23.65	22.38	41.06	48.85
10:00 AM	0.02	59.72	61.06	46.19	22.64	21.38	42.57	46.23
11:00 AM	0.04	81.54	87.98	43.52	29.10	27.02	44.94	34.82
12:00 PM	0.41	90.58	121.90	42.60	45.68	42.69	46.40	32.51
1:00 PM	0.66	77.00	131.22	59.22	48.44	45.00	46.55	30.93
2:00 PM	0.05	84.80	177.87	95.53	52.28	48.55	48.35	21.89
3:00 PM	0.97	81.16	178.64	129.93	52.06	48.78	48.70	22.91
4:00 PM	0.07	88.74	179.98	96.22	43.93	40.99	47.50	29.90
5:00 PM	0.13	76.29	152.35	92.98	44.65	41.31	44.98	39.30
6:00 PM	0.02	71.69	122.76	67.67	29.98	27.70	41.26	48.13
7:00 PM	0.15	57.15	79.72	49.43	43.10	40.93	39.21	47.21
8:00 PM	0.48	54.31	53.00	47.02	50.69	48.79	37.89	52.48
9:00 PM	0.76	57.02	55.13	43.96	54.91	52.79	37.06	56.77
10:00 PM	0.86	46.98	43.09	50.64	53.60	51.44	36.29	61.81
11:00 PM	0.89	51.13	45.63	60.94	57.25	55.07	36.25	65.64
12:00 AM	0.39	54.63	47.75	55.65	53.47	51.23	35.75	67.63
Min	**0.02**	**36.81**	**40.77**	**40.96**	**22.64**	**21.38**	**33.54**	**21.89**
Max	**0.97**	**90.58**	**179.98**	**129.93**	**72.98**	**70.81**	**48.70**	**67.63**
Avg	**0.33**	**60.04**	**81.62**	**59.23**	**47.70**	**45.38**	**39.69**	**47.49**

Project	**: ALBA (Ambient Air Quality Monitoring Campaign, August 2021)**
Monitoring Date	**: 28/08/2021**
Monitoring Location	**: Manufacture of aluminium alloys**
Intrument Serial No.	**: SL031906**
Monitoring Period	**: Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.36	45.52	37.15	59.98	57.40	55.40	35.34	67.27
2:00 AM	0.23	51.83	39.67	56.67	73.46	71.27	34.87	72.26
3:00 AM	0.11	43.61	30.29	53.18	77.94	75.90	33.46	73.17
4:00 AM	0.16	33.74	19.51	57.79	82.41	80.09	33.14	73.23
5:00 AM	0.20	31.64	16.49	56.77	86.37	84.05	33.13	74.02
6:00 AM	0.18	33.57	15.80	53.86	101.38	98.23	33.36	72.39
7:00 AM	0.14	33.92	15.88	51.65	89.91	87.01	34.14	71.72
8:00 AM	0.17	36.21	18.75	51.38	71.73	70.15	36.33	63.84
9:00 AM	0.19	51.38	32.38	50.19	43.37	41.35	39.00	53.30
10:00 AM	0.20	59.23	43.81	48.26	41.65	39.46	41.66	46.00
11:00 AM	0.98	40.68	32.60	88.87	54.46	54.09	43.28	49.23
12:00 PM	0.49	51.15	44.55	71.15	61.64	58.32	44.33	45.84
1:00 PM	1.43	84.11	101.04	95.70	58.45	54.84	47.01	31.79
2:00 PM	1.26	76.65	134.67	39.24	61.55	57.65	48.12	31.94
3:00 PM	0.91	80.96	147.48	68.50	67.73	63.79	47.84	35.62
4:00 PM	0.31	79.69	126.04	81.67	69.52	65.56	45.97	39.56
5:00 PM	0.35	78.09	108.87	77.51	55.98	52.55	45.17	38.68
6:00 PM	0.36	73.60	89.62	67.19	58.14	54.98	42.67	38.55
7:00 PM	0.27	71.96	76.04	53.29	72.92	69.92	39.42	42.33
8:00 PM	0.23	52.98	46.25	46.25	74.46	69.53	38.17	46.00
9:00 PM	0.18	57.92	45.67	59.46	73.19	70.65	37.22	52.63
10:00 PM	0.20	51.00	38.51	58.83	68.77	66.49	36.02	56.01
11:00 PM	0.22	49.81	39.72	55.85	64.87	62.72	36.24	53.10
12:00 AM	0.92	43.25	30.33	74.79	68.61	66.22	36.75	65.08
Min	**0.11**	**31.64**	**15.80**	**39.24**	**41.65**	**39.46**	**33.13**	**31.79**
Max	**1.43**	**84.11**	**147.48**	**95.70**	**101.38**	**98.23**	**48.12**	**74.02**
Avg	**0.42**	**54.69**	**55.46**	**61.58**	**68.16**	**65.43**	**39.28**	**53.90**

Project	: ALBA (Baseline Ambient Air Quality Monitoring Campaign, August 2021)							
Monitoring Date	: 29/08/2021							
Monitoring Location	: Manufacture of aluminium alloys							
Intrument Serial No.	: SL031906							
Monitoring Period	: Day & Night							
Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.62	35.64	19.34	74.72	54.87	52.81	36.37	58.21
2:00 AM	0.59	30.90	16.04	79.73	63.16	60.97	35.99	66.10
3:00 AM	0.88	33.50	18.83	88.29	54.68	52.57	36.38	59.17
4:00 AM	0.46	35.67	18.62	68.67	57.32	55.14	35.54	64.98
5:00 AM	0.48	32.24	14.18	79.02	59.62	57.19	35.87	65.45
6:00 AM	0.19	36.75	17.94	63.96	53.06	50.73	36.08	64.08
7:00 AM	0.02	39.70	20.64	57.04	45.80	43.42	37.53	56.81
8:00 AM	0.18	43.61	25.61	69.85	44.27	42.01	40.70	47.16
9:00 AM	0.17	48.41	34.49	64.76	37.42	35.34	42.17	41.54
10:00 AM	0.15	50.35	36.24	63.25	39.25	34.24	43.25	40.25
11:00 AM	0.32	47.52	42.92	74.58	43.28	40.48	44.84	35.70
12:00 PM	0.89	56.04	62.16	70.51	45.18	42.16	46.48	29.09
1:00 PM	0.30	64.43	105.64	23.26	49.01	45.30	46.85	35.77
2:00 PM	0.29	70.78	145.02	46.73	50.28	46.69	48.82	30.98
3:00 PM	1.07	72.28	155.30	130.70	46.66	43.68	48.76	29.03
4:00 PM	1.74	72.02	143.71	138.64	58.23	55.03	46.89	31.97
5:00 PM	0.84	54.44	91.73	101.98	48.81	45.77	41.95	47.42
6:00 PM	0.04	56.17	67.68	74.77	45.17	42.74	39.43	52.31
7:00 PM	1.13	41.65	34.04	99.90	46.11	43.79	38.44	56.72
8:00 PM	1.58	42.89	35.06	98.91	43.85	46.70	38.64	53.31
9:00 PM	0.70	44.35	36.69	88.35	47.11	44.97	38.65	49.34
10:00 PM	0.39	43.63	32.50	74.10	39.78	37.77	37.90	51.00
11:00 PM	0.35	39.56	26.84	79.72	40.40	38.33	37.36	53.11
12:00 AM	0.31	42.26	27.89	74.09	42.81	40.57	36.73	54.00
Min	**0.02**	**30.90**	**14.18**	**23.26**	**37.42**	**34.24**	**35.54**	**29.03**
Max	**1.74**	**72.28**	**155.30**	**138.64**	**63.16**	**60.97**	**48.82**	**66.10**
Avg	**0.57**	**47.28**	**51.21**	**78.56**	**48.17**	**45.77**	**40.48**	**48.90**

Project	**: ALBA (Baseline Ambient Air Quality Monitoring Campaign, August 2021)**
Monitoring Date	**: 30/08/2021**
Monitoring Location	**: Manufacture of aluminium alloys**
Intrument Serial No.	**: SL031906**
Monitoring Period	**: Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.84	41.15	26.77	84.45	44.52	42.34	37.19	51.38
2:00 AM	1.11	37.96	24.02	87.00	47.90	45.74	36.72	55.96
3:00 AM	0.40	65.43	99.06	93.96	42.44	39.84	43.25	38.81
4:00 AM	0.51	48.02	71.55	75.55	40.06	37.64	40.74	43.51
5:00 AM	1.04	33.29	15.98	77.76	45.30	43.11	35.23	68.69
6:00 AM	1.04	35.74	17.57	73.06	35.35	33.33	35.29	70.91
7:00 AM	0.81	40.06	20.88	68.75	33.77	31.71	36.33	67.60
8:00 AM	0.70	45.94	27.56	76.60	35.74	33.72	39.06	51.92
9:00 AM	0.82	45.72	28.74	91.23	38.78	36.73	41.14	45.21
10:00 AM	1.29	50.57	39.04	100.55	40.92	38.40	43.52	40.17
11:00 AM	0.72	50.98	63.17	73.06	41.11	38.19	46.67	30.39
12:00 PM	0.78	53.71	122.63	31.06	47.04	43.81	49.03	27.65
1:00 PM	1.20	56.28	145.63	108.93	45.44	42.30	50.13	23.54
2:00 PM	0.88	51.00	137.06	150.53	46.18	43.14	50.41	20.86
3:00 PM	1.33	52.20	134.18	151.18	45.54	42.52	47.55	27.36
4:00 PM	0.59	50.85	99.42	129.92	44.44	41.19	43.77	37.88
5:00 PM	0.40	65.43	99.10	93.96	42.44	39.84	43.25	38.81
6:00 PM	0.51	48.02	71.55	75.55	40.06	37.64	40.74	43.51
7:00 PM	0.29	49.09	55.53	66.36	48.48	46.15	38.44	61.44
8:00 PM	0.88	43.51	40.16	79.67	46.89	44.55	36.84	69.48
9:00 PM	1.69	39.71	34.40	91.58	43.34	41.22	37.13	62.45
10:00 PM	0.55	38.46	30.83	76.09	40.32	38.07	37.00	60.69
11:00 PM	0.31	41.27	29.94	67.08	37.36	35.16	36.68	60.44
12:00 AM	0.17	41.00	29.37	56.48	45.74	43.41	35.86	66.38
Min	**0.17**	**33.29**	**15.98**	**31.06**	**33.77**	**31.71**	**35.23**	**20.86**
Max	**1.69**	**65.43**	**145.63**	**151.18**	**48.48**	**46.15**	**50.41**	**70.91**
Avg	**0.79**	**46.89**	**61.01**	**86.68**	**42.47**	**39.99**	**40.92**	**48.54**

Project	: ALBA (Baseline Ambient Air Quality Monitoring Campaign, August 2021)							
Monitoring Date	: 31/08/2021							
Monitoring Location	: Manufacture of aluminium alloys							
Intrument Serial No.	: SL031906							
Monitoring Period	: Day & Night							
Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.15	43.47	32.41	60.88	46.72	44.45	36.30	55.89
2:00 AM	0.23	41.42	28.69	66.46	40.09	38.02	36.79	51.24
3:00 AM	0.38	38.74	25.91	76.96	40.84	38.59	37.07	49.37
4:00 AM	0.40	35.57	21.94	79.51	41.32	39.14	36.64	54.59
5:00 AM	0.21	36.72	23.09	61.06	39.37	37.65	35.69	59.10
6:00 AM	0.17	36.27	22.10	49.57	48.67	46.42	33.75	62.68
7:00 AM	0.29	39.96	25.46	51.58	48.57	46.24	34.72	56.72
8:00 AM	0.21	43.78	26.37	52.04	42.66	40.58	37.68	48.80
9:00 AM	0.20	38.98	25.04	58.04	40.38	38.27	39.81	45.49
10:00 AM	0.66	40.29	28.69	89.96	39.83	37.79	41.93	46.18
11:00 AM	0.62	44.83	34.98	88.35	42.52	39.94	42.92	44.82
12:00 PM	1.25	57.53	56.78	101.09	45.23	42.50	45.16	36.83
1:00 PM	1.10	61.22	61.65	73.72	44.03	47.23	46.03	31.34
2:00 PM	1.58	60.89	65.57	83.02	49.61	46.71	46.73	28.96
3:00 PM	1.77	63.33	67.91	81.44	45.67	42.69	45.92	32.30
4:00 PM	2.22	60.67	57.67	105.25	49.08	46.39	44.13	36.64
5:00 PM	2.17	69.21	64.10	103.17	44.98	42.54	42.76	40.42
6:00 PM	1.66	69.73	60.44	93.53	39.01	36.94	40.51	42.74
7:00 PM	0.92	58.31	45.11	83.47	50.76	48.02	39.39	41.22
8:00 PM	1.51	49.65	32.47	99.27	53.74	51.24	38.08	49.38
9:00 PM	0.41	45.48	28.42	57.08	37.37	35.10	36.79	56.45
10:00 PM	0.71	42.11	24.16	66.38	45.38	43.04	36.66	58.87
11:00 PM	0.30	39.74	21.88	60.46	43.64	41.27	35.94	60.87
12:00 AM	0.56	37.60	17.42	68.56	50.24	48.05	35.83	60.61
Min	**0.15**	**35.57**	**17.42**	**49.57**	**37.37**	**35.10**	**33.75**	**28.96**
Max	**2.22**	**69.73**	**67.91**	**105.25**	**53.74**	**51.24**	**46.73**	**62.68**
Avg	**0.82**	**48.15**	**37.43**	**75.45**	**44.57**	**42.45**	**39.47**	**47.98**

Project	**: ALBA (Baseline Ambient Air Quality Monitoring Campaign, September 2021)**
Monitoring Date	**: 01/09/2021**
Monitoring Location	**: Manufacture of aluminium alloys**
Intrument Serial No.	**: SL031906**
Monitoring Period	**: Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.45	36.02	16.25	66.73	53.38	51.24	35.29	65.58
2:00 AM	0.68	34.15	12.19	84.52	49.83	47.58	35.29	65.18
3:00 AM	0.32	32.90	10.85	74.51	45.17	42.97	34.89	65.39
4:00 AM	0.26	33.43	12.33	81.54	49.37	46.87	34.52	68.11
5:00 AM	0.14	33.25	10.52	68.65	49.42	46.85	33.99	70.27
6:00 AM	0.07	33.69	10.23	57.73	59.88	57.05	33.19	70.43
7:00 AM	0.13	34.57	10.59	56.63	50.98	48.23	34.71	63.48
8:00 AM	0.15	41.17	20.81	52.94	32.83	30.88	37.34	35.79
9:00 AM	0.06	47.91	27.15	52.68	34.10	32.02	40.08	43.53
10:00 AM	0.09	49.47	34.47	63.79	40.29	38.13	42.28	39.07
11:00 AM	0.66	43.83	35.15	94.07	38.45	36.01	43.72	40.37
12:00 PM	0.76	46.43	47.73	89.76	42.60	39.60	45.12	41.44
1:00 PM	0.29	61.84	63.98	61.65	39.60	36.69	45.65	37.38
2:00 PM	1.36	57.33	58.29	80.65	46.99	43.95	45.21	35.88
3:00 PM	2.51	54.00	47.07	101.37	43.41	40.40	43.79	37.57
4:00 PM	2.20	58.85	105.21	105.21	43.82	41.31	43.44	38.43
5:00 PM	2.42	68.02	56.51	112.19	47.04	44.65	41.05	45.88
6:00 PM	1.87	57.69	40.16	104.20	48.74	46.60	38.29	52.45
7:00 PM	1.15	53.02	31.94	85.87	38.77	36.72	36.86	55.45
8:00 PM	0.56	54.21	33.56	68.90	46.10	43.96	36.72	56.12
9:00 PM	0.92	47.43	28.35	79.00	43.80	41.56	37.15	55.67
10:00 PM	0.98	49.32	34.21	86.32	44.32	42.25	37.35	54.21
11:00 PM	1.02	51.32	33.25	76.32	47.23	44.25	38.21	53.21
12:00 AM	0.96	56.25	35.21	78.92	48.32	45.32	36.21	56.32
Min	**0.06**	**32.90**	**10.23**	**52.68**	**32.83**	**30.88**	**33.19**	**35.79**
Max	**2.51**	**68.02**	**105.21**	**112.19**	**59.88**	**57.05**	**45.65**	**70.43**
Avg	**0.83**	**47.34**	**34.00**	**78.51**	**45.19**	**42.71**	**38.76**	**51.97**

Project	: ALBA (Baseline Ambient Air Quality Monitoring Campaign, September 2021)							
Monitoring Date	: 02/09/2021							
Monitoring Location	: Manufacture of aluminium alloys							
Intrument Serial No.	: SL031906							
Monitoring Period	: Day & Night							
Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 (μg/m^3)	PM2.5 (μg/m^3)	Temperature (°C)	Humidity (%)
1:00 AM	0.14	59.67	51.07	45.85	38.35	35.64	37.22	40.77
2:00 AM	0.13	61.19	53.17	47.85	38.13	35.71	36.78	41.92
3:00 AM	0.13	68.00	58.66	52.70	40.76	38.29	37.17	38.87
4:00 AM	0.56	79.10	69.10	86.75	57.46	54.56	38.74	34.28
5:00 AM	0.93	70.61	61.70	83.93	68.00	65.06	39.57	33.08
6:00 AM	1.48	65.14	57.62	104.38	43.93	41.07	39.55	35.43
7:00 AM	0.38	67.40	57.34	112.09	43.78	41.28	40.39	37.42
8:00 AM	0.12	75.02	75.48	54.98	70.45	67.16	43.98	34.50
9:00 AM	0.11	84.64	87.14	57.20	64.65	61.39	45.71	30.39
10:00 AM	0.15	76.25	91.25	53.25	69.35	63.24	45.90	32.12
11:00 AM	0.92	47.43	28.35	79.00	43.80	41.56	37.15	55.67
12:00 PM	0.00	57.23	42.77	78.39	33.65	29.94	44.95	32.08
1:00 PM	0.00	63.10	45.35	56.21	35.76	32.83	45.95	29.76
2:00 PM	0.88	64.83	46.59	43.61	44.21	40.90	46.93	28.19
3:00 PM	0.57	84.09	87.83	31.22	39.22	36.47	45.96	31.56
4:00 PM	0.67	77.33	78.93	63.82	46.32	42.89	43.93	33.76
5:00 PM	0.03	83.96	80.20	48.22	33.33	30.43	43.66	30.61
6:00 PM	0.00	69.64	66.64	39.89	37.94	34.48	41.75	36.90
7:00 PM	0.04	87.04	77.21	38.77	32.14	29.31	39.74	42.65
8:00 PM	0.37	79.64	71.58	61.09	44.26	41.12	38.21	51.75
9:00 PM	1.47	61.50	54.73	93.17	50.71	47.11	38.23	42.72
10:00 PM	1.58	54.43	47.81	90.04	53.11	49.60	38.32	47.73
11:00 PM	0.71	48.96	45.19	63.77	43.32	39.93	37.11	52.25
12:00 AM	0.20	49.02	44.13	55.50	42.64	54.16	36.64	54.16
Min	**0.00**	**47.43**	**28.35**	**31.22**	**32.14**	**29.31**	**36.64**	**28.19**
Max	**1.58**	**87.04**	**91.25**	**112.09**	**70.45**	**67.16**	**46.93**	**55.67**
Avg	**0.48**	**68.13**	**61.66**	**64.24**	**46.47**	**43.92**	**40.98**	**38.69**

Project	**: ALBA (Baseline Ambient Air Quality Monitoring Campaign, September 2021)**
Monitoring Date	**: 03/09/2021**
Monitoring Location	**: Manufacture of aluminium alloys**
Instrument Serial No.	**: SL031906**
Monitoring Period	**: Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.04	48.74	42.34	41.74	41.57	38.12	36.00	59.92
2:00 AM	0.00	44.60	38.32	42.98	40.62	37.13	35.13	61.43
3:00 AM	0.09	44.30	35.26	48.00	39.59	36.23	34.76	61.64
4:00 AM	0.26	50.94	42.61	42.88	46.54	42.84	35.13	61.15
5:00 AM	0.11	38.98	31.24	47.94	44.21	40.64	34.93	63.03
6:00 AM	0.14	37.79	28.52	48.81	50.61	47.05	34.64	64.27
7:00 AM	0.16	46.57	35.43	44.90	59.02	55.43	35.49	63.11
8:00 AM	0.18	47.50	37.33	41.77	51.19	47.54	37.69	57.48
9:00 AM	0.25	54.39	45.82	40.10	61.11	57.42	39.96	49.81
10:00 AM	0.21	61.23	53.47	45.36	61.70	57.87	42.10	44.84
11:00 AM	0.18	69.23	60.52	46.15	61.54	57.66	43.18	43.20
12:00 PM	0.28	86.43	78.59	36.10	65.63	61.75	43.51	44.22
1:00 PM	0.36	102.04	96.74	30.85	68.39	64.67	44.85	40.74
2:00 PM	0.30	121.98	138.71	28.79	70.06	66.10	45.53	36.54
3:00 PM	0.20	104.89	120.51	47.04	64.03	60.42	45.20	33.70
4:00 PM	0.08	76.81	85.72	54.60	64.07	60.35	44.06	31.96
5:00 PM	0.05	68.13	68.63	51.13	57.36	53.55	42.26	37.10
6:00 PM	0.11	53.79	50.74	52.96	59.39	55.56	39.32	49.54
7:00 PM	0.17	47.48	44.21	54.73	57.13	53.47	37.46	58.35
8:00 PM	0.20	51.32	47.51	53.23	55.35	51.44	36.92	59.47
9:00 PM	0.14	46.21	40.58	51.42	49.86	46.36	36.96	57.88
10:00 PM	0.19	44.33	38.13	53.93	58.35	54.65	36.16	58.72
11:00 PM	0.26	40.69	33.98	51.56	59.36	55.57	35.43	61.61
12:00 AM	0.29	34.65	27.59	57.11	54.97	51.10	34.33	64.24
Min	**0.00**	**34.65**	**27.59**	**28.79**	**39.59**	**36.23**	**34.33**	**31.96**
Max	**0.36**	**121.98**	**138.71**	**57.11**	**70.06**	**66.10**	**45.53**	**64.27**
Avg	**0.18**	**59.29**	**55.10**	**46.42**	**55.90**	**52.21**	**38.79**	**52.66**

Project	: ALBA (Baseline Ambient Air Quality Monitoring Campaign,September 2021)
Monitoring Date	: 04/09/2021
Monitoring Location	: Manufacture of aluminium alloys
Intrument Serial No.	: SL031906
Monitoring Period	: Day & Night

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.26	34.77	27.17	56.17	50.79	47.18	33.55	67.05
2:00 AM	0.38	37.89	29.02	57.09	42.85	39.65	33.09	69.92
3:00 AM	0.20	48.42	37.83	49.96	40.04	36.61	33.23	71.35
4:00 AM	0.18	42.40	30.29	49.29	38.97	35.69	33.22	72.25
5:00 AM	0.25	35.02	24.22	50.86	44.61	41.45	30.06	72.23
6:00 AM	0.35	36.65	23.98	53.65	56.33	53.21	32.65	71.76
7:00 AM	0.38	39.27	24.76	53.00	49.87	46.82	33.91	66.80
8:00 AM	0.30	45.88	34.98	46.04	37.61	34.42	36.91	54.30
9:00 AM	0.23	55.29	45.35	41.00	34.02	30.99	39.65	46.61
10:00 AM	0.18	63.98	55.33	40.81	38.41	35.06	42.26	39.68
11:00 AM	0.14	68.02	61.02	42.89	38.35	35.11	44.29	32.69
12:00 PM	0.10	71.15	65.53	47.74	38.57	35.36	45.54	27.68
1:00 PM	0.00	68.30	95.40	63.96	33.98	31.39	46.45	23.74
2:00 PM	0.00	68.44	129.46	77.08	37.14	34.59	47.09	18.84
3:00 PM	0.00	68.11	136.89	83.85	37.00	35.03	46.61	17.88
4:00 PM	0.00	65.89	104.76	77.78	36.63	33.86	45.06	18.31
5:00 PM	0.00	62.73	96.55	66.71	32.69	30.16	43.35	19.40
6:00 PM	0.00	61.66	85.19	56.11	33.29	30.45	40.84	20.95
7:00 PM	0.00	61.67	63.60	48.10	32.65	29.84	38.54	26.54
8:00 PM	0.00	58.85	61.59	49.85	29.49	26.98	38.18	31.55
9:00 PM	0.02	59.13	63.60	49.17	34.09	30.97	37.43	35.54
10:00 PM	0.21	51.00	55.76	49.54	35.89	32.64	35.36	38.72
11:00 PM	0.37	48.45	49.17	34.05	31.02	31.02	34.66	41.94
12:00 AM	0.41	50.21	49.00	35.09	35.09	31.99	33.91	44.32
Min	**0.00**	**34.77**	**23.98**	**34.05**	**29.49**	**26.98**	**30.06**	**17.88**
Max	**0.41**	**71.15**	**136.89**	**83.85**	**56.33**	**53.21**	**47.09**	**72.25**
Avg	**0.17**	**54.30**	**60.44**	**53.32**	**38.31**	**35.44**	**38.58**	**42.92**

Project : **ALBA (Baseline Ambient Air Quality Monitoring Campaign, September 2021)**
Monitoring Date : **05/09/2021**
Monitoring Location : **ALBA**
Intrument Serial No. : **SL031906**
Monitoring Period : **Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 (µg/m^3)	PM2.5 (µg/m^3)	Temperature (ºC)	Humidity (%)
1:00 AM	0.53	47.40	50.28	51.34	37.40	33.90	32.97	46.26
2:00 AM	0.39	49.28	50.36	49.09	36.87	33.51	32.83	50.29
3:00 AM	0.46	47.61	48.27	51.55	40.73	37.01	32.30	54.14
4:00 AM	0.45	45.98	44.98	49.12	43.64	40.15	32.52	55.52
5:00 AM	0.44	42.02	39.44	50.83	39.73	36.14	32.06	55.90
6:00 AM	0.44	44.59	40.17	48.63	45.59	41.90	31.63	54.59
7:00 AM	0.39	48.81	43.85	46.60	49.29	45.59	34.04	48.52
8:00 AM	0.33	56.38	52.55	41.77	51.14	47.55	37.17	42.56
9:00 AM	0.38	67.94	67.06	37.27	49.56	45.79	39.51	39.72
10:00 AM	0.46	75.55	73.17	37.43	49.95	46.24	42.10	35.59
11:00 AM	0.39	97.41	99.54	33.76	51.71	48.09	44.38	30.43
12:00 PM	0.32	99.10	114.16	40.39	53.46	50.06	45.54	32.52
1:00 PM	0.65	85.04	90.04	75.40	57.16	53.38	45.62	35.89
2:00 PM	1.84	101.51	113.09	88.87	54.03	50.43	45.20	36.10
3:00 PM	1.99	97.02	105.29	89.96	47.09	43.69	43.53	39.70
4:00 PM	2.22	97.02	93.92	86.46	49.85	46.18	42.69	40.21
5:00 PM	2.07	92.60	86.07	78.07	54.71	51.10	41.91	41.30
6:00 PM	0.64	77.32	71.55	53.53	40.68	37.20	38.68	46.76
7:00 PM	0.94	69.64	62.28	71.57	43.22	39.81	37.18	53.21
8:00 PM	0.38	67.73	61.96	50.31	42.20	38.44	36.46	55.19
9:00 PM	0.14	63.55	55.47	42.98	44.71	40.97	35.87	58.22
10:00 PM	0.21	63.08	52.42	46.31	49.96	46.23	35.74	57.27
11:00 PM	0.61	64.47	54.00	53.23	52.81	48.96	35.21	57.60
12:00 AM	0.29	59.27	47.63	45.23	50.97	47.27	35.04	56.42
Min	**0.14**	**42.02**	**39.44**	**33.76**	**36.87**	**33.51**	**31.63**	**30.43**
Max	**2.22**	**101.51**	**114.16**	**89.96**	**57.16**	**53.38**	**45.62**	**58.22**
Avg	**0.71**	**69.18**	**67.40**	**54.99**	**47.35**	**43.73**	**37.92**	**46.83**

Project	**: ALBA (Baseline Ambient Air Quality Monitoring Campaign, September 2021)**
Monitoring Date	**: 06/09/2021**
Monitoring Location	**: ALBA**
Intrument Serial No.	**: SL031906**
Monitoring Period	**: Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.25	48.41	37.50	51.67	52.68	48.74	34.23	59.61
2:00 AM	0.58	45.77	32.91	53.94	50.69	46.77	33.81	59.14
3:00 AM	0.54	47.83	33.96	49.04	50.40	46.56	33.26	61.53
4:00 AM	0.73	40.13	27.58	56.04	50.72	47.01	32.53	63.38
5:00 AM	0.72	48.43	34.74	54.77	49.34	45.45	32.56	64.96
6:00 AM	0.46	54.53	39.21	49.32	55.78	52.25	32.56	70.26
7:00 AM	0.43	42.40	25.98	47.72	56.16	52.55	34.38	69.42
8:00 AM	0.37	52.57	36.57	40.96	43.05	39.68	37.25	58.48
9:00 AM	0.21	59.04	42.33	37.42	43.79	40.18	39.34	55.16
10:00 AM	0.14	65.73	48.78	37.53	39.20	35.94	41.04	51.97
11:00 AM	0.47	64.58	49.04	46.89	43.47	40.01	42.63	47.84
12:00 PM	0.99	69.52	58.72	57.85	46.46	42.83	43.40	47.61
1:00 PM	0.86	61.16	48.31	64.71	46.58	43.16	43.64	46.01
2:00 PM	1.09	54.86	38.51	75.90	45.07	41.53	41.64	52.63
3:00 PM	0.56	68.73	52.19	64.31	38.74	35.53	42.01	49.23
4:00 PM	0.38	65.89	51.57	50.20	40.90	37.57	42.22	47.08
5:00 PM	0.15	47.70	31.32	42.87	39.94	36.38	40.08	52.96
6:00 PM	0.14	47.22	30.04	45.89	40.73	37.11	38.09	56.60
7:00 PM	0.17	44.53	27.84	54.47	39.56	36.03	36.82	62.93
8:00 PM	0.16	43.15	25.39	54.65	39.76	36.30	36.88	62.63
9:00 PM	0.21	43.02	22.53	52.04	38.84	35.61	36.62	63.47
10:00 PM	0.16	44.96	24.45	51.81	36.51	33.54	36.42	61.27
11:00 PM	0.24	45.54	26.67	53.79	37.76	34.48	36.40	58.88
12:00 AM	0.21	49.43	31.17	54.06	38.93	35.60	36.18	59.40
Min	**0.14**	**40.13**	**22.53**	**37.42**	**36.51**	**33.54**	**32.53**	**46.01**
Max	**1.09**	**69.52**	**58.72**	**75.90**	**56.16**	**52.55**	**43.64**	**70.26**
Avg	**0.43**	**52.30**	**36.55**	**51.99**	**44.38**	**40.87**	**37.67**	**57.60**

Project : **ALBA (Baseline Ambient Air Quality Monitoring Campaign, September 2021)**
Monitoring Date : **07/09/2021**
Monitoring Location : **ALBA**
Intrument Serial No. : **SL031906**
Monitoring Period : **Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.21	55.26	36.02	54.70	42.33	38.72	36.10	59.18
2:00 AM	0.25	48.71	29.33	50.13	53.45	49.61	35.10	63.63
3:00 AM	0.32	41.51	21.88	50.18	51.78	48.02	34.06	69.49
4:00 AM	0.30	41.94	19.44	51.17	44.76	41.14	33.33	70.20
5:00 AM	0.47	41.02	19.89	51.40	45.80	42.26	33.13	69.17
6:00 AM	0.30	46.83	23.94	48.19	45.13	41.91	33.36	66.46
7:00 AM	0.22	46.60	25.17	45.64	45.03	41.77	34.94	64.24
8:00 AM	0.11	46.53	31.89	42.38	39.11	36.26	37.94	53.46
9:00 AM	0.00	46.73	30.79	46.94	39.13	36.06	39.57	47.81
10:00 AM	0.00	50.49	38.32	48.87	41.98	38.93	40.98	43.63
11:00 AM	0.00	54.57	41.41	47.41	49.77	46.42	42.30	40.32
12:00 PM	0.00	55.35	40.73	47.44	45.07	41.74	42.92	37.93
1:00 PM	0.00	55.38	40.08	49.42	35.43	32.66	43.36	35.03
2:00 PM	0.00	54.60	39.72	49.89	36.23	33.10	43.83	33.00
3:00 PM	0.00	53.76	36.08	47.27	35.84	32.91	43.14	33.89
4:00 PM	0.00	55.15	37.51	46.83	33.96	31.08	41.60	37.87
5:00 PM	0.00	57.24	38.86	46.67	33.01	30.23	39.92	40.69
6:00 PM	0.00	57.61	40.83	48.02	29.03	26.64	37.85	43.49
7:00 PM	0.00	60.66	44.43	49.47	29.99	27.51	36.57	45.59
8:00 PM	0.01	62.09	44.85	44.64	33.98	30.98	36.31	45.94
9:00 PM	0.07	69.79	51.13	39.75	36.92	33.80	36.60	45.30
10:00 PM	0.04	70.63	51.54	39.54	38.93	35.61	37.04	42.44
11:00 PM	0.05	64.81	47.28	41.87	40.44	37.26	37.11	42.05
12:00 AM	0.06	65.88	46.16	37.13	44.23	40.82	36.42	46.05
Min	**0.00**	**41.02**	**19.44**	**37.13**	**29.03**	**26.64**	**33.13**	**33.00**
Max	**0.47**	**70.63**	**51.54**	**54.70**	**53.45**	**49.61**	**43.83**	**70.20**
Avg	**0.10**	**54.30**	**36.55**	**46.87**	**40.47**	**37.31**	**38.06**	**49.04**

Project	**: ALBA (Baseline Ambient Air Quality Monitoring Campaign, September 2021)**
Monitoring Date	**: 08/09/2021**
Monitoring Location	**: ALBA**
Instrument Serial No.	**: SL031906**
Monitoring Period	**: Day & Night**

Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 ($\mu g/m^3$)	PM2.5 ($\mu g/m^3$)	Temperature (°C)	Humidity (%)
1:00 AM	0.06	59.44	40.27	37.77	37.96	34.73	35.62	51.18
2:00 AM	0.04	53.08	34.98	39.78	37.33	34.33	35.48	53.75
3:00 AM	0.00	50.23	31.29	41.48	37.39	34.65	35.68	51.74
4:00 AM	0.00	50.41	30.27	42.69	77.66	74.72	35.88	48.88
5:00 AM	0.00	48.72	29.04	44.67	85.39	82.63	35.79	48.32
6:00 AM	0.00	48.89	28.81	45.94	61.74	58.55	36.10	45.01
7:00 AM	0.00	47.71	28.06	43.98	34.46	31.57	36.70	42.93
8:00 AM	0.00	49.22	30.67	42.29	30.02	27.62	38.18	39.99
9:00 AM	0.00	49.85	32.41	40.15	44.17	41.52	39.44	40.62
10:00 AM	0.00	53.11	35.60	39.49	50.46	47.53	40.17	40.44
11:00 AM	0.00	56.24	37.98	38.86	45.86	42.77	40.80	39.73
12:00 PM	0.00	59.82	42.02	37.39	40.44	37.35	41.74	38.70
1:00 PM	0.00	61.32	43.79	38.87	36.02	32.91	43.02	32.09
2:00 PM	0.00	62.50	42.92	41.06	35.87	32.64	43.36	28.00
3:00 PM	0.00	60.14	43.90	43.02	33.56	30.69	42.95	27.58
4:00 PM	0.00	60.63	42.10	41.18	34.20	31.29	41.38	34.12
5:00 PM	0.00	61.89	43.26	40.36	30.90	28.33	39.59	37.98
6:00 PM	0.00	62.69	44.65	42.27	32.88	29.92	37.75	40.01
7:00 PM	0.00	64.43	45.86	45.37	30.66	27.99	36.37	43.43
8:00 PM	0.02	62.17	43.09	43.70	31.04	28.32	36.27	43.19
9:00 PM	0.07	59.88	39.90	40.73	30.68	28.11	35.85	45.83
10:00 PM	0.18	54.44	34.99	41.13	36.45	33.24	34.36	52.95
11:00 PM	0.36	53.73	34.33	41.19	36.24	33.10	33.33	56.80
12:00 AM	0.22	49.69	30.18	42.88	39.20	35.83	32.82	59.14
Min	**0.00**	**47.71**	**28.06**	**37.39**	**30.02**	**27.62**	**32.82**	**27.58**
Max	**0.36**	**64.43**	**45.86**	**45.94**	**85.39**	**82.63**	**43.36**	**59.14**
Avg	**0.04**	**55.84**	**37.10**	**41.51**	**41.27**	**38.35**	**37.86**	**43.43**

Project	: ALBA (Baseline Ambient Air Quality Monitoring Campaign, September 2021)							
Monitoring Date	**: 09/09/2021**							
Monitoring Location	**: ALBA**							
Instrument Serial No.	**: SL031906**							
Monitoring Period	**: Day & Night**							
Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 (µg/m^3)	PM2.5 (µg/m^3)	Temperature (°C)	Humidity (%)
1:00 AM	0.26	47.67	26.02	44.13	38.85	35.59	32.57	57.02
2:00 AM	0.38	47.04	26.26	43.45	41.11	37.72	32.39	54.62
3:00 AM	0.14	45.06	23.04	45.81	41.56	38.41	32.57	50.85
4:00 AM	0.13	41.75	19.94	48.46	41.70	38.33	32.60	49.41
5:00 AM	0.14	42.20	20.34	50.54	40.70	37.46	32.62	46.16
6:00 AM	0.16	42.60	20.81	50.13	44.68	41.47	32.15	44.60
7:00 AM	0.22	38.66	17.34	50.21	46.41	43.18	33.19	45.96
8:00 AM	0.19	39.92	19.49	45.31	46.16	43.07	35.57	49.35
9:00 AM	0.06	42.52	21.68	38.38	37.45	34.74	38.07	48.65
10:00 AM	0.05	52.20	31.80	34.02	42.20	38.94	39.96	47.86
11:00 AM	0.05	56.23	34.94	31.57	43.69	40.23	41.29	45.92
12:00 PM	0.07	59.17	38.25	32.15	46.55	42.98	42.67	41.50
1:00 PM	0.07	60.87	39.15	36.89	48.37	44.62	42.78	40.11
2:00 PM	0.06	61.33	39.38	38.60	44.74	41.17	41.78	45.32
3:00 PM	0.07	59.57	37.13	40.15	44.05	40.53	40.99	47.51
4:00 PM	0.07	55.87	33.57	40.57	42.48	38.91	40.26	47.58
5:00 PM	0.08	56.06	33.57	42.94	43.21	39.65	39.14	50.55
6:00 PM	0.14	59.19	37.60	43.25	44.69	41.11	37.04	57.39
7:00 PM	0.16	61.38	36.58	42.90	46.99	43.38	35.85	62.00
8:00 PM	0.16	68.48	42.56	38.40	50.60	47.02	35.31	64.53
9:00 PM	0.18	74.20	46.75	37.40	61.21	57.57	35.09	62.81
10:00 PM	0.25	72.38	46.00	34.85	59.74	56.42	34.58	64.04
11:00 PM	0.32	72.35	46.65	34.42	65.13	61.83	34.48	63.97
12:00 AM	0.32	66.74	40.18	38.30	59.48	56.33	34.72	62.05
Min	**0.05**	**38.66**	**17.34**	**31.57**	**37.45**	**34.74**	**32.15**	**40.11**
Max	**0.38**	**74.20**	**46.75**	**50.54**	**65.13**	**61.83**	**42.78**	**64.53**
Avg	**0.16**	**55.14**	**32.46**	**40.95**	**46.74**	**43.36**	**36.57**	**52.07**

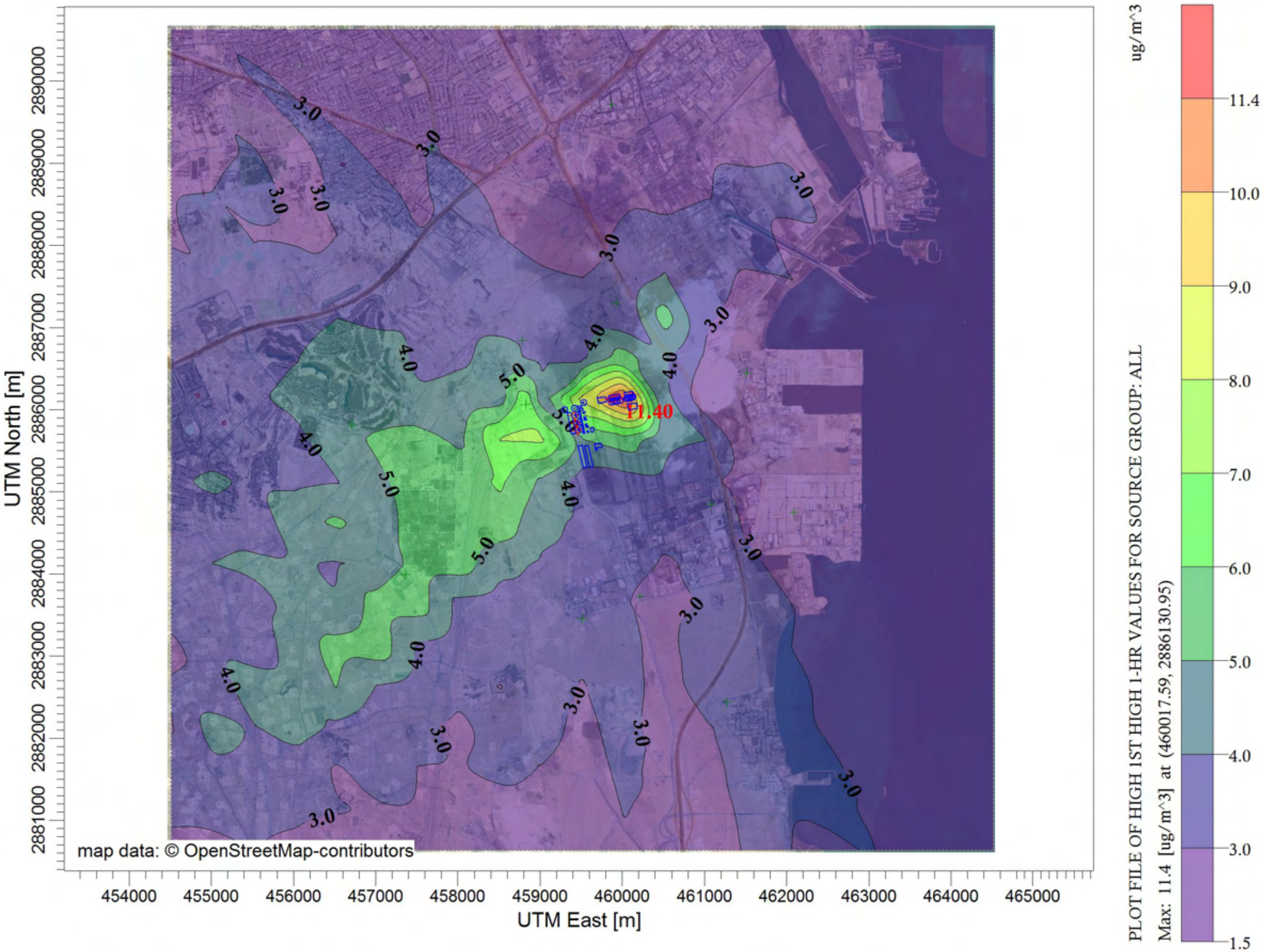
Project	: ALBA (Baseline Ambient Air Quality Monitoring Campaign, September 2021)							
Monitoring Date	**: 10/09/2021**							
Monitoring Location	**: ALBA**							
Instrument Serial No.	**: SL031906**							
Monitoring Period	**: Day & Night**							
Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 (µg/m^3)	PM2.5 (µg/m^3)	Temperature (°C)	Humidity (%)
1:00 AM	0.28	62.94	34.85	39.13	67.74	64.41	34.12	63.81
2:00 AM	0.21	54.83	36.33	40.98	67.06	63.69	33.40	68.04
3:00 AM	0.25	47.81	19.13	43.60	60.62	57.54	32.50	69.80
4:00 AM	0.16	51.67	22.24	43.47	56.85	54.34	32.08	69.18
5:00 AM	0.18	50.47	23.09	44.96	59.37	56.57	31.72	66.08
6:00 AM	0.28	54.00	25.65	43.04	59.90	57.51	31.84	62.16
7:00 AM	0.35	54.13	27.08	44.48	57.43	54.84	33.66	53.79
8:00 AM	0.25	46.32	22.79	41.77	45.93	43.35	36.07	53.87
9:00 AM	0.07	45.35	21.50	39.29	40.64	37.91	38.38	53.12
10:00 AM	0.01	46.88	25.80	35.41	35.96	33.30	40.36	47.86
11:00 AM	0.02	49.55	26.83	38.81	37.26	34.57	41.11	45.60
12:00 PM	0.01	48.49	26.00	43.31	34.06	31.57	41.58	45.10
1:00 PM	0.01	50.81	26.02	44.62	35.89	33.21	41.71	43.52
2:00 PM	0.00	50.51	26.64	46.72	33.95	31.05	41.64	42.84
3:00 PM	0.00	51.13	27.83	46.70	33.27	30.43	40.89	43.16
4:00 PM	0.00	54.94	30.27	48.84	33.54	30.63	39.31	46.19
5:00 PM	0.00	62.83	39.06	47.56	38.15	34.81	37.89	50.17
6:00 PM	0.00	59.63	34.85	46.02	35.38	32.44	36.48	52.63
7:00 PM	0.00	56.13	29.29	45.46	30.97	28.43	35.63	54.01
8:00 PM	0.01	54.09	27.15	44.04	29.10	26.64	32.52	52.88
9:00 PM	0.05	54.65	25.44	45.33	29.03	62.68	35.47	50.32
10:00 PM	0.09	53.89	25.51	45.02	30.03	27.53	35.43	48.51
11:00 PM	0.20	51.22	25.41	44.87	35.28	32.30	34.92	49.83
12:00 AM	0.35	48.81	22.57	46.83	47.90	44.38	33.14	58.08
Min	**0.00**	**45.35**	**19.13**	**35.41**	**29.03**	**26.64**	**31.72**	**42.84**
Max	**0.35**	**62.94**	**39.06**	**48.84**	**67.74**	**64.41**	**41.71**	**69.80**
Avg	**0.12**	**52.55**	**27.14**	**43.76**	**43.14**	**41.84**	**36.33**	**53.77**

Project	: ALBA (Baseline Ambient Air Quality Monitoring Campaign, September 2021)							
Monitoring Date	**: 11/09/2021**							
Monitoring Location	**: ALBA**							
Instrument Serial No.	**: SL031906**							
Monitoring Period	**: Day & Night**							
Time	Carbon Monoxide (PPM)	Nitrogen Dioxide (PPB)	Ozone (PPB)	Sulfur Dioxide (PPB)	PM10 (µg/m^3)	PM2.5 (µg/m^3)	Temperature (°C)	Humidity (%)
1:00 AM	0.32	47.20	20.35	47.93	46.43	42.99	32.61	60.49
2:00 AM	0.32	45.72	18.04	48.62	44.71	41.19	32.11	60.91
3:00 AM	0.27	52.06	26.06	45.08	43.87	40.42	32.87	53.14
4:00 AM	0.25	48.70	21.70	45.04	47.73	44.22	32.84	53.98
5:00 AM	0.18	48.38	20.74	47.00	39.18	35.73	32.66	54.84
6:00 AM	0.14	44.42	16.63	47.31	32.34	29.65	33.46	54.08
7:00 AM	0.29	43.38	15.19	47.13	34.67	31.69	33.78	57.82
8:00 AM	0.25	43.91	17.38	41.68	32.75	30.02	35.15	56.47
9:00 AM	0.12	45.49	22.55	39.35	35.34	32.32	37.56	52.08
10:00 AM	0.03	50.27	27.52	38.63	33.13	30.34	39.42	46.75
11:00 AM	0.04	54.44	32.81	37.81	32.79	30.04	40.76	42.35
12:00 PM	0.05	55.81	32.15	39.26	34.86	31.85	41.70	40.10
1:00 PM	0.01	58.59	34.71	39.12	33.51	30.51	42.25	37.36
2:00 PM	0.00	58.13	33.92	41.13	34.21	31.18	42.41	35.72
3:00 PM	0.00	56.86	31.55	42.67	32.00	29.29	41.10	38.79
4:00 PM	0.00	55.41	29.57	45.74	30.92	28.28	39.70	41.26
5:00 PM	0.00	55.98	30.73	46.76	28.52	26.12	38.18	44.34
6:00 PM	0.00	56.73	33.17	47.48	30.23	27.81	36.04	48.91
7:00 PM	0.01	50.13	22.29	48.02	26.34	23.89	35.10	49.92
8:00 PM	0.08	54.23	27.51	42.36	26.18	23.92	34.37	51.97
9:00 PM	0.21	57.54	30.08	39.96	27.78	25.38	33.68	53.76
10:00 PM	0.29	49.24	22.63	45.98	26.42	24.03	32.95	55.64
11:00 PM	0.33	47.63	20.14	47.84	27.32	24.88	32.33	58.98
12:00 AM	0.31	46.21	19.32	48.25	29.32	26.31	32.10	60.32
Min	**0.00**	**43.38**	**15.19**	**37.81**	**26.18**	**23.89**	**32.10**	**35.72**
Max	**0.33**	**58.59**	**34.71**	**48.62**	**47.73**	**44.22**	**42.41**	**60.91**
Avg	**0.15**	**51.10**	**25.28**	**44.17**	**33.77**	**30.92**	**36.05**	**50.42**

Appendix I: Maximum Ground Level Concentration Isopleths

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1A - Carbon Monoxide Plot File - 1 Hour Values



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 1 GT and 1 ST

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

11.4 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:73,543

0 2 km

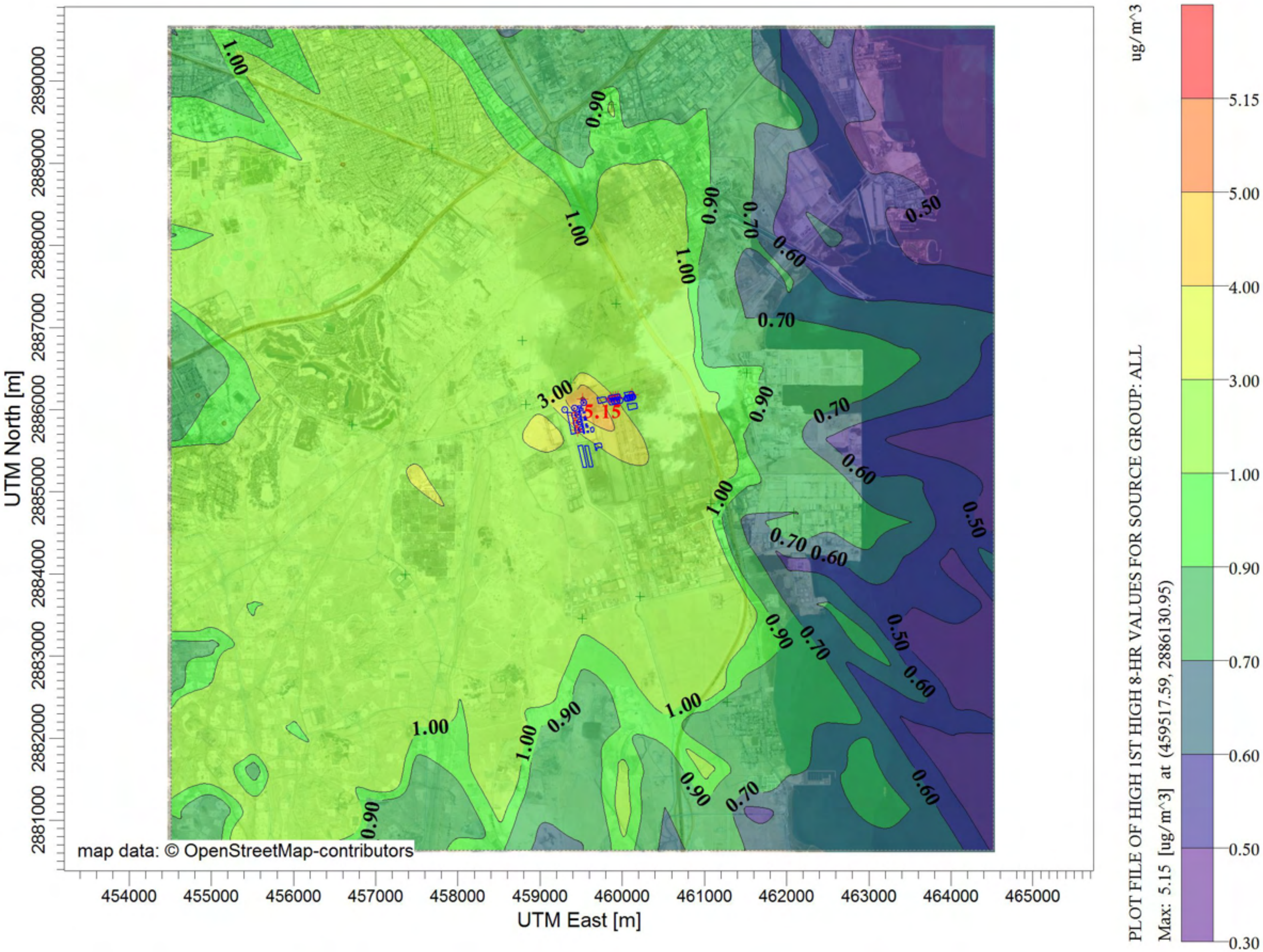
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1A - Carbon Monoxide Plot File - 8 Hour Values



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 1 GT and 1 ST

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

5.15 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:73,543

0 2 km

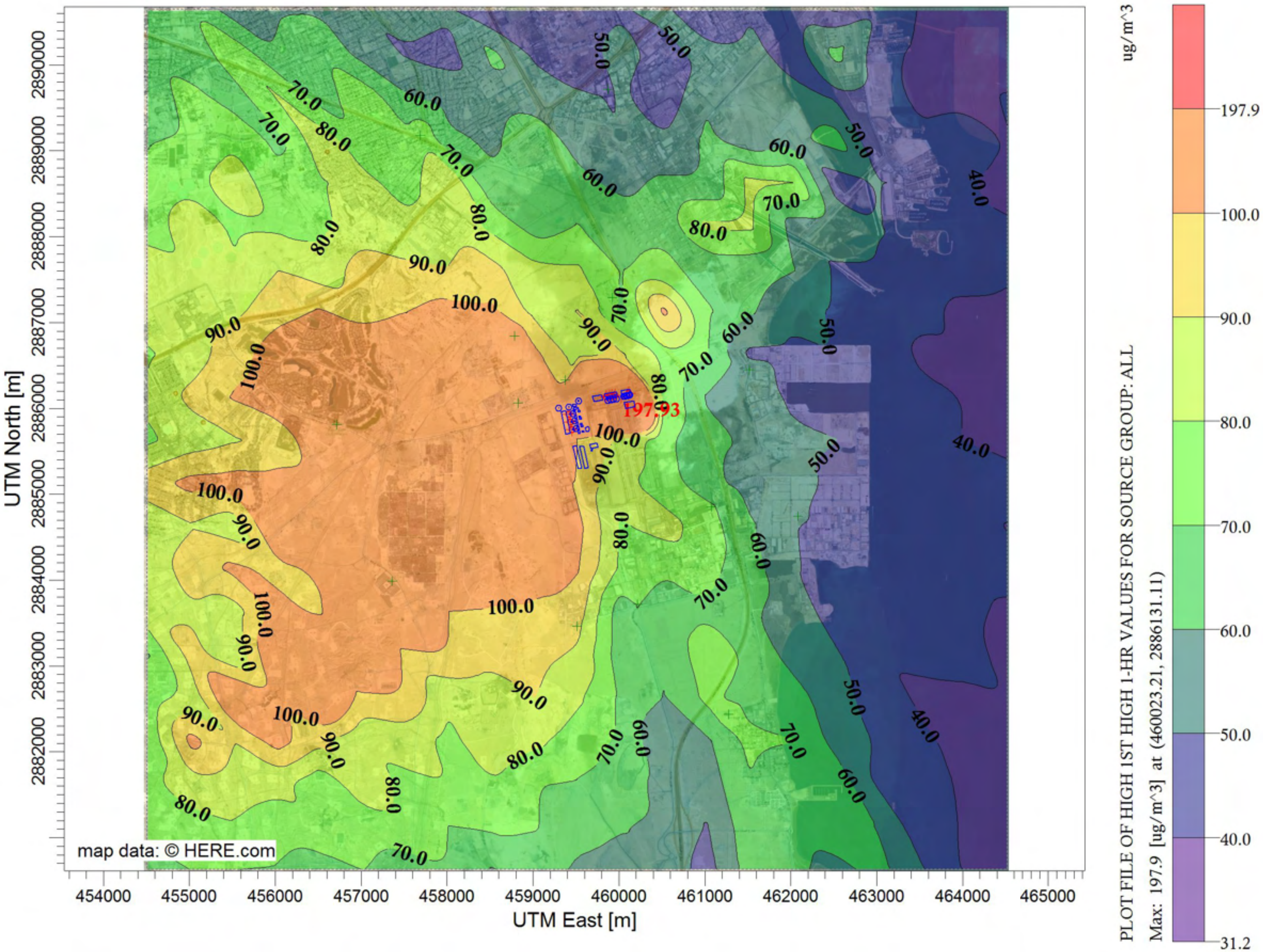
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1A - Nitrogen Dioxide Plot File - 1 Hour Values



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 1 GT and 1 ST

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

197.9 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:70,343

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

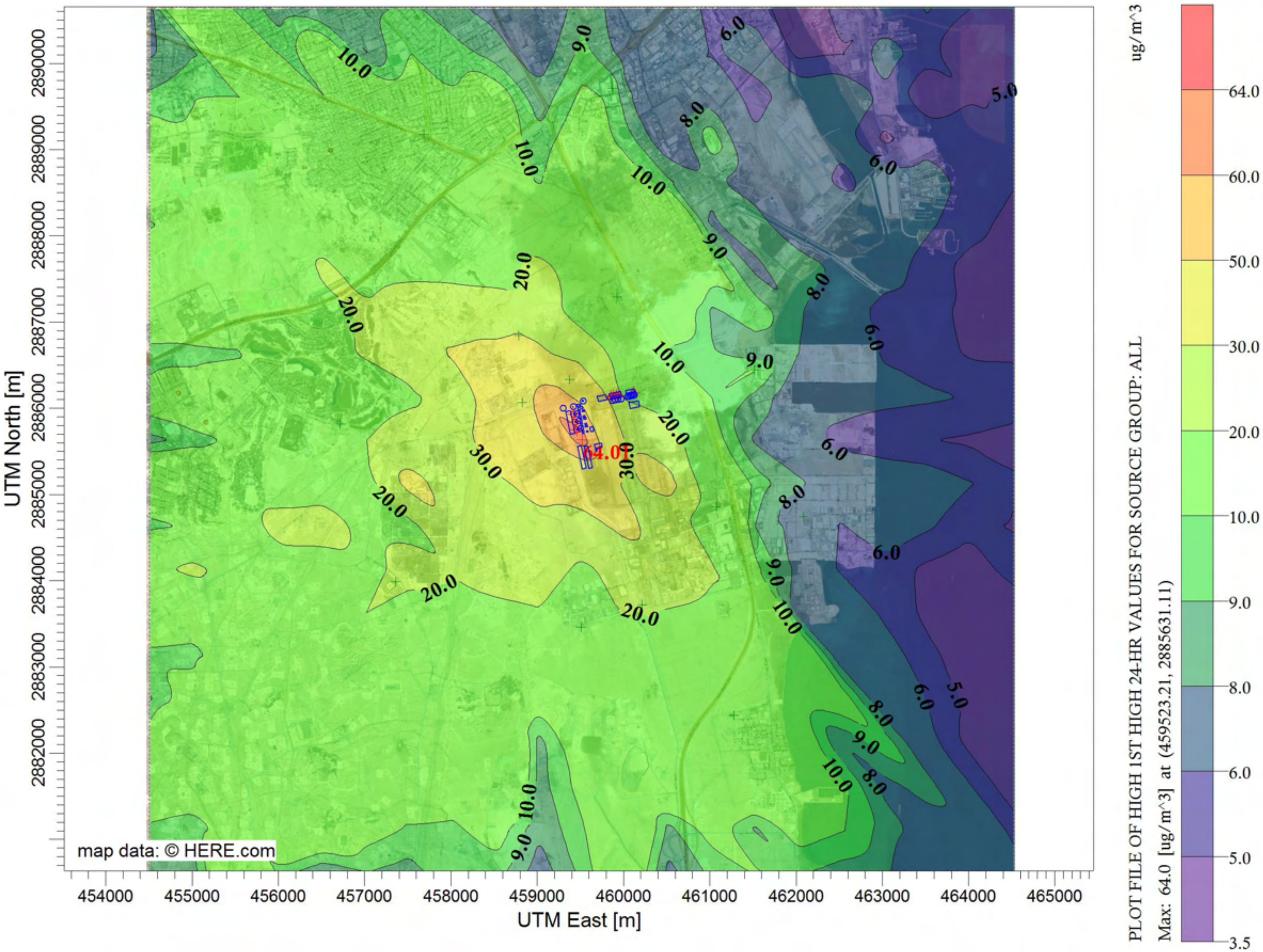
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\1A_NO2-WB-S1\1A_NO2-WB-S1.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1A - Nitrogen Dioxide Plot File - 24 Hour Values



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 1 GT and 1 ST

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

64.0 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:70,039

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

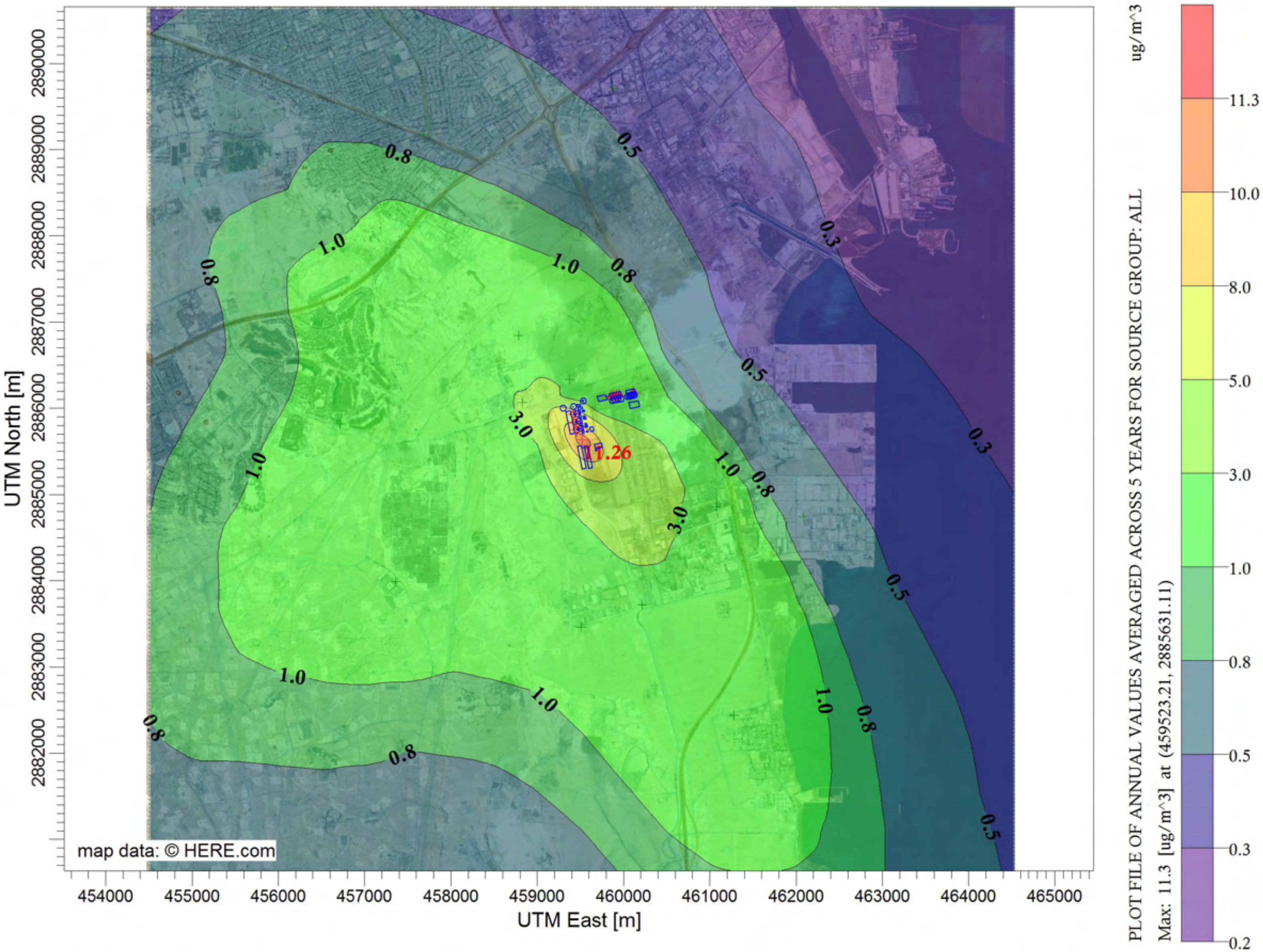
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\1A_NO2-WB-S1\1A_NO2-WB-S1.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1A - Nitrogen Dioxide Plot File - Annual Values Averaged Across 5 Years



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 1 GT and 1 ST

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

11.3 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:70,039

0 2 km

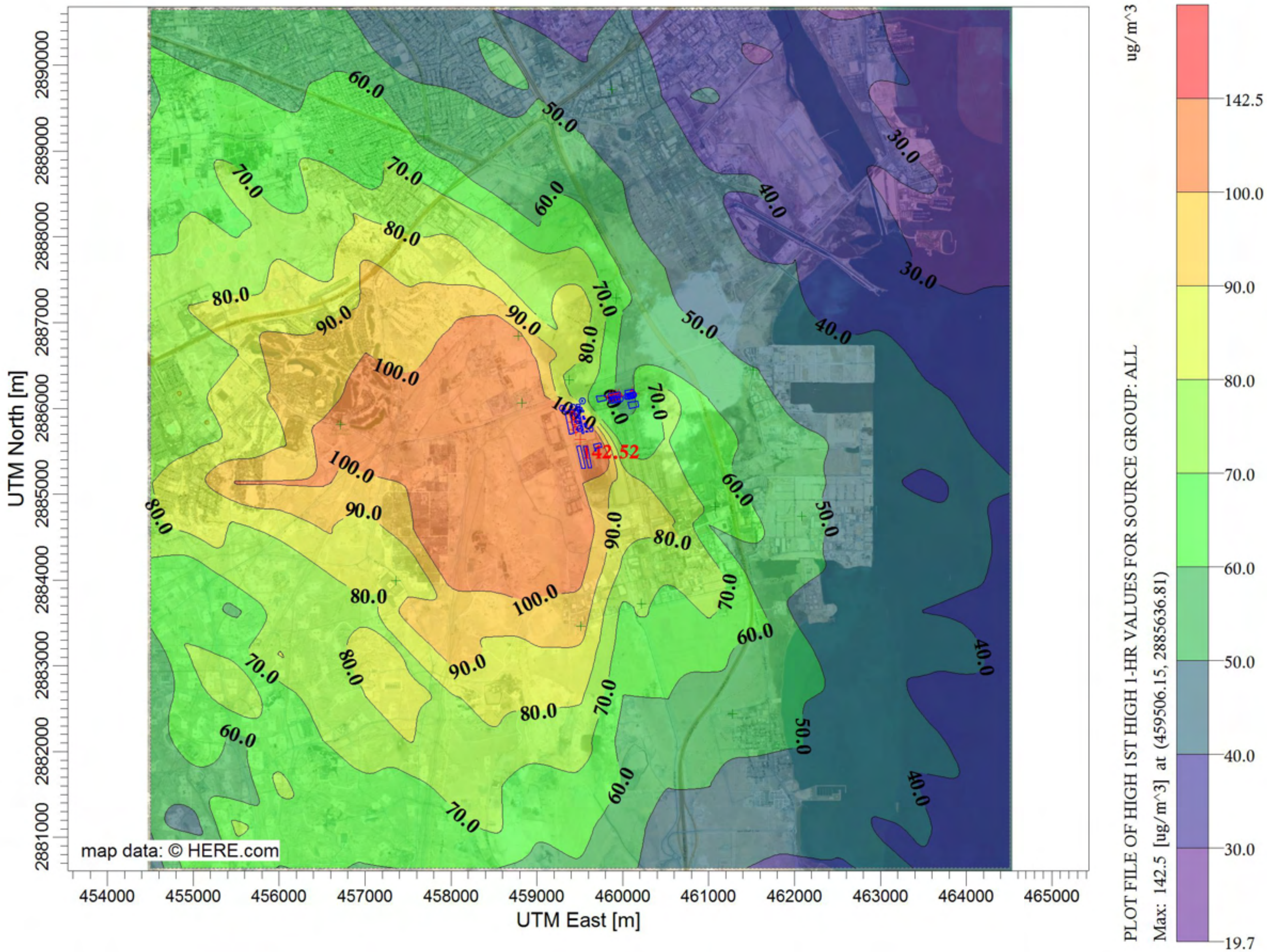
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1A - Sulfur Dioxide Plot File - 1 Hour Values



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 1 GT and 1 ST

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

142.5 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:70,393

0 2 km

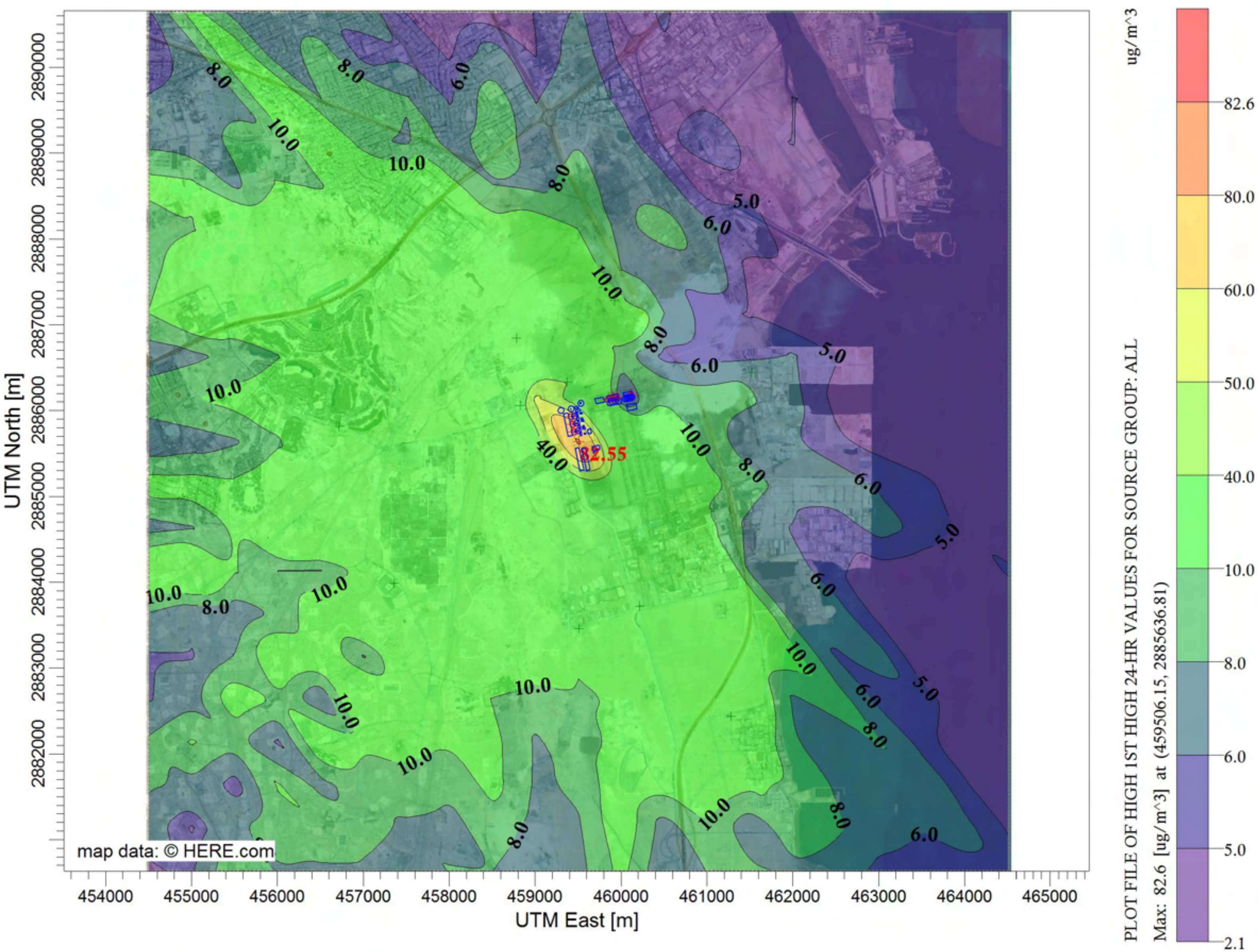
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1A - Sulfur Dioxide Plot File - 24 Hour Values



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 1 GT and 1 ST

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

82.6 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:70,090

0 2 km

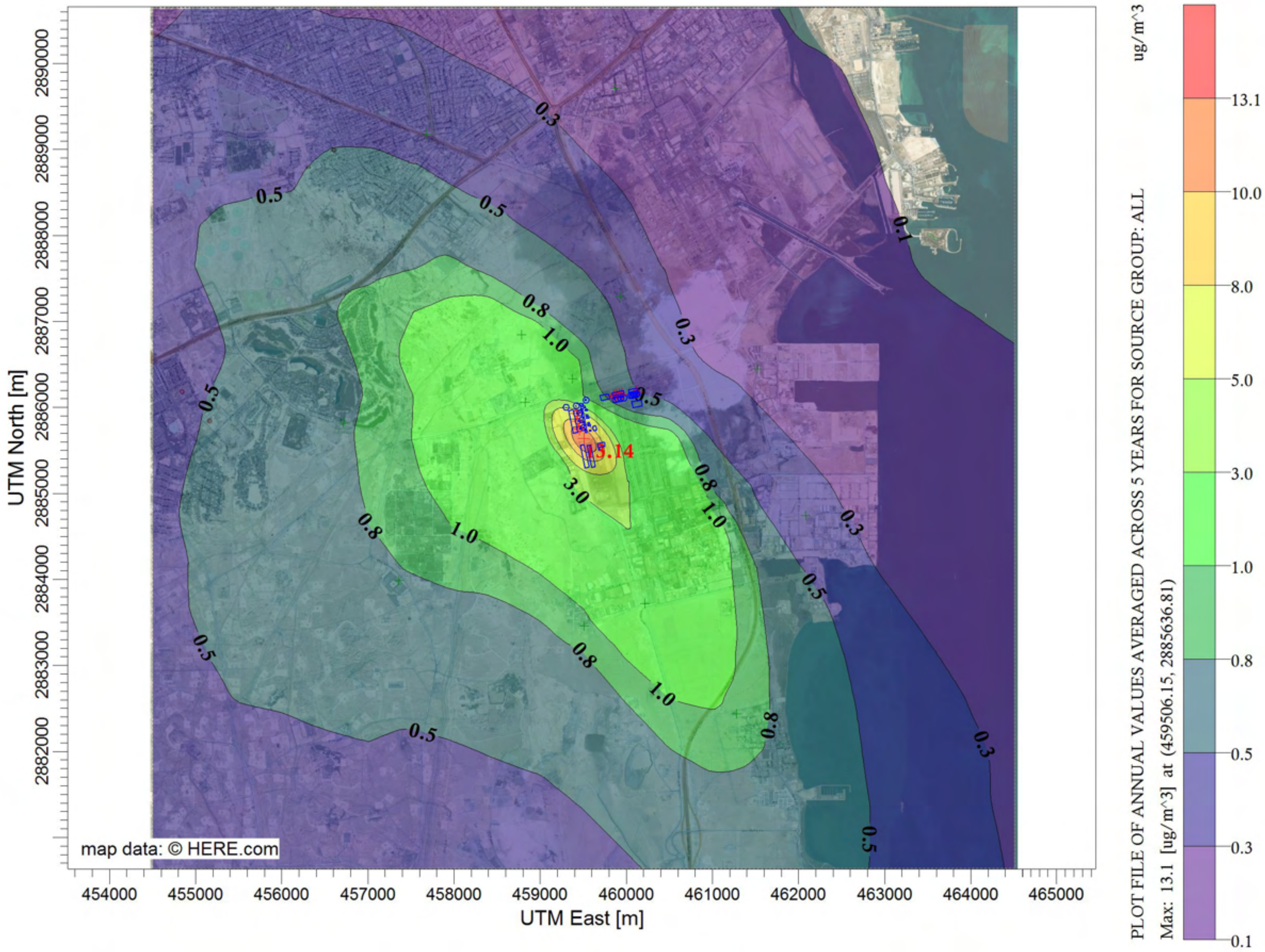
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1A - Sulfur Dioxide Plot File - Annual Values Averaged Across 5 Years



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 1 GT and 1 ST

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

13.1 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:70,090

0 2 km

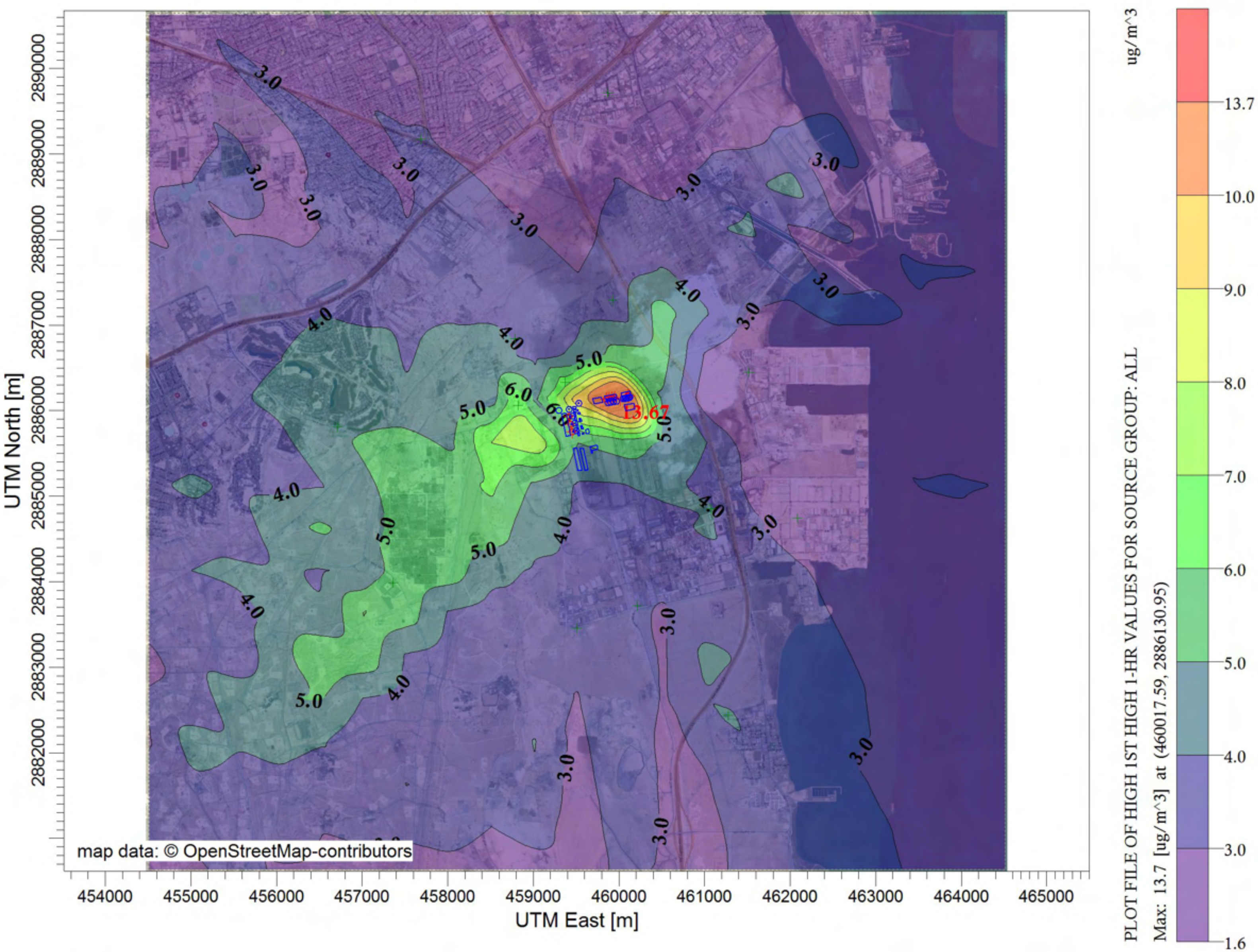
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1B - Carbon Monoxide Plot File - 1 Hour Values



COMMENTS:

Summer Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 2 GTs and 1 ST

SOURCES:

9

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

13.7 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:70,322

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

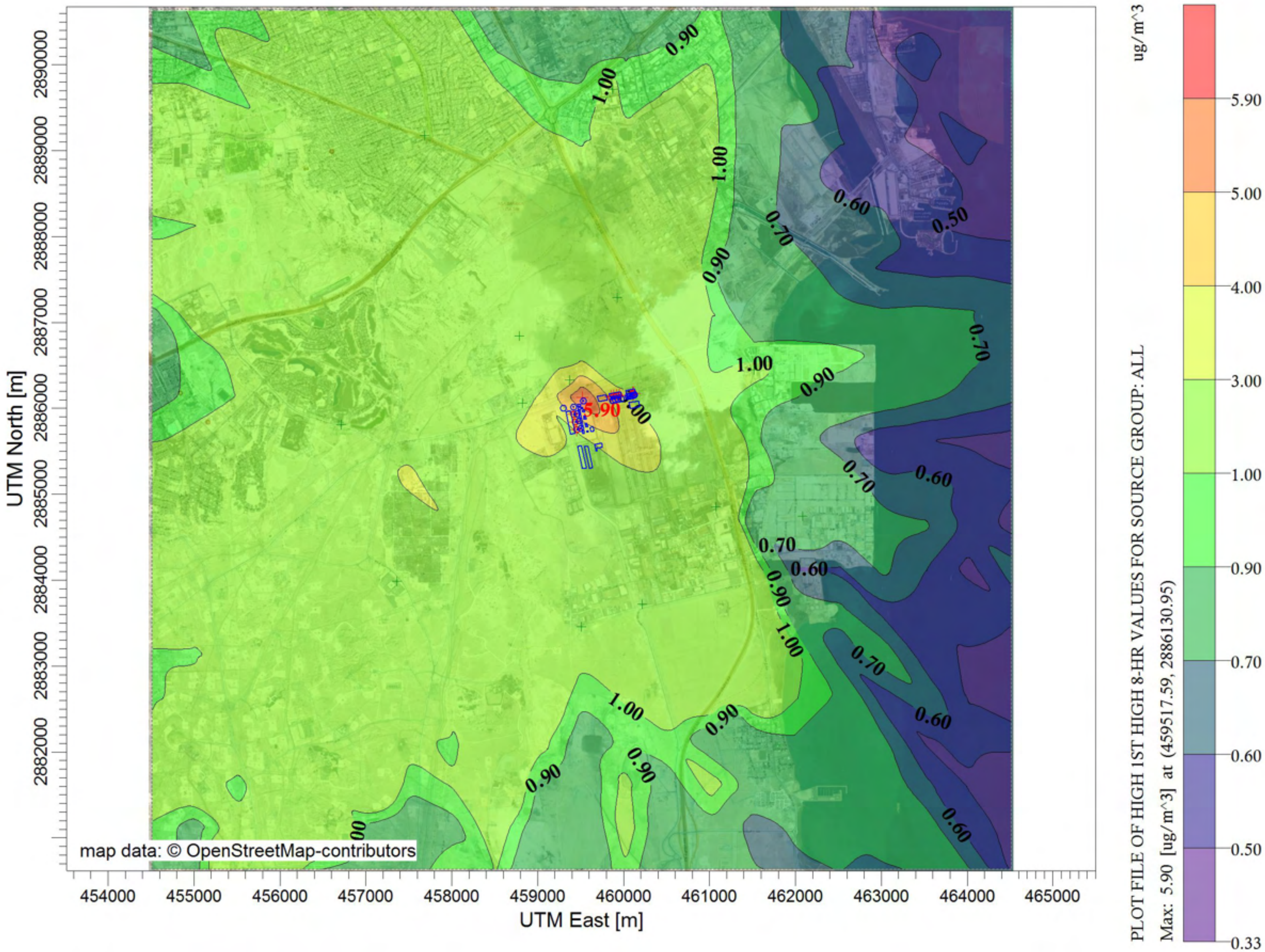
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\1B_CO-SB-S1\1B_CO-SB-S1.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1B - Carbon Monoxide Plot File - 8 Hour Values



COMMENTS:

Summer Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 2 GTs and 1 ST

SOURCES:

9

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

5.90 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:70,322

0 2 km

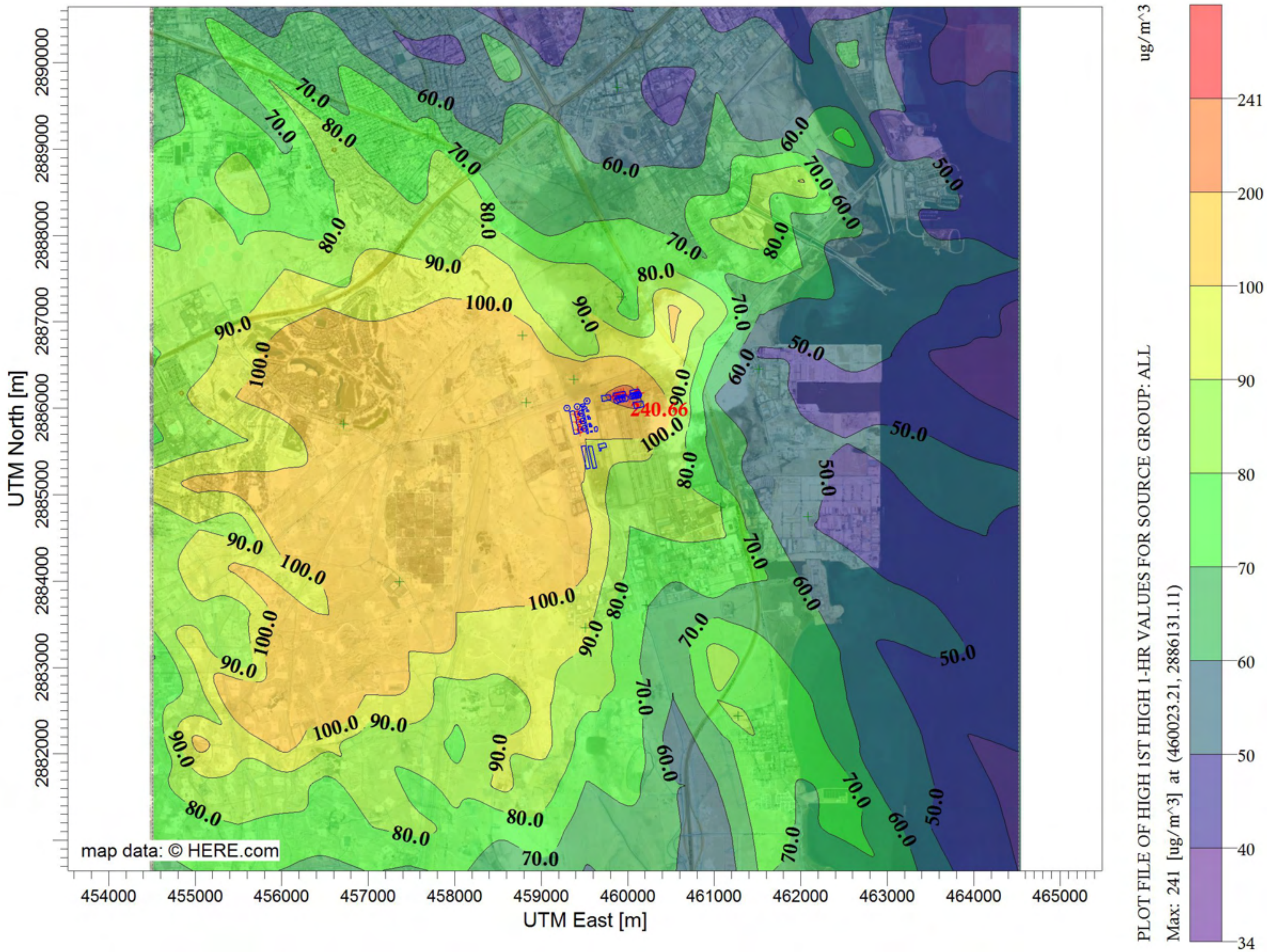
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1B - Nitrogen Dioxide Plot File - 1 Hour Values



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 2 GTs and 1 ST

SOURCES: **9**

RECEPTORS: **455**

OUTPUT TYPE: **Concentration**

MAX: **241 ug/m^3**

COMPANY NAME: **Envirotech Consultancy W.L.L**

MODELER: **Rajith Chandran**

DATE: **12/25/2021**

SCALE: 1:69,888

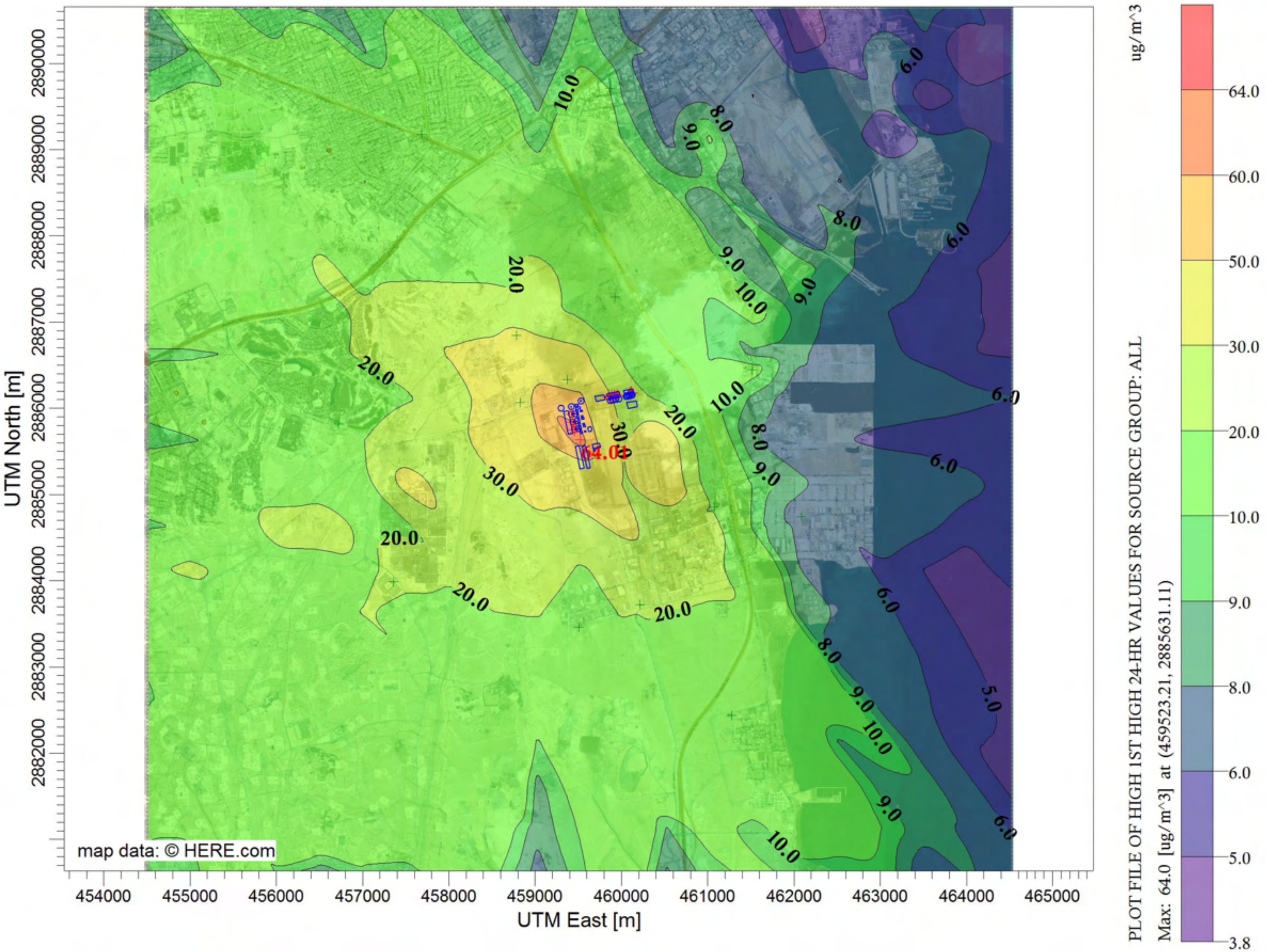
0 — 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.: **EL-1917-20**

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1B - Nitrogen Dioxide Plot File - 24 Hour Values



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 2 GTs and 1 ST

SOURCES:

9

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

64.0 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:70,039

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

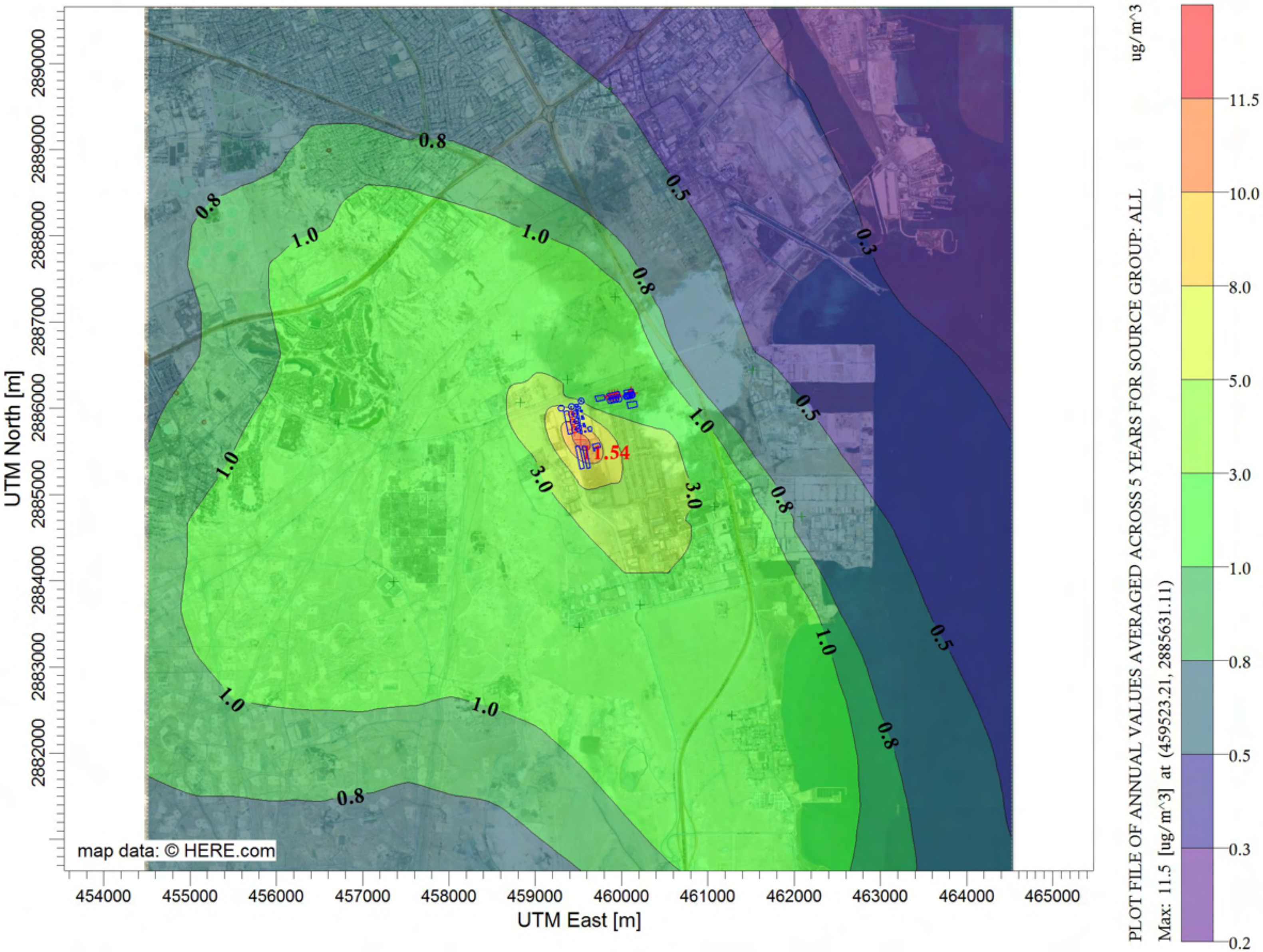
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\1B_NO2-SB-S1\1B_NO2-SB-S1.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1B - Nitrogen Dioxide Plot File - Annual Values Averaged Across 5 Years



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 2 GTs and 1 ST

SOURCES:

9

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

11.5 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:70,039

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

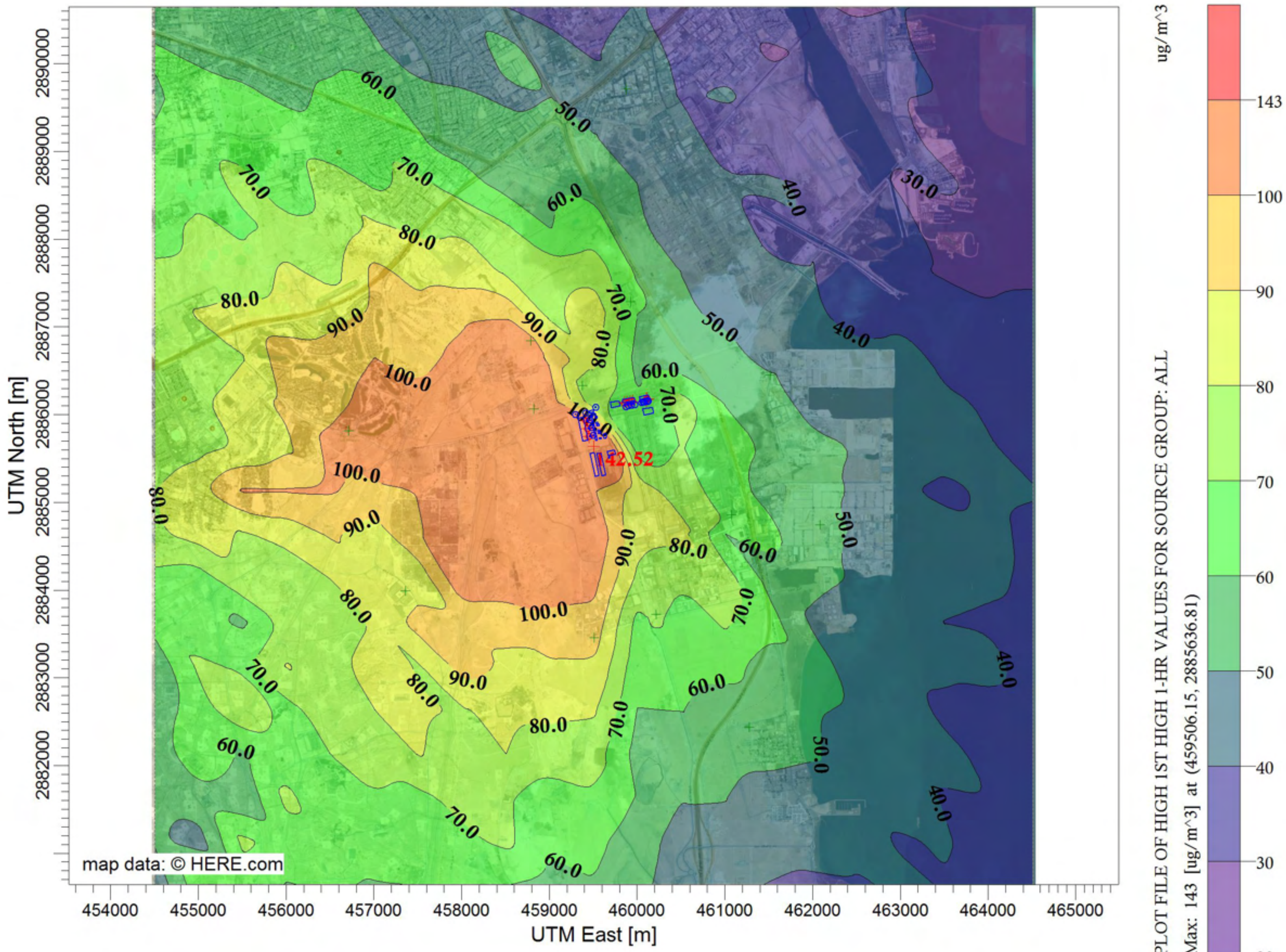
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\1B_NO2-SB-S1\1B_NO2-SB-S1.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1B - Sulfur Dioxide Plot File - 1 Hour Values



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 2 GTs and 1 ST

SOURCES:

9

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

143 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:69,939

0 2 km

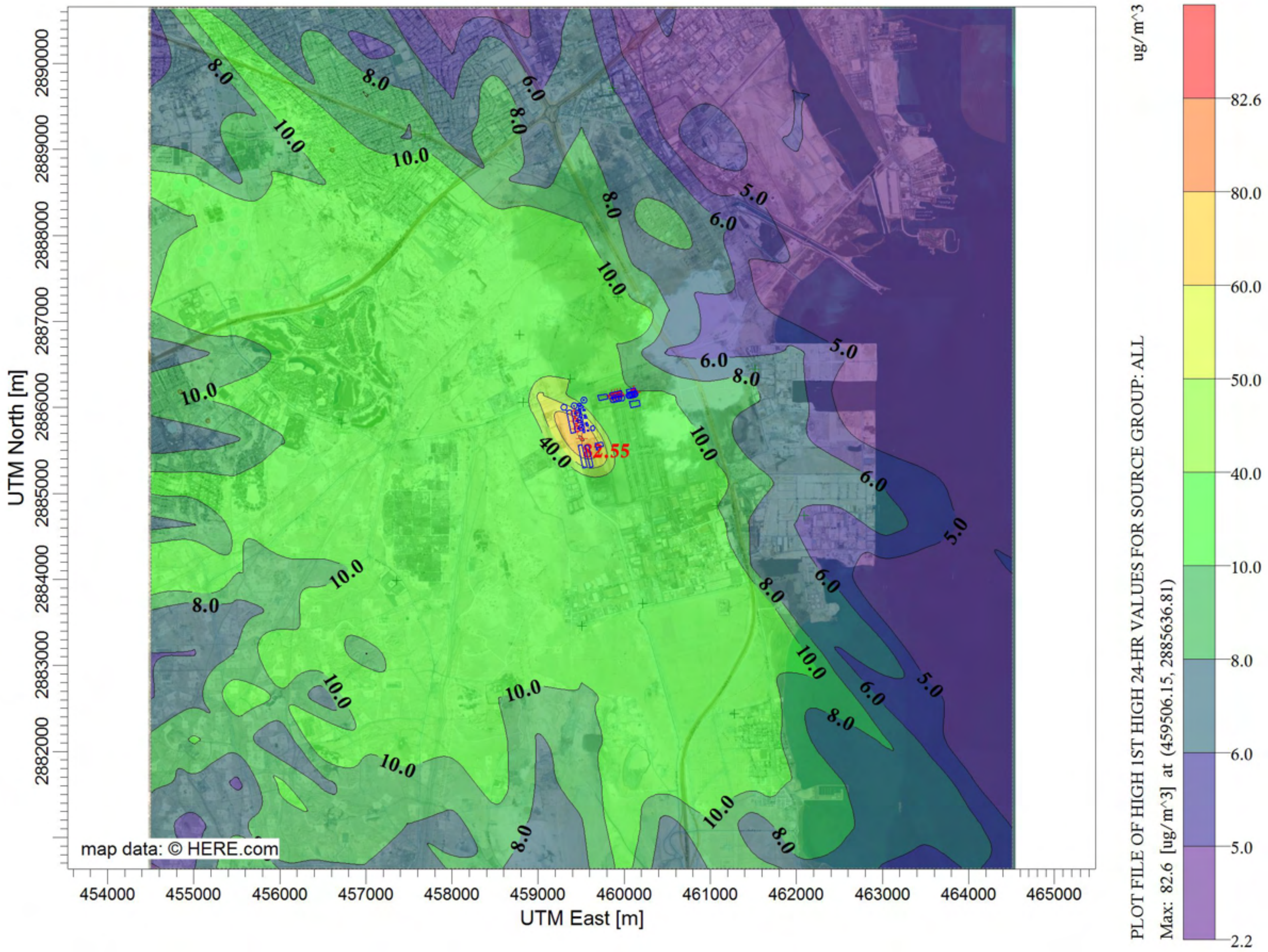
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1B - Sulfur Dioxide Plot File - 24 Hour Values



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 2 GTs and 1 ST

SOURCES:

9

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

82.6 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:70,090

0 2 km

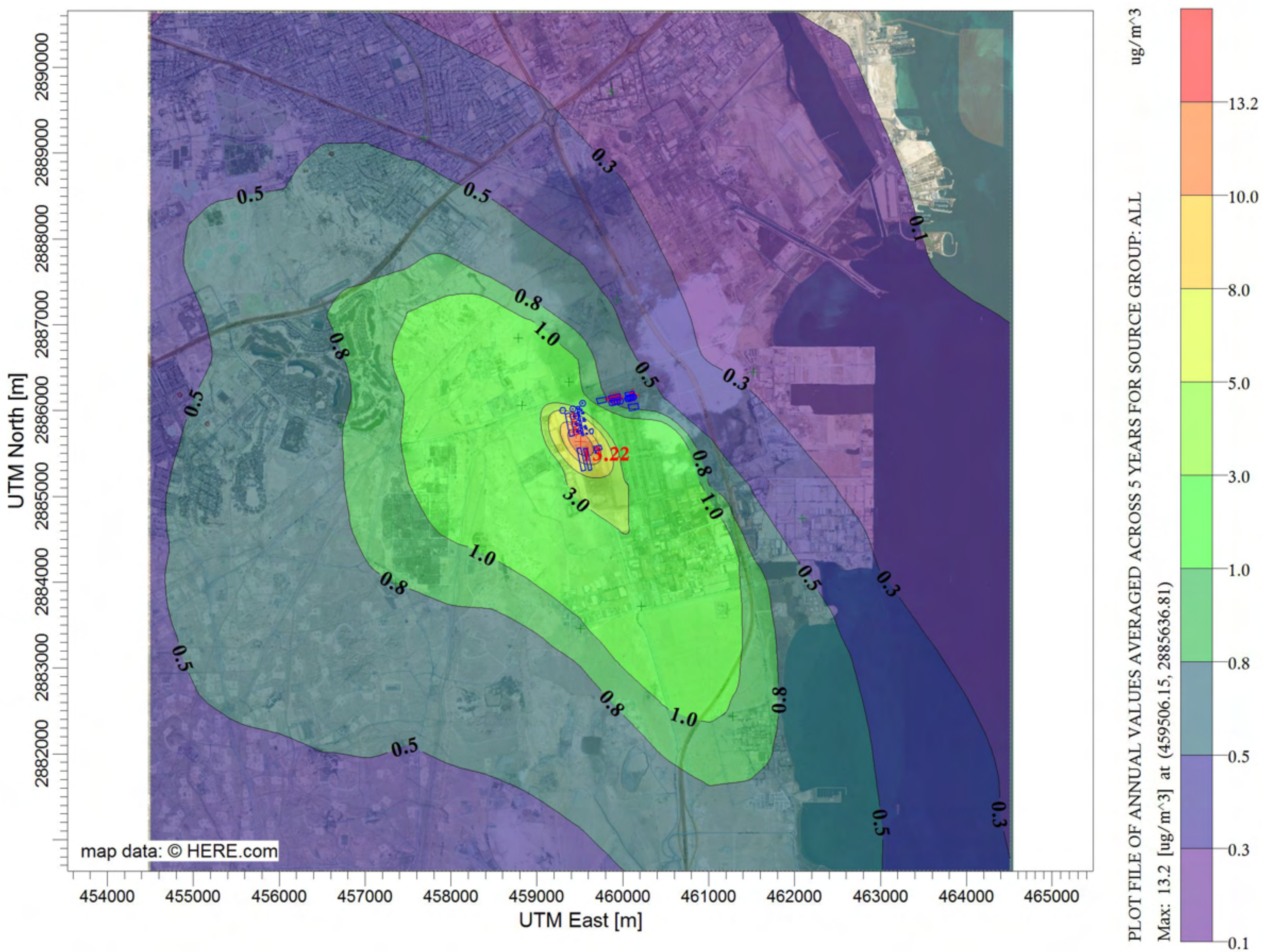
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 1B - Sulfur Dioxide Plot File - Annual Values Averaged Across 5 Years



COMMENTS:

Winter Base Case (3 PS5 Units Operational):
PS5: GT 71, ST 72, GT 73, ST 74, GT 81 and ST 82
PS4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63
PS3: 2 GTs and 1 ST

SOURCES:

9

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

13.2 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:70,090

0 — 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

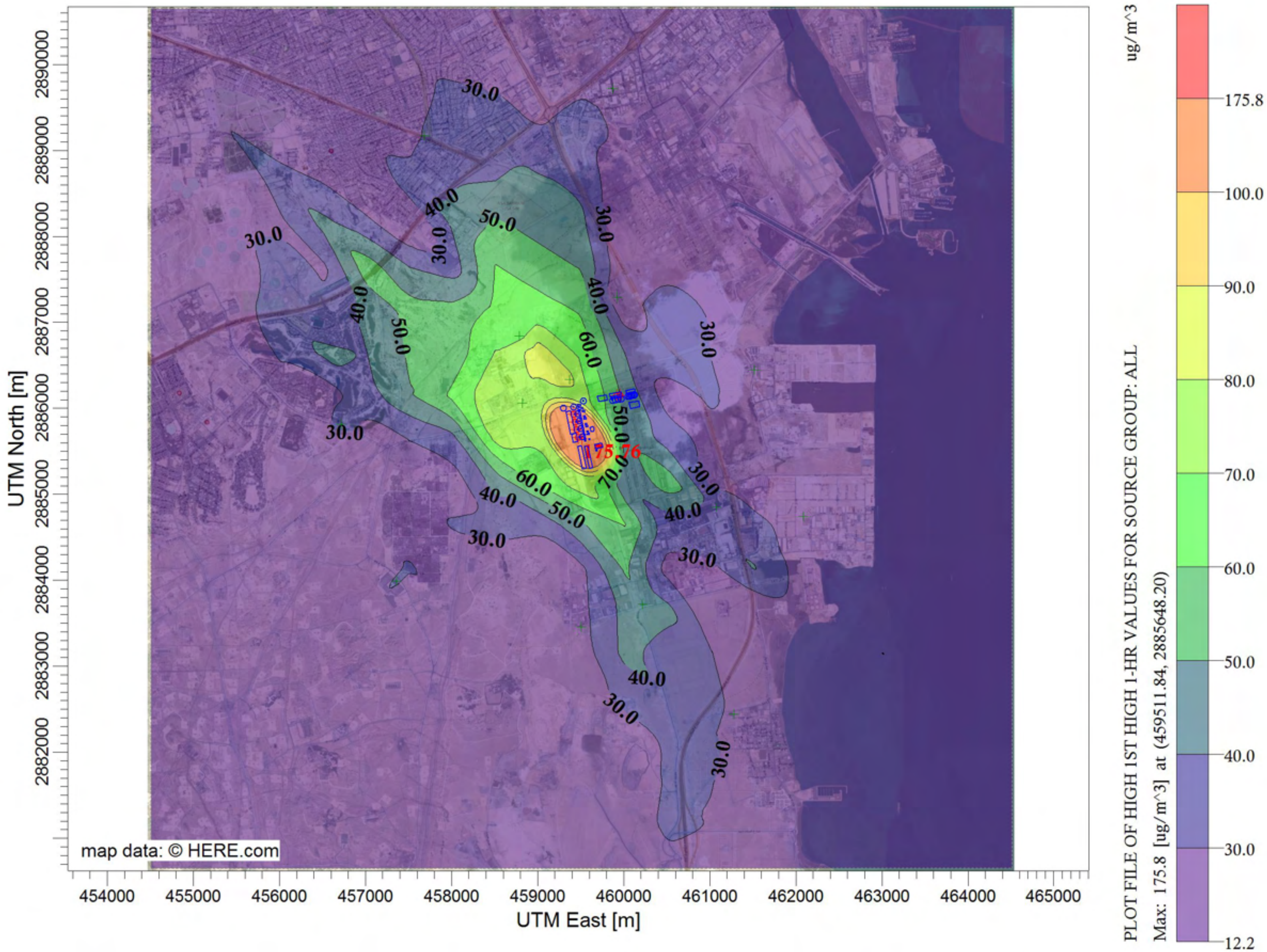
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\1B_SO2-SB-S1\1B_SO2-SB-S1.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2A - Carbon Monoxide Plot File - 1 Hour Values



COMMENTS:

Winter Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: 2 GTs and 1 ST

SOURCES:

6

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

175.8 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:70,241

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

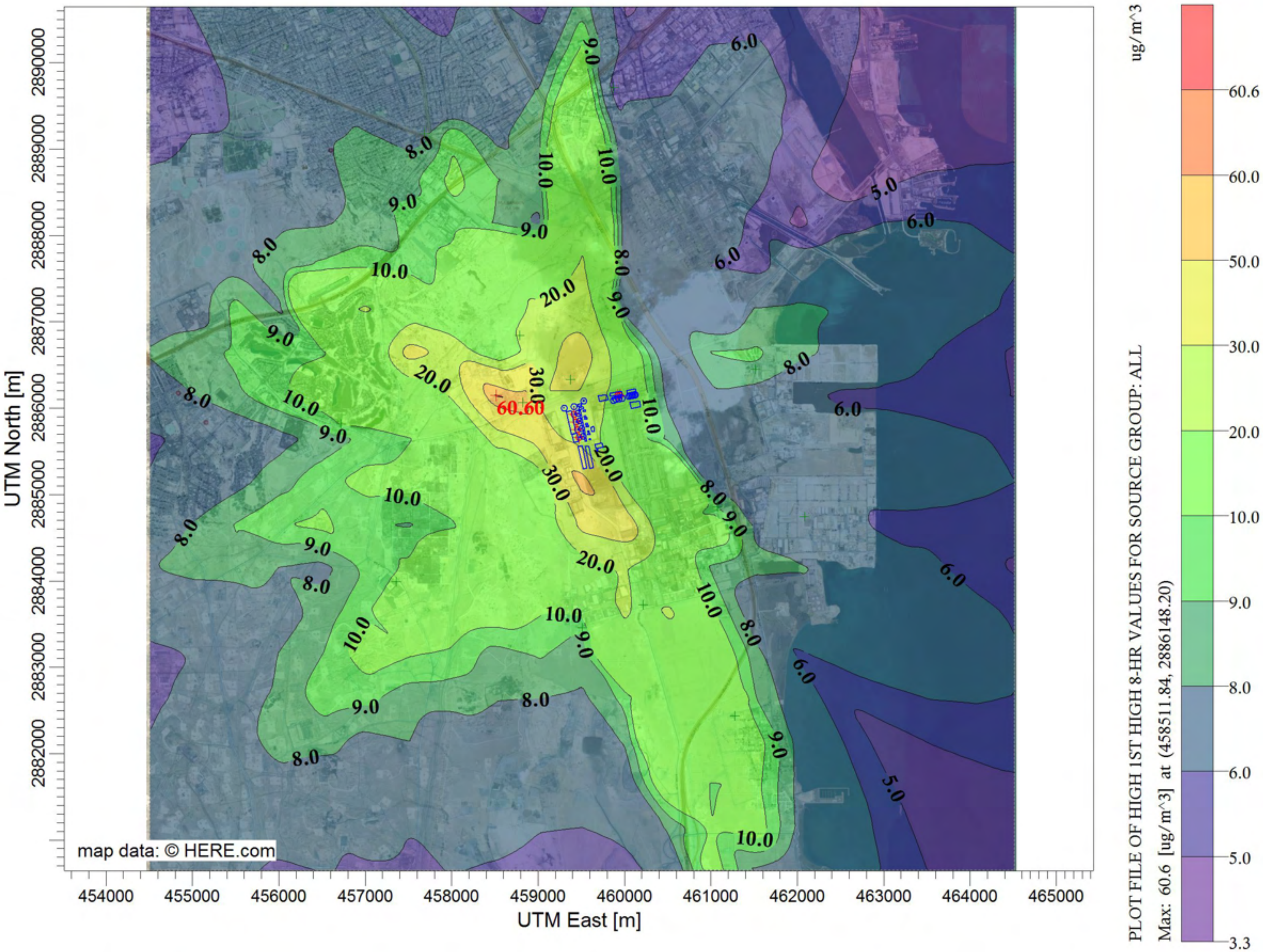
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\2A_CO-WB-S2\2A_CO-WB-S2.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2A - Carbon Monoxide Plot File - 8 Hour Values



COMMENTS:

Winter Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: 2 GTs and 1 ST

SOURCES: **6**

RECEPTORS: **455**

OUTPUT TYPE: **Concentration**

MAX: **60.6 ug/m^3**

COMPANY NAME: **Envirotech Consultancy W.L.L**

MODELER: **Rajith Chandran**

DATE: **12/25/2021**

SCALE: 1:69,938

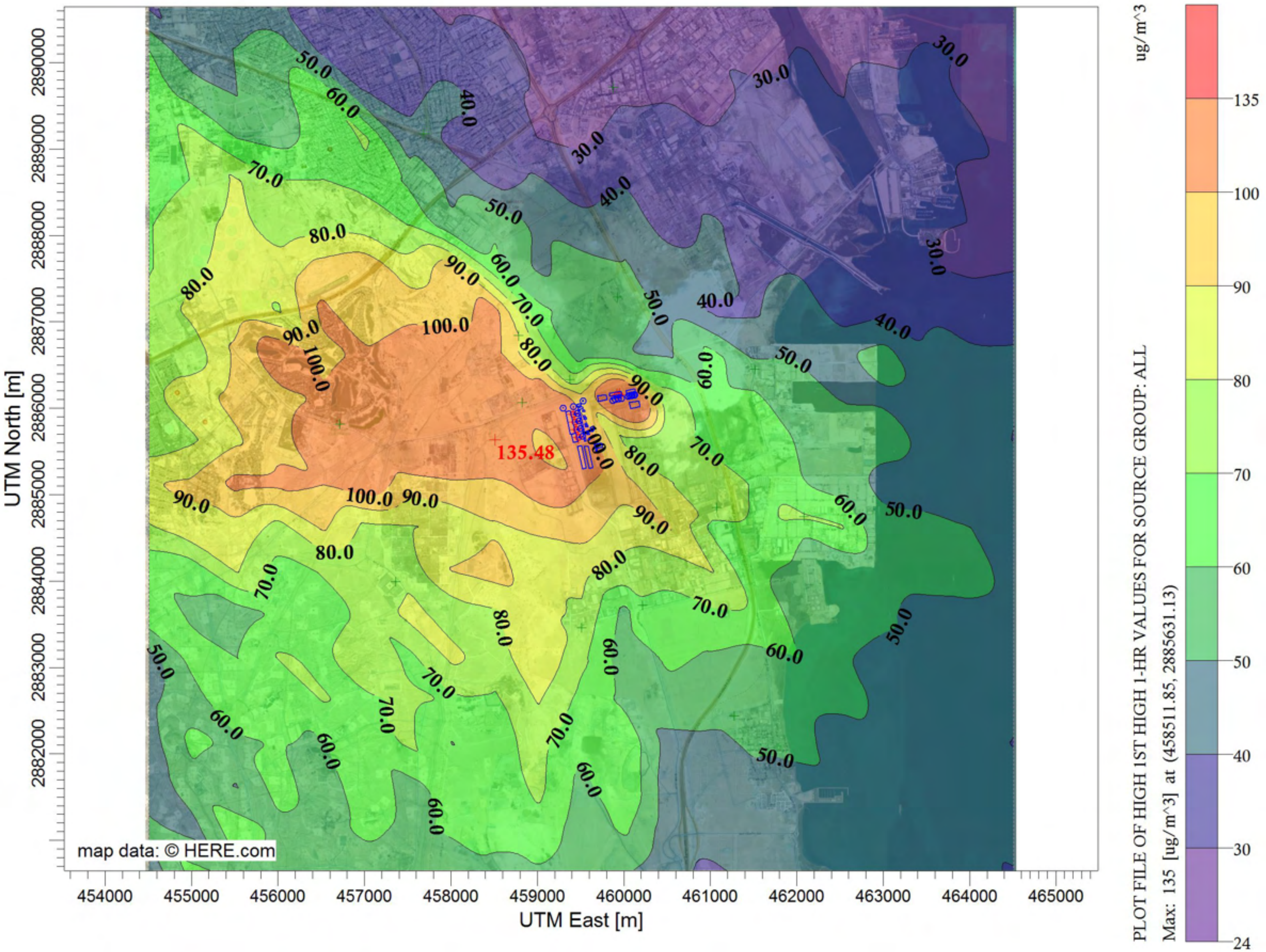
0 — 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.: **EL-1917-20**

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2A - Nitrogen Dioxide Plot File - 1 Hour Values



COMMENTS:

Winter Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: 2 GTs and 1 ST

SOURCES: **6**

RECEPTORS: **455**

OUTPUT TYPE: **Concentration**

MAX: **135 ug/m^3**

COMPANY NAME: **Envirotech Consultancy W.L.L**

MODELER: **Rajith Chandran**

DATE: **12/25/2021**

SCALE: 1:69,888

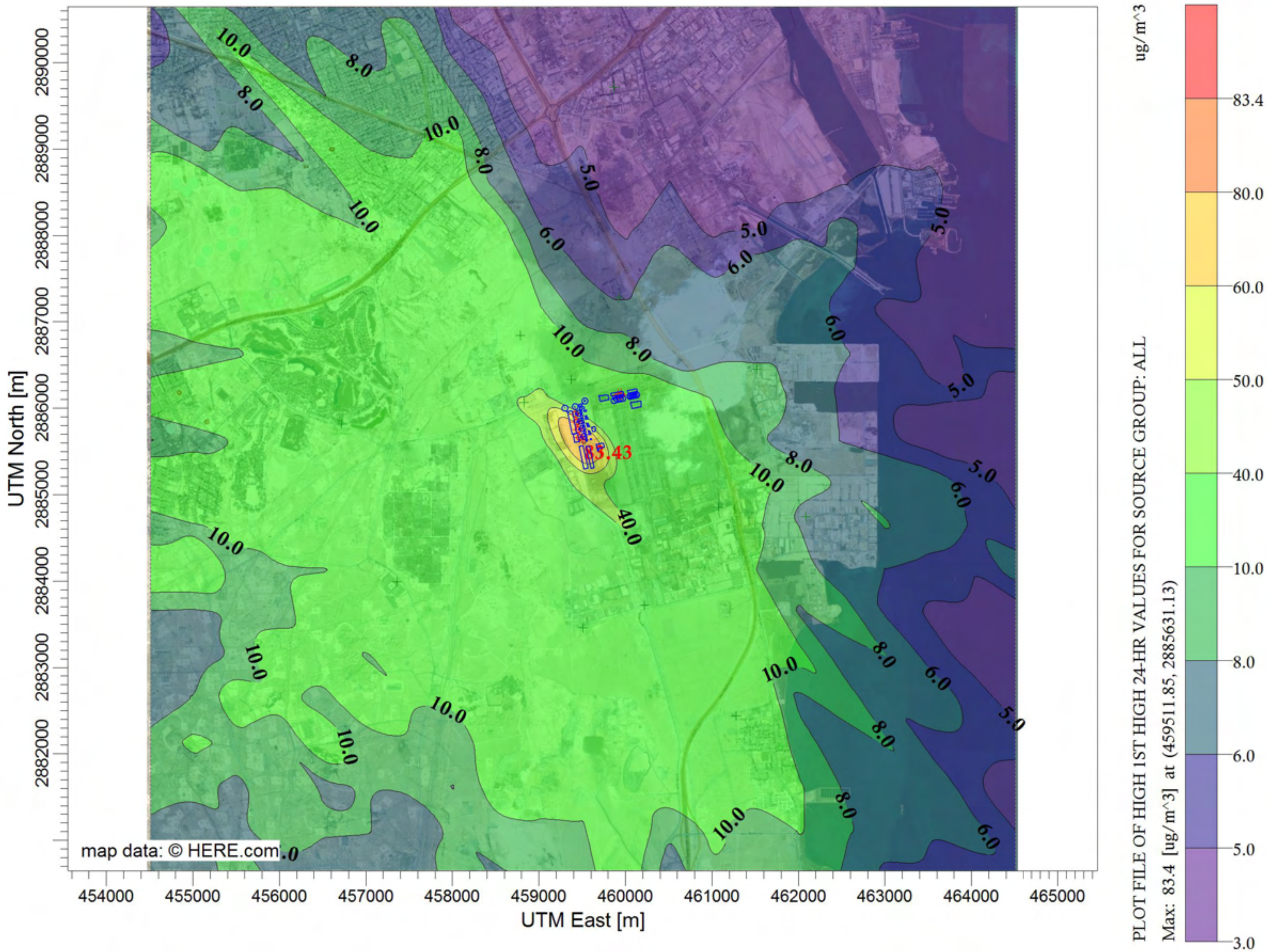
0 — 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.: **EL-1917-20**

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2A - Nitrogen Dioxide Plot File - 24 Hour Values



COMMENTS:

Winter Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: 2 GTs and 1 ST

SOURCES:

6

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

83.4 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:69,888

0 2 km

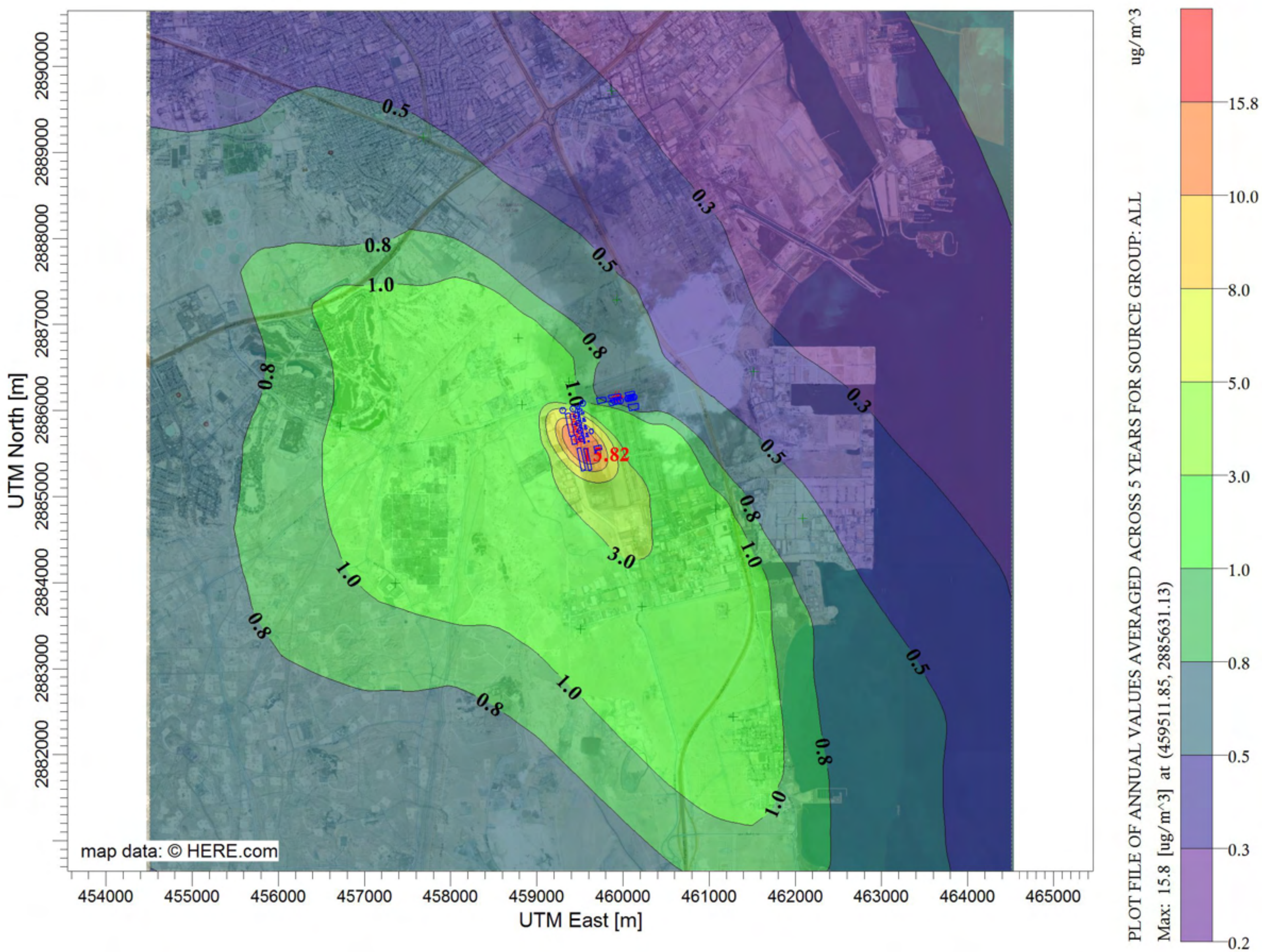
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2A - Nitrogen Dioxide Plot File - Annual Values Averaged Across 5 Years



COMMENTS:

Winter Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: 2 GTs and 1 ST

SOURCES:

6

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

15.8 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:69,888

0 2 km

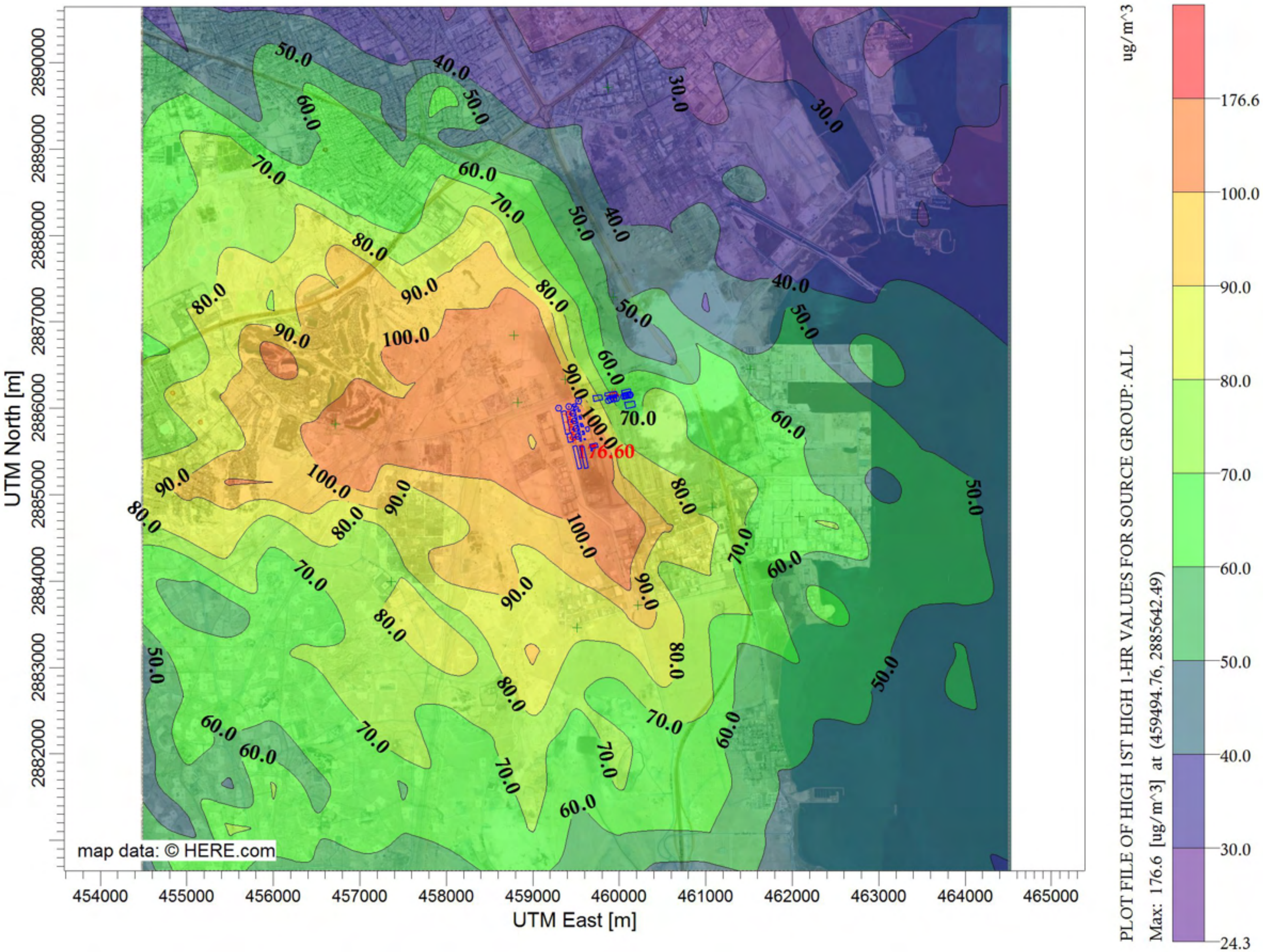
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2A - Sulfur Dioxide Plot File - 1 Hour Values



COMMENTS:

Winter Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: 2 GTs and 1 ST

SOURCES:

6

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

176.6 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:69,888

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

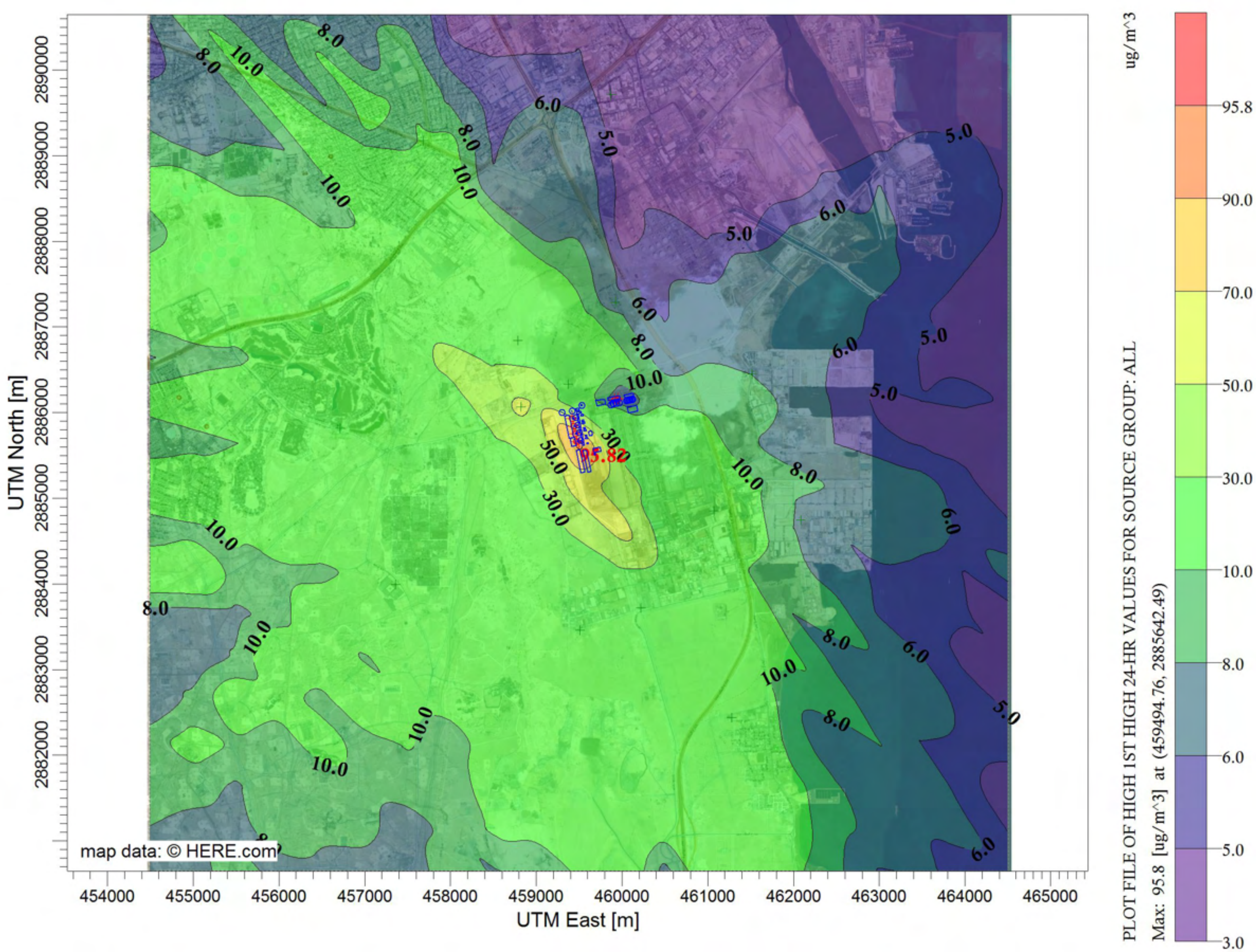
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\2A-SO2-SB-S2\2A-SO2-SB-S2.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2A - Sulfur Dioxide Plot File - 24 Hour Values



COMMENTS:

Winter Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: 2 GTs and 1 ST

SOURCES:

6

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

95.8 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:69,888

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

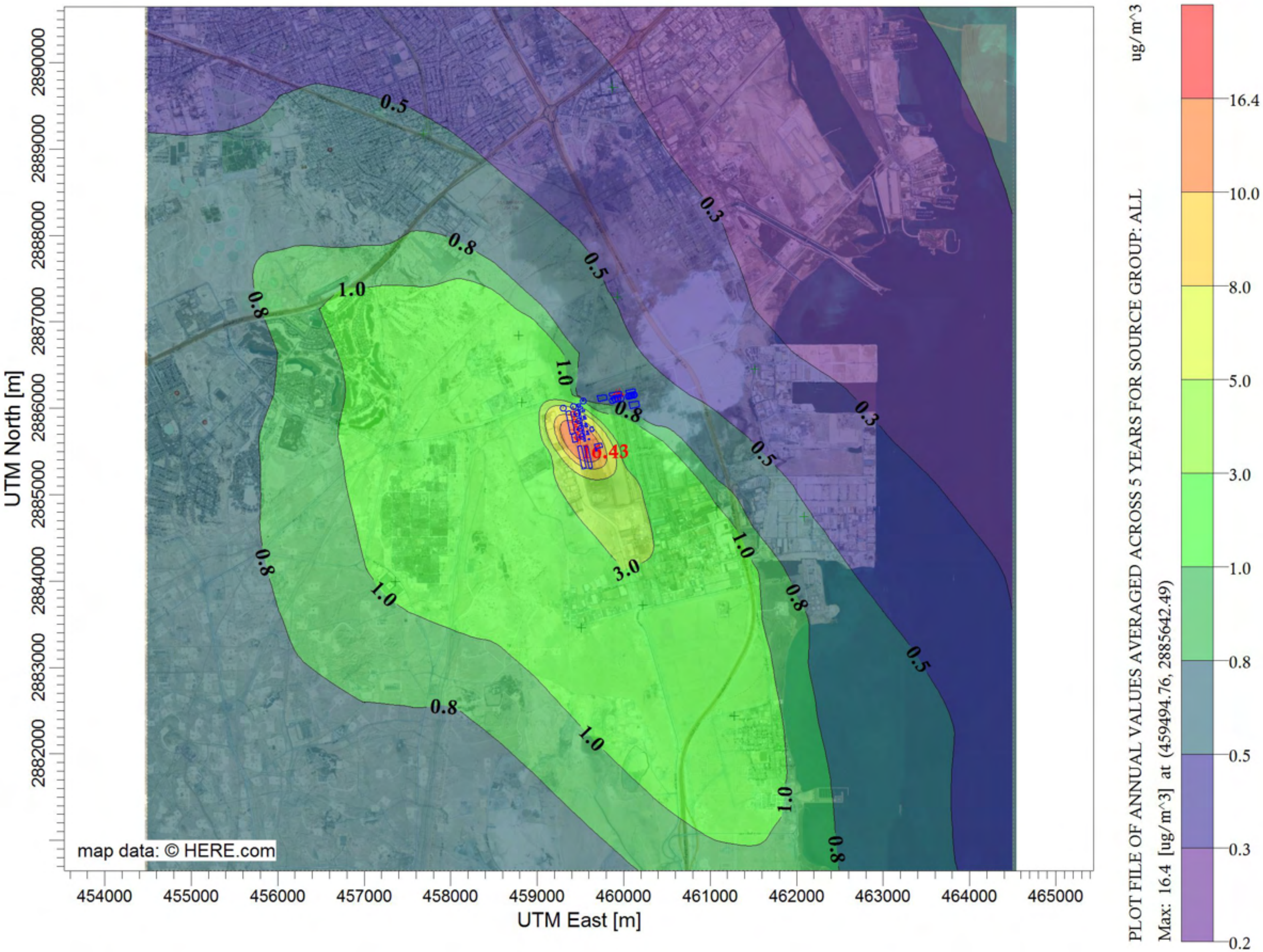
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\2A-SO2-SB-S2\2A-SO2-SB-S2.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2A - Sulfur Dioxide Plot File - Annual Values Averaged Across 5 Years



COMMENTS:

Winter Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: 2 GTs and 1 ST

SOURCES:

6

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

16.4 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:69,888

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

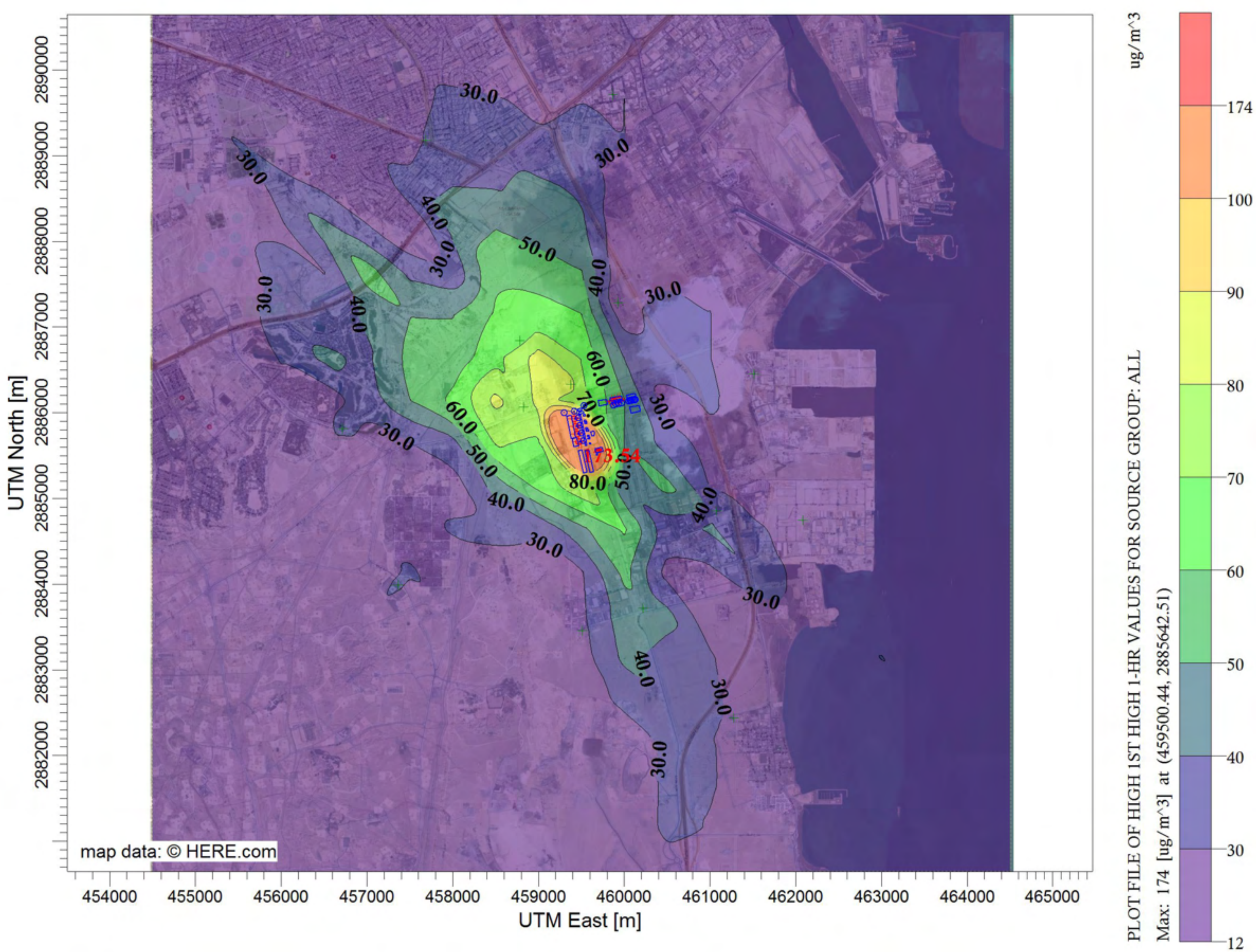
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\2A-SO2-SB-S2\2A-SO2-SB-S2.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2B - Carbon Monoxide Plot File - 1 Hour Values



COMMENTS:

Summer Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

174 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:69,888

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

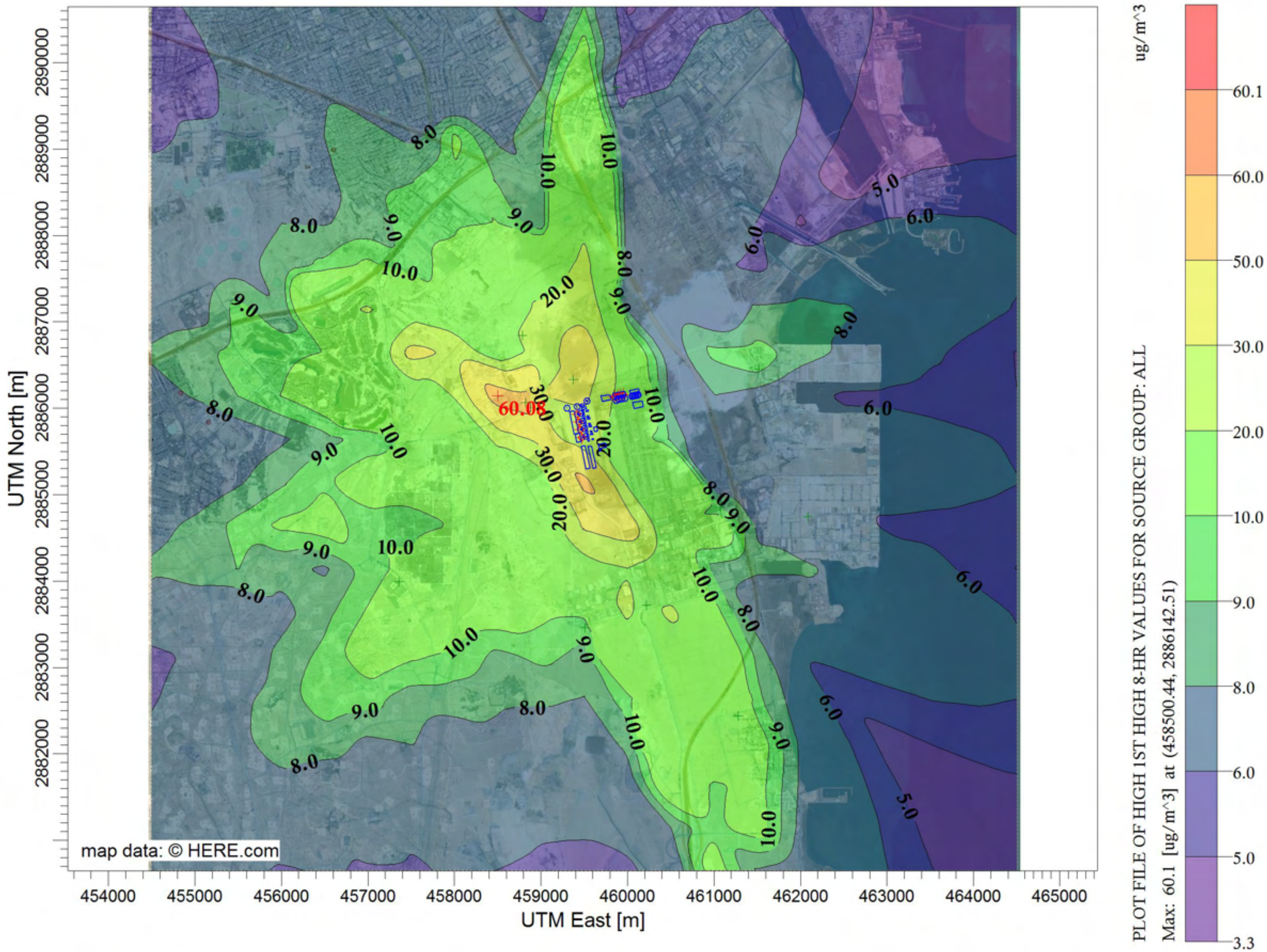
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\2B_CO-SB-S2\2B_CO-SB-S2.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2B - Carbon Monoxide Plot File - 8 Hour Values



COMMENTS:

Summer Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

60.1 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:69,888

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

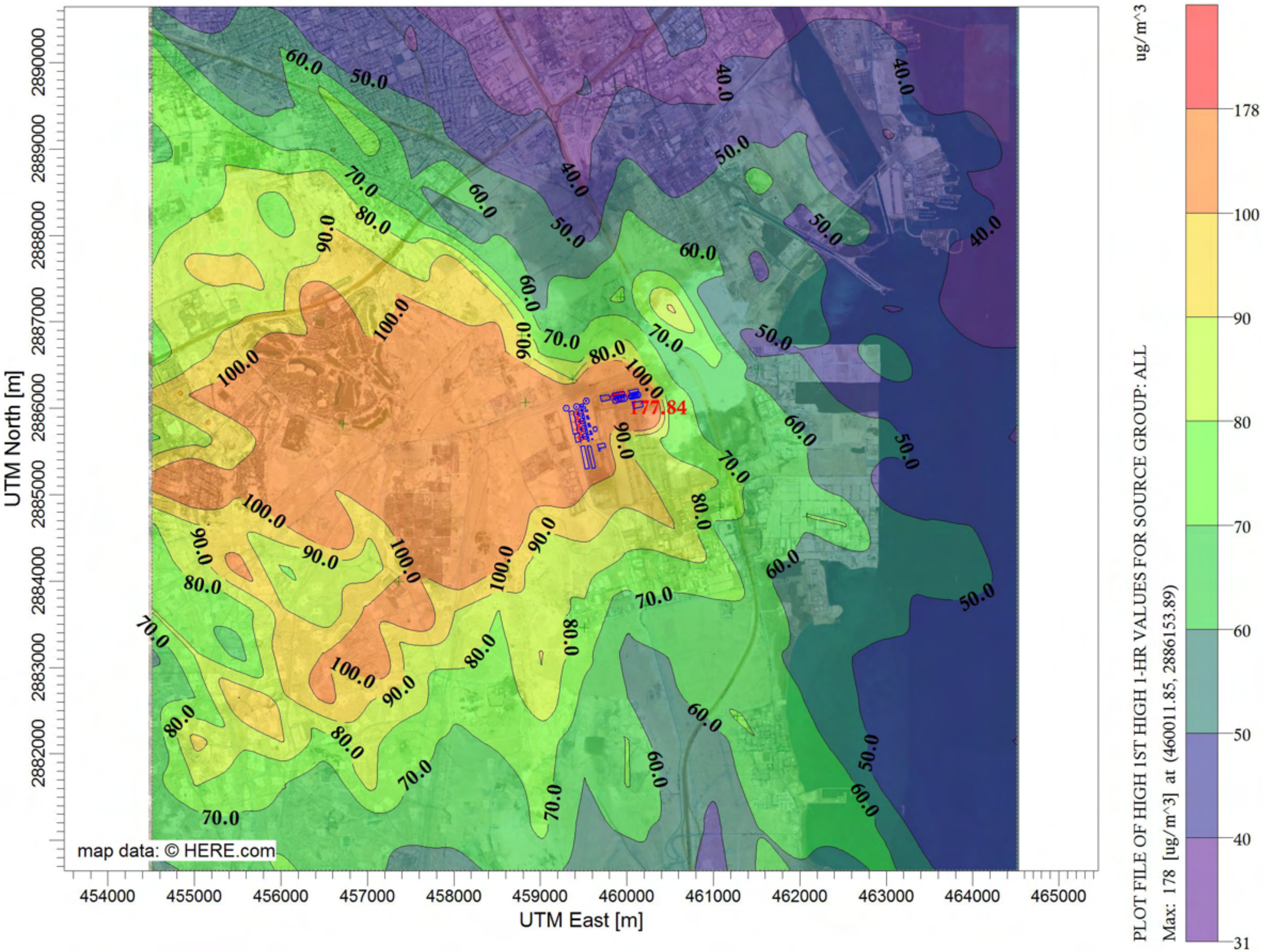
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\2B_CO-SB-S2\2B_CO-SB-S2.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2B - Nitrogen Dioxide Plot File - 1 Hour Values



COMMENTS:

Summer Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

178 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:69,888

0 2 km

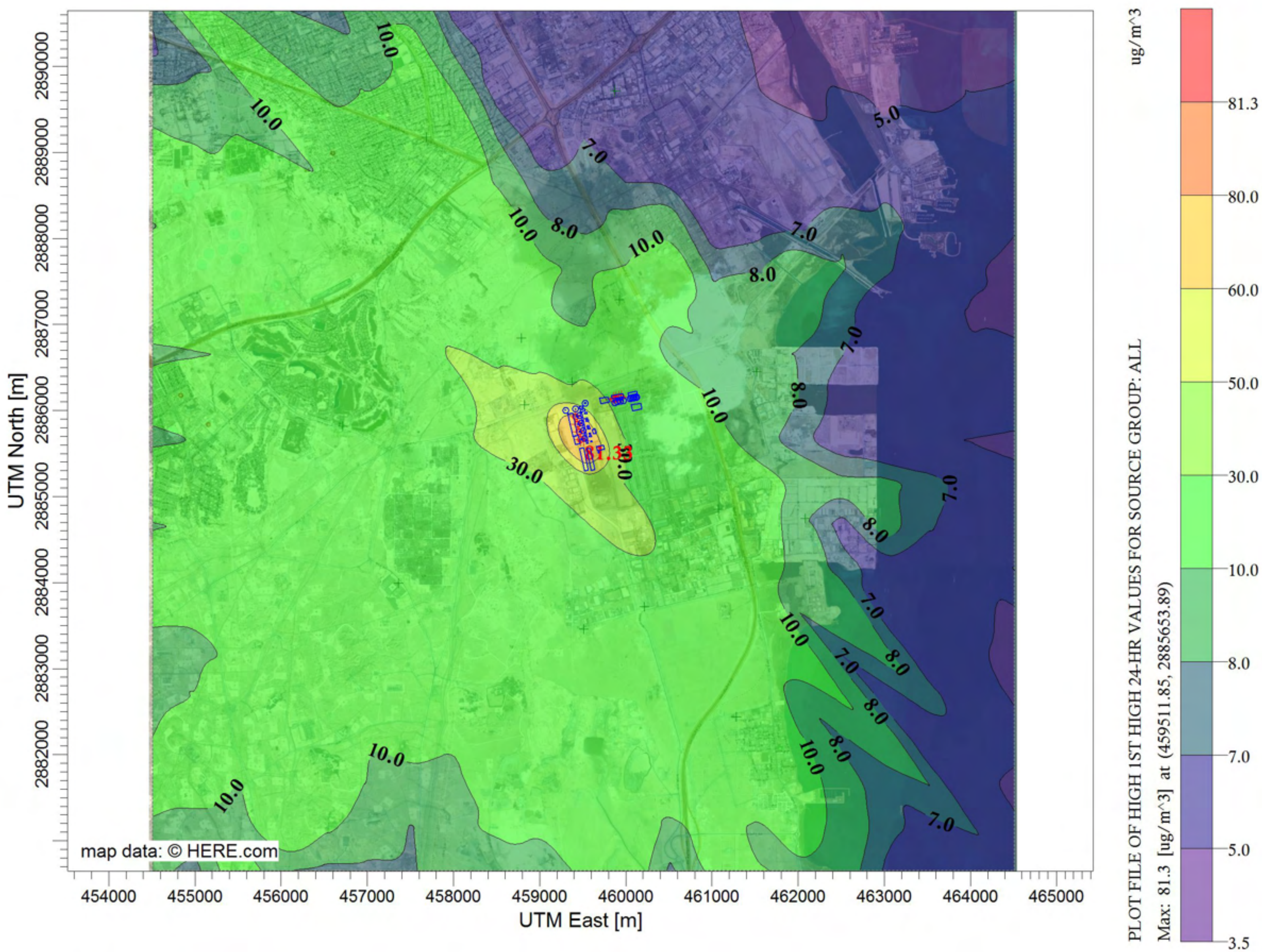
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2B - Nitrogen Dioxide Plot File - 24 Hour Values



COMMENTS:

Summer Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

81.3 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:69,888

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

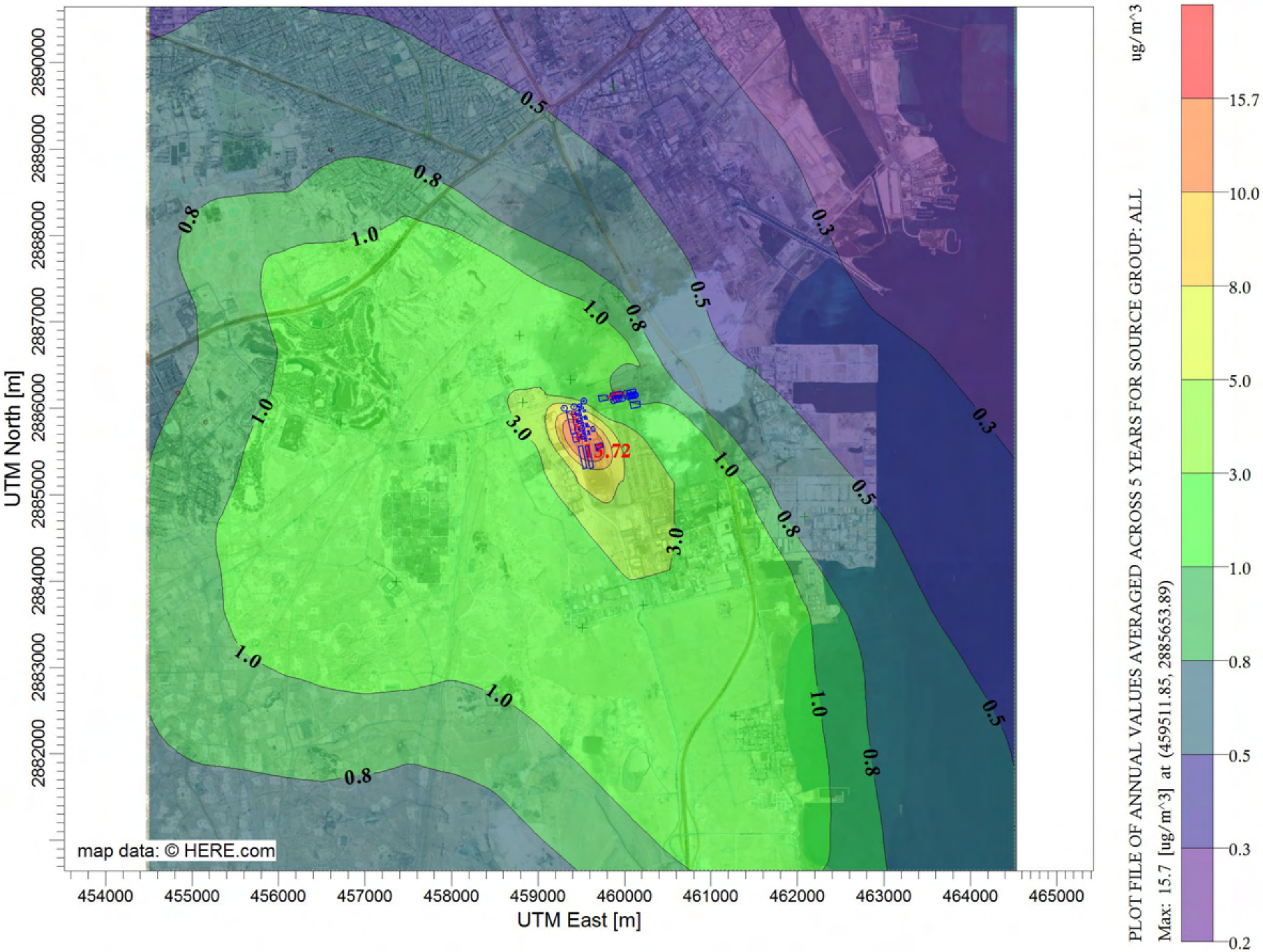
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\2B_NO2-SB-S2\2B_NO2-SB-S2.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2B - Nitrogen Dioxide Plot File - Annual Values Averaged Across 5 Years



COMMENTS:

Summer Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

15.7 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/25/2021

SCALE: 1:69,888

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

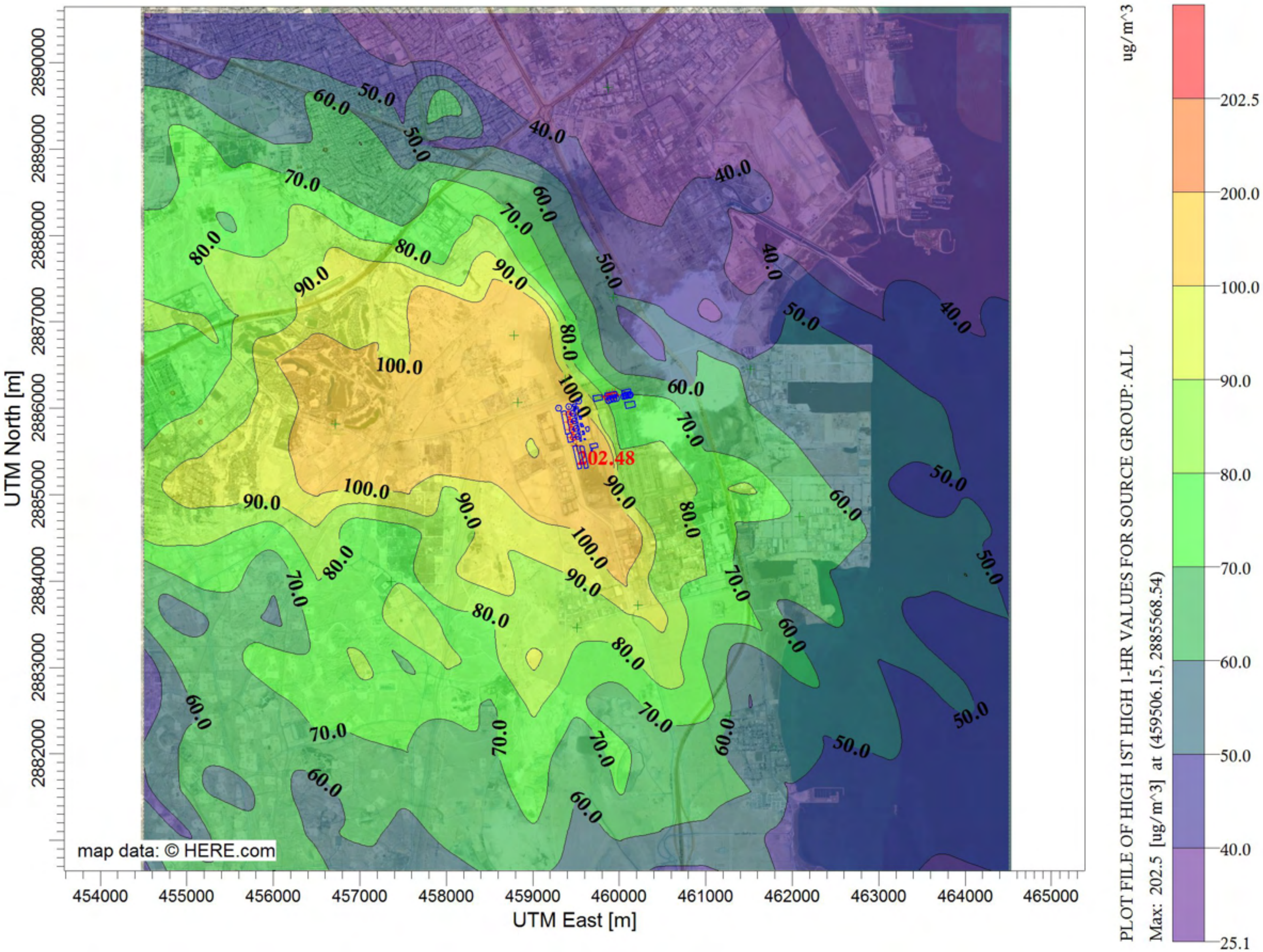
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\2B_NO2-SB-S2\2B_NO2-SB-S2.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2B - Sulfur Dioxide Plot File - 1 Hour Values



COMMENTS:

Summer Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

202.5 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:69,888

0 2 km

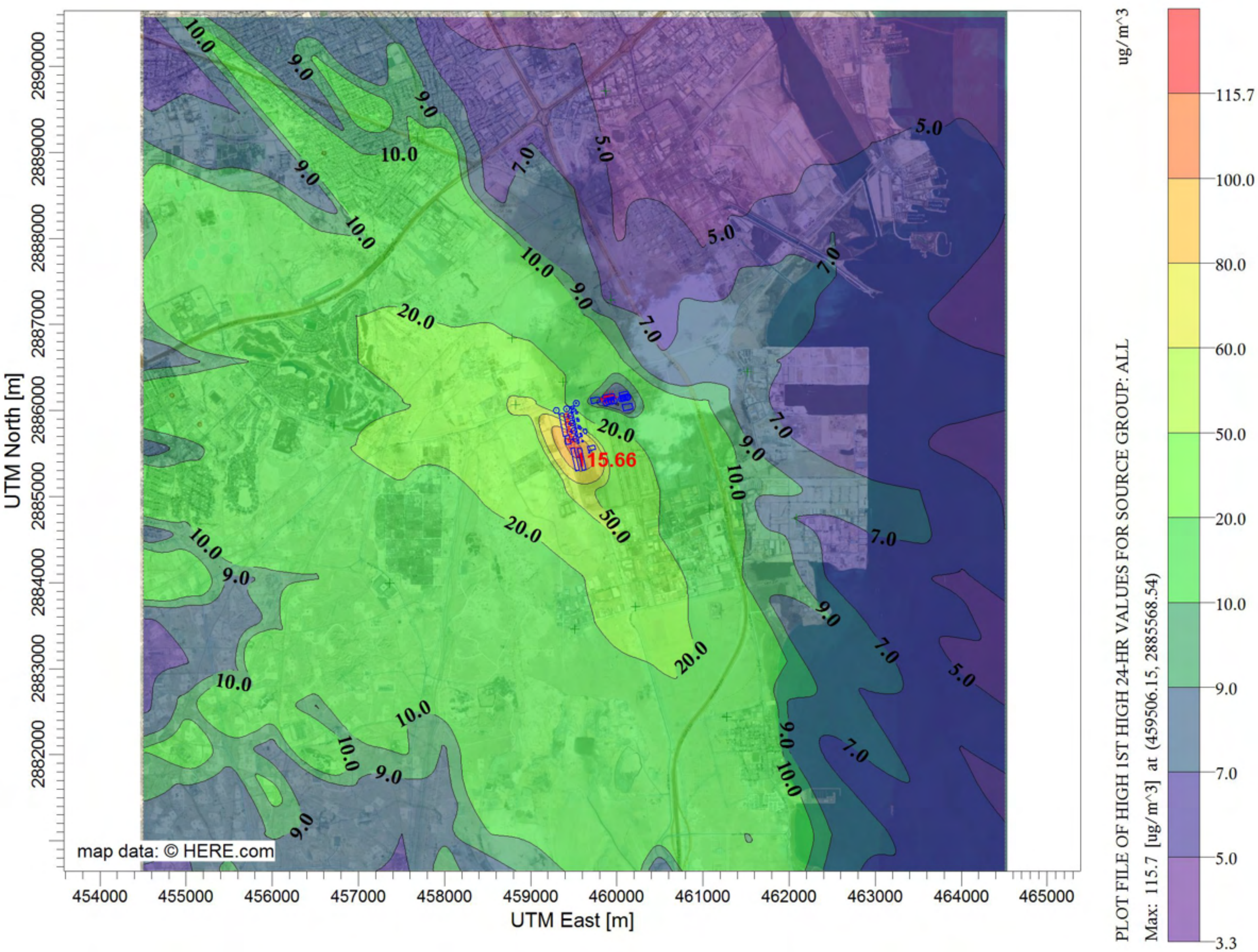
ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2B - Sulfur Dioxide Plot File - 24 Hour Values



COMMENTS:

Summer Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

115.7 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:69,888

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

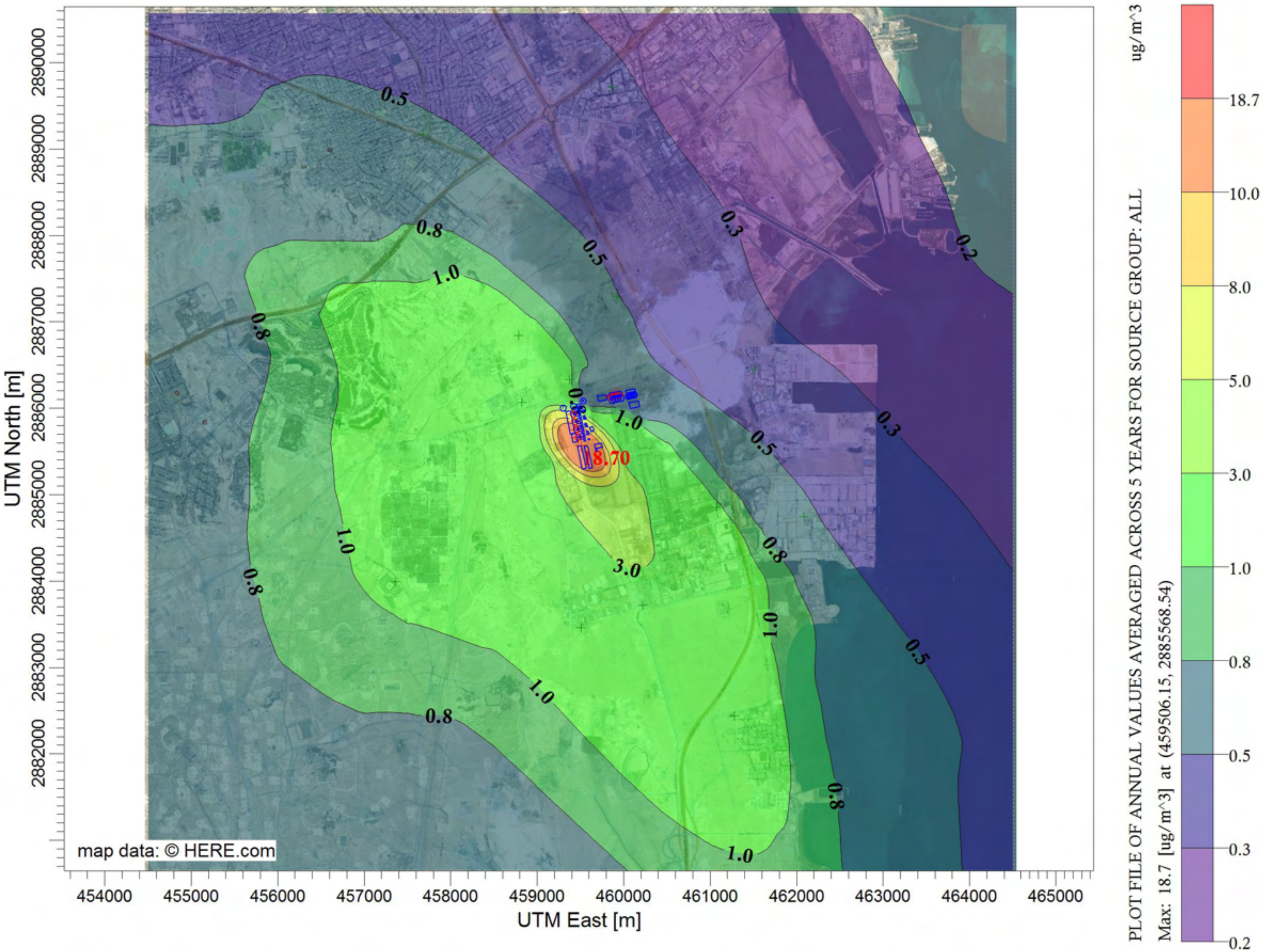
EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\2B_SO2-SB-S2\2B_SO2-SB-S2.isc

PROJECT TITLE:

Aluminium Bahrain BSC - PS5 Block 4 Expansion Project
Scenario 2B - Sulfur Dioxide Plot File - Annual Values Averaged Across 5 Years



COMMENTS:

Summer Base Case (4 PS 5 Units Operational)
PS 5: GT 71, ST 72, GT 73, ST 74, GT 81, ST 82, GT 83 and ST 84
PS 4: GT 51, GT 52, ST 53, GT 61, GT 62 and ST 63

SOURCES:

8

RECEPTORS:

455

OUTPUT TYPE:

Concentration

MAX:

18.7 ug/m^3

COMPANY NAME:

Envirotech Consultancy W.L.L

MODELER:

Rajith Chandran

DATE:

12/26/2021

SCALE: 1:69,888

0 2 km

ENVIROTECH CONSULTANCY W.L.L.

PROJECT NO.:

EL-1917-20

AERMOD View - Lakes Environmental Software

E:\PROJECTS\ALBA PS5\AERMOD\2B_SO2-SB-S2\2B_SO2-SB-S2.isc

Appendix J: Noise Monitoring Field Data Sheet

Project	: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)
Monitoring Date	: 19/11/2020
Monitoring Location	: NML 1 - Accommodation and Recreational Area North of PS 5
Monitoring Period	: Weekday - Morning (Logged Broadband Data)

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
19-11-20 7:03:17 AM	19-11-20 7:04:17 AM	00:01:00	63.8	66.8	64.0	66.8	65.0	65.8	64.8	64.1	64.1
19-11-20 7:04:17 AM	19-11-20 7:05:17 AM	00:01:00	63.6	66.0	63.8	65.5	64.8	65.2	64.8	64.2	64.1
19-11-20 7:05:17 AM	19-11-20 7:06:17 AM	00:01:00	64.2	66.8	64.3	66.6	65.4	66.2	65.3	64.8	64.8
19-11-20 7:06:17 AM	19-11-20 7:07:17 AM	00:01:00	64.1	66.9	64.3	66.7	65.5	66.3	65.5	64.7	64.3
19-11-20 7:07:17 AM	19-11-20 7:08:17 AM	00:01:00	64.2	67.8	64.5	67.5	65.7	66.4	65.4	64.8	64.7
19-11-20 7:08:17 AM	19-11-20 7:09:17 AM	00:01:00	63.5	68.9	63.7	68.7	65.7	67.0	65.4	64.2	64.1
19-11-20 7:09:17 AM	19-11-20 7:10:17 AM	00:01:00	63.9	69.0	64.2	68.8	66.2	68.1	65.4	64.5	64.4
19-11-20 7:10:17 AM	19-11-20 7:11:17 AM	00:01:00	64.0	68.6	64.2	68.7	65.7	66.6	65.3	64.8	64.5
19-11-20 7:11:17 AM	19-11-20 7:12:17 AM	00:01:00	64.4	68.6	64.5	68.4	66.5	67.7	66.4	65.0	64.7
19-11-20 7:12:17 AM	19-11-20 7:13:17 AM	00:01:00	63.7	69.7	63.8	69.5	65.8	68.2	65.2	64.0	64.0
19-11-20 7:13:17 AM	19-11-20 7:14:17 AM	00:01:00	63.8	67.3	64.0	67.2	65.3	66.1	65.1	64.3	64.3
19-11-20 7:14:17 AM	19-11-20 7:15:17 AM	00:01:00	63.1	67.6	63.3	67.2	65.7	66.5	65.8	64.7	63.7
19-11-20 7:15:17 AM	19-11-20 7:16:17 AM	00:01:00	63.2	69.0	63.3	68.6	65.7	66.9	65.3	63.8	63.6
19-11-20 7:16:17 AM	19-11-20 7:17:17 AM	00:01:00	64.1	67.7	64.2	67.5	65.3	66.5	65.0	64.6	64.5
19-11-20 7:17:17 AM	19-11-20 7:18:17 AM	00:01:00	63.7	66.6	63.9	66.8	64.8	65.3	64.8	64.0	63.9
19-11-20 7:18:17 AM	19-11-20 7:19:17 AM	00:01:00	63.7	66.6	63.9	66.4	64.8	65.5	64.7	64.1	63.9
19-11-20 7:19:17 AM	19-11-20 7:20:17 AM	00:01:00	64.1	73.2	64.2	73.0	69.0	71.7	67.3	64.8	64.6
19-11-20 7:20:17 AM	19-11-20 7:21:17 AM	00:01:00	64.2	69.5	64.6	69.1	66.2	67.4	65.8	65.0	64.9
19-11-20 7:21:17 AM	19-11-20 7:22:17 AM	00:01:00	63.5	68.1	63.9	67.9	65.4	66.0	65.2	64.3	64.2
19-11-20 7:22:17 AM	19-11-20 7:23:17 AM	00:01:00	63.7	69.0	63.9	68.7	65.9	67.6	65.5	64.6	64.4
19-11-20 7:23:17 AM	19-11-20 7:24:17 AM	00:01:00	64.0	70.5	64.2	70.0	66.2	68.5	65.4	64.7	64.6
19-11-20 7:24:17 AM	19-11-20 7:25:17 AM	00:01:00	64.1	67.1	64.2	66.9	65.3	66.2	65.2	64.4	64.3
19-11-20 7:25:17 AM	19-11-20 7:26:17 AM	00:01:00	62.7	65.6	62.8	65.3	64.2	65.0	64.2	63.1	63.0
19-11-20 7:26:17 AM	19-11-20 7:27:17 AM	00:01:00	63.6	72.4	63.7	71.9	66.6	69.9	65.4	64.0	63.9
19-11-20 7:27:17 AM	19-11-20 7:28:17 AM	00:01:00	63.2	67.7	63.6	67.4	65.4	66.3	65.2	64.3	64.2
19-11-20 7:28:17 AM	19-11-20 7:29:17 AM	00:01:00	63.1	66.2	63.4	66.1	64.8	65.7	64.6	63.9	63.7
19-11-20 7:29:17 AM	19-11-20 7:30:17 AM	00:01:00	64.1	70.3	64.3	69.9	66.2	68.7	65.3	64.5	64.4
19-11-20 7:30:17 AM	19-11-20 7:31:17 AM	00:01:00	63.0	67.9	63.2	68.2	64.9	66.1	64.4	63.7	63.5
19-11-20 7:31:17 AM	19-11-20 7:32:17 AM	00:01:00	63.3	67.2	63.5	66.8	65.2	65.9	65.3	63.8	63.7
19-11-20 7:32:17 AM	19-11-20 7:33:17 AM	00:01:00	63.3	65.9	63.5	65.6	64.7	65.3	64.7	64.0	63.8
Min			**62.7**	**65.6**	**62.8**	**65.3**	**64.2**	**65.0**	**64.2**	**63.1**	**63.0**
Max			**64.4**	**73.2**	**64.6**	**73.0**	**69.0**	**71.7**	**67.3**	**65.0**	**64.9**
Avg			**63.7**	**68.6**	**63.9**	**68.3**	**65.7**	**67.1**	**65.3**	**64.3**	**64.2**

Project : Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)
Monitoring Date : 19/11/2020
Monitoring Location : NML 1 - Accommodation and Recreational Area North of PS 5
Monitoring Period : Weekday - Morning (Logged Broadband Data)

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
19-11-20 7:03:17 AM	19-11-20 7:04:17 AM	00:01:00	35.8	49.7	53.8	56.5	56.1	59.7	59.4	54.1	34.1	25.2
19-11-20 7:04:17 AM	19-11-20 7:05:17 AM	00:01:00	35.2	49.7	53.5	56.8	55.1	59.1	59.4	54.0	34.2	26.1
19-11-20 7:05:17 AM	19-11-20 7:06:17 AM	00:01:00	34.8	50.4	54.1	57.3	55.7	60.0	59.9	54.6	35.6	24.2
19-11-20 7:06:17 AM	19-11-20 7:07:17 AM	00:01:00	35.0	50.4	54.1	57.1	56.6	60.1	60.0	54.4	34.6	24.2
19-11-20 7:07:17 AM	19-11-20 7:08:17 AM	00:01:00	34.1	50.8	54.1	58.0	57.1	59.6	60.1	54.6	35.2	23.7
19-11-20 7:08:17 AM	19-11-20 7:09:17 AM	00:01:00	34.8	50.4	54.3	58.9	57.2	59.6	59.7	54.2	35.2	23.8
19-11-20 7:09:17 AM	19-11-20 7:10:17 AM	00:01:00	34.6	51.0	54.7	58.7	58.7	60.1	59.9	54.6	41.1	26.4
19-11-20 7:10:17 AM	19-11-20 7:11:17 AM	00:01:00	34.7	51.3	55.3	58.1	57.1	59.8	59.8	54.4	37.4	25.5
19-11-20 7:11:17 AM	19-11-20 7:12:17 AM	00:01:00	35.4	50.8	55.5	60.2	59.1	60.0	59.8	54.3	38.6	25.5
19-11-20 7:12:17 AM	19-11-20 7:13:17 AM	00:01:00	34.0	49.7	54.3	59.3	58.4	59.2	59.5	54.3	36.9	22.7
19-11-20 7:13:17 AM	19-11-20 7:14:17 AM	00:01:00	33.8	50.0	54.4	57.8	56.9	59.2	59.4	54.1	35.6	24.6
19-11-20 7:14:17 AM	19-11-20 7:15:17 AM	00:01:00	34.6	50.0	55.0	57.9	57.2	59.9	59.8	54.6	37.7	24.3
19-11-20 7:15:17 AM	19-11-20 7:16:17 AM	00:01:00	35.2	49.9	54.6	58.2	57.6	59.5	59.8	54.5	38.0	25.9
19-11-20 7:16:17 AM	19-11-20 7:17:17 AM	00:01:00	34.0	49.2	54.2	58.0	56.5	59.2	59.7	54.6	36.1	21.8
19-11-20 7:17:17 AM	19-11-20 7:18:17 AM	00:01:00	34.2	50.2	53.9	56.9	55.6	59.1	59.1	53.9	35.0	23.7
19-11-20 7:18:17 AM	19-11-20 7:19:17 AM	00:01:00	36.4	50.8	53.6	57.1	55.6	59.1	59.1	53.8	34.7	24.1
19-11-20 7:19:17 AM	19-11-20 7:20:17 AM	00:01:00	35.9	54.8	58.0	63.1	62.1	61.5	61.5	57.3	45.6	30.4
19-11-20 7:20:17 AM	19-11-20 7:21:17 AM	00:01:00	34.9	50.9	55.1	59.3	57.7	60.3	60.2	54.9	37.6	22.7
19-11-20 7:21:17 AM	19-11-20 7:22:17 AM	00:01:00	35.2	50.1	54.0	57.5	56.7	59.6	59.8	54.4	35.1	23.2
19-11-20 7:22:17 AM	19-11-20 7:23:17 AM	00:01:00	35.4	52.4	54.9	58.4	57.4	59.7	59.9	54.3	38.8	25.6
19-11-20 7:23:17 AM	19-11-20 7:24:17 AM	00:01:00	35.5	51.2	54.9	60.2	58.6	59.3	59.6	54.5	37.5	22.7
19-11-20 7:24:17 AM	19-11-20 7:25:17 AM	00:01:00	34.8	51.0	54.7	57.7	56.7	59.6	59.3	54.1	35.7	24.2
19-11-20 7:25:17 AM	19-11-20 7:26:17 AM	00:01:00	34.7	50.9	54.0	56.8	55.3	58.4	58.1	52.6	34.0	26.4
19-11-20 7:26:17 AM	19-11-20 7:27:17 AM	00:01:00	35.2	53.6	56.7	60.3	58.0	59.6	59.8	54.6	35.9	24.5
19-11-20 7:27:17 AM	19-11-20 7:28:17 AM	00:01:00	35.2	51.0	54.5	57.3	56.4	59.8	59.8	54.3	35.8	25.3
19-11-20 7:28:17 AM	19-11-20 7:29:17 AM	00:01:00	34.5	51.2	54.0	57.3	56.4	58.7	58.9	53.6	35.2	23.9
19-11-20 7:29:17 AM	19-11-20 7:30:17 AM	00:01:00	34.4	52.0	54.5	58.6	58.3	60.0	60.2	54.9	39.3	25.5
19-11-20 7:30:17 AM	19-11-20 7:31:17 AM	00:01:00	35.1	50.2	54.4	57.5	56.5	58.7	58.9	53.4	35.2	23.8
19-11-20 7:31:17 AM	19-11-20 7:32:17 AM	00:01:00	34.7	49.8	53.6	57.2	56.4	59.5	59.6	54.3	36.1	24.8
19-11-20 7:32:17 AM	19-11-20 7:33:17 AM	00:01:00	34.2	50.9	53.7	56.8	55.2	58.8	59.2	53.9	33.9	23.2
Min			**33.8**	**49.2**	**53.5**	**56.5**	**55.1**	**58.4**	**58.1**	**52.6**	**33.9**	**21.8**
Max			**36.4**	**54.8**	**58.0**	**63.1**	**62.1**	**61.5**	**61.5**	**57.3**	**45.6**	**30.4**
Avg			**34.9**	**51.0**	**54.7**	**58.4**	**57.3**	**59.6**	**59.7**	**54.4**	**37.5**	**24.9**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 19/11/2020**
Monitoring Location	**: NML 2 - North East Boundary of PS 5**
Monitoring Period	**: Weekday Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
19-11-20 8:10:05 AM	19-11-20 8:11:05 AM	00:01:00	68.6	70.7	68.8	70.5	69.3	69.9	69.1	68.9	68.8
19-11-20 8:11:05 AM	19-11-20 8:12:05 AM	00:01:00	69.0	70.0	69.1	70.0	69.5	69.7	69.5	69.1	69.1
19-11-20 8:12:05 AM	19-11-20 8:13:05 AM	00:01:00	68.7	69.6	68.8	69.5	69.2	69.4	69.1	68.8	68.8
19-11-20 8:13:05 AM	19-11-20 8:14:05 AM	00:01:00	68.5	69.8	68.6	69.7	69.0	69.3	68.9	68.7	68.6
19-11-20 8:14:05 AM	19-11-20 8:15:05 AM	00:01:00	69.0	75.7	69.0	75.5	70.6	72.8	69.3	69.0	69.0
19-11-20 8:15:05 AM	19-11-20 8:16:05 AM	00:01:00	69.0	73.6	69.1	74.0	70.3	73.1	69.5	69.2	69.2
19-11-20 8:16:05 AM	19-11-20 8:17:05 AM	00:01:00	68.6	70.3	68.7	70.2	69.4	69.8	69.5	68.9	68.9
19-11-20 8:17:05 AM	19-11-20 8:18:05 AM	00:01:00	68.6	69.7	68.8	69.7	69.2	69.4	69.1	68.9	68.9
19-11-20 8:18:05 AM	19-11-20 8:19:05 AM	00:01:00	68.4	70.0	68.5	69.9	69.1	69.3	69.0	68.6	68.6
19-11-20 8:19:05 AM	19-11-20 8:20:05 AM	00:01:00	68.9	73.7	69.0	73.4	70.3	72.6	69.5	69.2	69.0
19-11-20 8:20:05 AM	19-11-20 8:21:05 AM	00:01:00	68.8	70.5	68.9	70.5	69.5	69.9	69.4	69.0	69.0
19-11-20 8:21:05 AM	19-11-20 8:22:05 AM	00:01:00	68.7	69.8	68.7	69.8	69.2	69.5	69.1	68.8	68.8
19-11-20 8:22:05 AM	19-11-20 8:23:05 AM	00:01:00	68.5	70.0	68.7	69.8	69.3	69.6	69.4	68.8	68.7
19-11-20 8:23:05 AM	19-11-20 8:24:05 AM	00:01:00	68.7	70.0	68.8	69.8	69.4	69.7	69.4	69.0	68.9
19-11-20 8:24:05 AM	19-11-20 8:25:05 AM	00:01:00	68.9	70.1	69.0	70.0	69.4	69.8	69.3	69.1	69.1
19-11-20 8:25:05 AM	19-11-20 8:26:05 AM	00:01:00	69.2	74.6	69.3	74.0	70.6	72.7	69.9	69.4	69.4
19-11-20 8:26:05 AM	19-11-20 8:27:05 AM	00:01:00	69.0	70.1	69.0	70.0	69.4	69.7	69.4	69.1	69.0
19-11-20 8:27:05 AM	19-11-20 8:28:05 AM	00:01:00	68.5	69.6	68.6	69.6	69.1	69.3	69.1	68.8	68.8
19-11-20 8:28:05 AM	19-11-20 8:29:05 AM	00:01:00	68.7	69.9	68.8	69.8	69.3	69.6	69.2	68.9	68.9
19-11-20 8:29:05 AM	19-11-20 8:30:05 AM	00:01:00	68.8	69.7	68.9	69.6	69.2	69.4	69.2	69.0	68.9
19-11-20 8:30:05 AM	19-11-20 8:31:05 AM	00:01:00	68.8	78.8	68.8	78.1	71.7	75.6	69.4	69.0	68.9
19-11-20 8:31:05 AM	19-11-20 8:32:05 AM	00:01:00	68.5	70.4	68.6	70.2	69.3	69.7	69.2	68.8	68.8
19-11-20 8:32:05 AM	19-11-20 8:33:05 AM	00:01:00	68.6	69.9	68.7	69.8	69.2	69.4	69.1	68.8	68.7
19-11-20 8:33:05 AM	19-11-20 8:34:05 AM	00:01:00	68.6	70.0	68.8	69.9	69.2	69.6	69.1	69.0	68.9
19-11-20 8:34:05 AM	19-11-20 8:35:05 AM	00:01:00	68.7	69.9	68.8	69.8	69.3	69.6	69.3	69.0	68.9
19-11-20 8:35:05 AM	19-11-20 8:36:05 AM	00:01:00	68.5	73.7	68.7	73.2	70.1	71.4	69.6	69.1	69.1
19-11-20 8:36:05 AM	19-11-20 8:37:05 AM	00:01:00	68.6	70.0	68.7	69.9	69.1	69.3	69.1	68.8	68.8
19-11-20 8:37:05 AM	19-11-20 8:38:05 AM	00:01:00	68.3	69.9	68.5	69.7	69.2	69.5	69.1	68.8	68.7
19-11-20 8:38:05 AM	19-11-20 8:39:05 AM	00:01:00	68.6	70.0	68.8	69.9	69.4	69.7	69.3	69.0	69.0
19-11-20 8:39:05 AM	19-11-20 8:40:05 AM	00:01:00	68.8	69.7	68.8	69.6	69.3	69.5	69.2	69.0	68.9
Min			**68.3**	**69.6**	**68.5**	**69.5**	**69.0**	**69.3**	**68.9**	**68.6**	**68.6**
Max			**69.2**	**78.8**	**69.3**	**78.1**	**71.7**	**75.6**	**69.9**	**69.4**	**69.4**
Avg			**68.7**	**71.8**	**68.8**	**71.5**	**69.6**	**70.6**	**69.3**	**69.0**	**68.9**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **19/11/2020**
Monitoring Location : **NML 2 - North East Boundary of PS 5**
Monitoring Period : **Weekday Morning (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
19-11-20 8:10:05 AM	19-11-20 8:11:05 AM	00:01:00	41.4	55.4	56.9	58.2	62.1	63.2	63.9	59.1	49.9	32.3
19-11-20 8:11:05 AM	19-11-20 8:12:05 AM	00:01:00	41.6	58.4	58.3	57.7	61.6	63.2	63.9	59.4	50.2	32.7
19-11-20 8:12:05 AM	19-11-20 8:13:05 AM	00:01:00	41.0	56.4	56.8	57.5	61.5	62.9	63.8	59.4	50.2	31.9
19-11-20 8:13:05 AM	19-11-20 8:14:05 AM	00:01:00	40.6	55.1	56.0	57.4	61.5	63.0	63.8	59.3	50.0	31.5
19-11-20 8:14:05 AM	19-11-20 8:15:05 AM	00:01:00	41.1	57.3	57.0	59.7	63.5	65.0	64.7	60.1	49.9	32.1
19-11-20 8:15:05 AM	19-11-20 8:16:05 AM	00:01:00	42.0	56.1	57.1	59.9	63.4	64.5	64.4	59.8	50.1	32.0
19-11-20 8:16:05 AM	19-11-20 8:17:05 AM	00:01:00	41.6	56.1	57.2	58.1	61.8	63.4	64.2	59.7	49.8	32.0
19-11-20 8:17:05 AM	19-11-20 8:18:05 AM	00:01:00	41.7	56.7	57.0	57.5	61.4	63.0	63.8	59.4	49.9	32.3
19-11-20 8:18:05 AM	19-11-20 8:19:05 AM	00:01:00	41.5	55.4	56.8	57.8	61.4	63.0	63.8	59.2	49.8	32.5
19-11-20 8:19:05 AM	19-11-20 8:20:05 AM	00:01:00	41.8	57.0	57.2	59.2	62.9	64.6	64.6	59.8	50.3	32.6
19-11-20 8:20:05 AM	19-11-20 8:21:05 AM	00:01:00	41.4	57.4	56.9	58.0	61.7	63.4	64.0	59.6	50.6	32.8
19-11-20 8:21:05 AM	19-11-20 8:22:05 AM	00:01:00	40.5	54.9	56.0	57.5	61.5	63.2	64.0	59.5	50.7	32.7
19-11-20 8:22:05 AM	19-11-20 8:23:05 AM	00:01:00	41.5	56.0	56.6	57.4	61.7	63.4	64.0	59.6	50.6	32.5
19-11-20 8:23:05 AM	19-11-20 8:24:05 AM	00:01:00	43.6	57.1	56.8	57.5	61.5	63.3	64.0	59.7	50.8	32.5
19-11-20 8:24:05 AM	19-11-20 8:25:05 AM	00:01:00	41.5	55.4	56.5	57.9	61.8	63.4	64.1	59.7	50.7	32.3
19-11-20 8:25:05 AM	19-11-20 8:26:05 AM	00:01:00	42.0	56.1	57.1	59.6	63.5	65.1	64.7	60.3	50.5	32.9
19-11-20 8:26:05 AM	19-11-20 8:27:05 AM	00:01:00	40.8	56.9	56.6	57.5	61.6	63.3	64.1	59.8	50.4	32.4
19-11-20 8:27:05 AM	19-11-20 8:28:05 AM	00:01:00	40.9	55.7	56.0	57.6	61.6	63.0	63.8	59.4	50.5	32.0
19-11-20 8:28:05 AM	19-11-20 8:29:05 AM	00:01:00	41.1	57.0	56.7	57.6	61.5	63.1	64.1	59.7	50.5	32.5
19-11-20 8:29:05 AM	19-11-20 8:30:05 AM	00:01:00	41.0	56.1	56.4	57.3	61.4	63.2	64.1	59.8	50.3	32.0
19-11-20 8:30:05 AM	19-11-20 8:31:05 AM	00:01:00	42.1	55.2	57.2	61.3	65.5	66.5	65.2	60.3	50.6	31.8
19-11-20 8:31:05 AM	19-11-20 8:32:05 AM	00:01:00	40.5	57.1	56.9	57.9	61.8	63.2	63.8	59.3	50.1	32.6
19-11-20 8:32:05 AM	19-11-20 8:33:05 AM	00:01:00	40.8	56.8	56.6	57.7	61.6	63.0	63.7	59.2	50.4	32.8
19-11-20 8:33:05 AM	19-11-20 8:34:05 AM	00:01:00	42.0	56.0	57.0	57.7	61.4	63.2	64.0	59.5	50.7	33.2
19-11-20 8:34:05 AM	19-11-20 8:35:05 AM	00:01:00	41.0	57.1	56.8	57.6	61.4	63.2	64.0	59.5	50.5	32.8
19-11-20 8:35:05 AM	19-11-20 8:36:05 AM	00:01:00	41.7	56.0	56.4	58.9	62.7	64.3	64.7	60.0	50.5	32.8
19-11-20 8:36:05 AM	19-11-20 8:37:05 AM	00:01:00	40.6	54.8	55.9	57.7	61.5	63.2	63.9	59.4	50.6	32.6
19-11-20 8:37:05 AM	19-11-20 8:38:05 AM	00:01:00	40.8	56.6	56.4	57.6	61.5	63.1	63.8	59.4	50.4	32.8
19-11-20 8:38:05 AM	19-11-20 8:39:05 AM	00:01:00	40.5	56.2	56.5	57.6	61.7	63.5	63.9	59.5	50.3	33.4
19-11-20 8:39:05 AM	19-11-20 8:40:05 AM	00:01:00	42.1	55.3	56.5	57.5	61.8	63.3	63.9	59.5	50.4	33.6
Min			**40.5**	**54.8**	**55.9**	**57.3**	**61.4**	**62.9**	**63.7**	**59.1**	**49.8**	**31.5**
Max			**43.6**	**58.4**	**58.3**	**61.3**	**65.5**	**66.5**	**65.2**	**60.3**	**50.8**	**33.6**
Avg			**41.4**	**56.3**	**56.8**	**58.2**	**62.1**	**63.6**	**64.1**	**59.6**	**50.3**	**32.5**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 19/11/2020**
Monitoring Location	**: NML 3 - Block 4 Site - South of PS 5 Block 3**
Monitoring Period	**: Weekday Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
19-11-20 11:24:06 AM	19-11-20 11:25:06 AM	00:01:00	73.2	77.0	73.5	76.9	74.3	74.8	74.0	73.6	73.6
19-11-20 11:25:06 AM	19-11-20 11:26:06 AM	00:01:00	73.3	81.6	73.6	81.2	75.2	78.0	73.9	73.6	73.6
19-11-20 11:26:06 AM	19-11-20 11:27:06 AM	00:01:00	73.1	74.5	73.4	74.4	73.8	74.1	73.7	73.5	73.5
19-11-20 11:27:06 AM	19-11-20 11:28:06 AM	00:01:00	73.2	74.8	73.3	74.6	73.9	74.4	73.9	73.4	73.3
19-11-20 11:28:06 AM	19-11-20 11:29:06 AM	00:01:00	73.5	74.7	73.7	74.5	74.0	74.2	74.0	73.7	73.7
19-11-20 11:29:06 AM	19-11-20 11:30:06 AM	00:01:00	73.0	74.8	73.1	74.7	73.8	74.3	73.7	73.3	73.2
19-11-20 11:30:06 AM	19-11-20 11:31:06 AM	00:01:00	73.0	74.2	73.1	74.0	73.7	74.0	73.7	73.4	73.3
19-11-20 11:31:06 AM	19-11-20 11:32:06 AM	00:01:00	73.1	74.2	73.2	74.1	73.7	73.9	73.6	73.3	73.3
19-11-20 11:32:06 AM	19-11-20 11:33:06 AM	00:01:00	73.0	74.4	73.1	74.2	73.7	74.0	73.6	73.2	73.2
19-11-20 11:33:06 AM	19-11-20 11:34:06 AM	00:01:00	73.2	75.0	73.2	74.8	73.8	74.1	73.7	73.4	73.4
19-11-20 11:34:06 AM	19-11-20 11:35:06 AM	00:01:00	73.4	74.3	73.6	74.2	73.9	74.1	73.9	73.7	73.6
19-11-20 11:35:06 AM	19-11-20 11:36:06 AM	00:01:00	73.1	74.5	73.3	74.2	73.8	74.0	73.7	73.5	73.4
19-11-20 11:36:06 AM	19-11-20 11:37:06 AM	00:01:00	73.1	74.6	73.2	74.4	73.7	74.0	73.7	73.4	73.3
19-11-20 11:37:06 AM	19-11-20 11:38:06 AM	00:01:00	73.2	74.5	73.3	74.4	73.8	74.1	73.8	73.5	73.4
19-11-20 11:38:06 AM	19-11-20 11:39:06 AM	00:01:00	73.2	74.8	73.4	74.5	73.8	74.1	73.7	73.5	73.5
19-11-20 11:39:06 AM	19-11-20 11:40:06 AM	00:01:00	73.2	74.6	73.3	74.5	73.9	74.3	73.8	73.4	73.3
19-11-20 11:40:06 AM	19-11-20 11:41:06 AM	00:01:00	73.5	74.9	73.6	74.6	74.0	74.4	73.9	73.7	73.6
19-11-20 11:41:06 AM	19-11-20 11:42:06 AM	00:01:00	73.3	74.9	73.4	74.5	73.9	74.2	73.8	73.6	73.6
19-11-20 11:42:06 AM	19-11-20 11:43:06 AM	00:01:00	73.5	74.5	73.5	74.3	73.9	74.0	73.9	73.6	73.6
19-11-20 11:43:06 AM	19-11-20 11:44:06 AM	00:01:00	73.5	74.5	73.6	74.4	74.0	74.2	74.0	73.7	73.7
19-11-20 11:44:06 AM	19-11-20 11:45:06 AM	00:01:00	73.5	74.4	73.6	74.2	73.9	74.1	73.8	73.6	73.6
19-11-20 11:45:06 AM	19-11-20 11:46:06 AM	00:01:00	73.4	74.3	73.5	74.2	73.9	74.1	73.8	73.6	73.6
19-11-20 11:46:06 AM	19-11-20 11:47:06 AM	00:01:00	73.2	74.6	73.4	74.4	74.0	74.2	73.9	73.5	73.5
19-11-20 11:47:06 AM	19-11-20 11:48:06 AM	00:01:00	73.3	80.4	73.4	80.1	75.0	77.3	74.0	73.6	73.5
19-11-20 11:48:06 AM	19-11-20 11:49:06 AM	00:01:00	73.6	74.3	73.6	74.2	73.8	74.0	73.8	73.7	73.6
19-11-20 11:49:06 AM	19-11-20 11:50:06 AM	00:01:00	73.4	74.5	73.5	74.4	73.9	74.1	73.9	73.7	73.6
19-11-20 11:50:06 AM	19-11-20 11:51:06 AM	00:01:00	73.3	74.6	73.3	74.4	73.9	74.2	73.9	73.4	73.4
19-11-20 11:51:06 AM	19-11-20 11:52:06 AM	00:01:00	73.2	74.8	73.3	74.6	73.8	74.1	73.8	73.5	73.4
19-11-20 11:52:06 AM	19-11-20 11:53:06 AM	00:01:00	73.4	74.7	73.6	74.5	74.0	74.2	74.0	73.8	73.6
19-11-20 11:53:06 AM	19-11-20 11:54:06 AM	00:01:00	73.4	74.6	73.5	74.5	73.9	74.2	73.8	73.5	73.5
Min			**73.0**	**74.2**	**73.1**	**74.0**	**73.7**	**73.9**	**73.6**	**73.2**	**73.2**
Max			**73.6**	**81.6**	**73.7**	**81.2**	**75.2**	**78.0**	**74.0**	**73.8**	**73.7**
Avg			**73.3**	**75.6**	**73.4**	**75.3**	**74.0**	**74.5**	**73.8**	**73.5**	**73.5**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **19/11/2020**
Monitoring Location : **NML 3 - Block 4 Site - South of PS 5 Block 3**
Monitoring Period : **Weekday Morning (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
19-11-20 11:24:06 AM	19-11-20 11:25:06 AM	00:01:00	45.3	56.5	64.8	68.3	68.7	67.9	64.7	59.5	47.9	34.1
19-11-20 11:25:06 AM	19-11-20 11:26:06 AM	00:01:00	42.9	56.5	64.4	68.0	68.8	70.5	67.0	61.0	50.2	34.5
19-11-20 11:26:06 AM	19-11-20 11:27:06 AM	00:01:00	44.3	56.6	64.9	68.3	68.6	66.4	63.3	58.1	44.9	33.9
19-11-20 11:27:06 AM	19-11-20 11:28:06 AM	00:01:00	46.5	56.4	65.1	68.2	68.6	66.7	63.4	58.2	45.0	34.2
19-11-20 11:28:06 AM	19-11-20 11:29:06 AM	00:01:00	46.2	56.7	64.8	68.3	68.8	66.7	63.4	58.1	44.9	33.9
19-11-20 11:29:06 AM	19-11-20 11:30:06 AM	00:01:00	44.1	56.7	65.0	68.0	68.3	66.6	63.4	58.1	44.9	33.6
19-11-20 11:30:06 AM	19-11-20 11:31:06 AM	00:01:00	43.0	56.0	64.7	68.2	68.5	66.2	63.0	57.9	44.8	32.9
19-11-20 11:31:06 AM	19-11-20 11:32:06 AM	00:01:00	44.7	56.0	64.6	68.3	68.4	66.2	63.1	57.9	44.9	34.2
19-11-20 11:32:06 AM	19-11-20 11:33:06 AM	00:01:00	44.4	56.2	64.6	68.0	68.5	66.2	63.3	58.0	44.8	33.7
19-11-20 11:33:06 AM	19-11-20 11:34:06 AM	00:01:00	44.3	56.0	64.6	68.4	68.5	66.5	63.2	57.8	44.7	34.4
19-11-20 11:34:06 AM	19-11-20 11:35:06 AM	00:01:00	45.9	56.6	64.6	68.5	68.7	66.6	63.3	58.0	44.9	34.3
19-11-20 11:35:06 AM	19-11-20 11:36:06 AM	00:01:00	43.6	55.3	64.3	68.4	68.5	66.6	63.4	57.9	44.5	33.8
19-11-20 11:36:06 AM	19-11-20 11:37:06 AM	00:01:00	44.0	56.1	64.7	68.3	68.5	66.4	63.1	57.9	44.6	33.6
19-11-20 11:37:06 AM	19-11-20 11:38:06 AM	00:01:00	44.1	56.5	64.4	68.4	68.7	66.5	63.2	58.0	45.4	34.2
19-11-20 11:38:06 AM	19-11-20 11:39:06 AM	00:01:00	43.4	56.3	64.4	68.2	68.6	66.6	63.5	58.2	44.9	33.4
19-11-20 11:39:06 AM	19-11-20 11:40:06 AM	00:01:00	44.6	56.8	64.4	68.4	68.5	66.7	63.5	58.2	45.3	34.1
19-11-20 11:40:06 AM	19-11-20 11:41:06 AM	00:01:00	42.8	56.6	64.8	68.2	69.0	66.6	63.5	58.3	45.1	33.5
19-11-20 11:41:06 AM	19-11-20 11:42:06 AM	00:01:00	44.1	56.3	64.6	68.1	68.8	66.7	63.5	58.1	44.9	33.8
19-11-20 11:42:06 AM	19-11-20 11:43:06 AM	00:01:00	45.3	56.7	64.6	68.2	68.7	66.6	63.4	58.0	45.0	34.0
19-11-20 11:43:06 AM	19-11-20 11:44:06 AM	00:01:00	45.2	56.9	64.6	68.4	68.9	66.7	63.5	58.1	44.7	34.0
19-11-20 11:44:06 AM	19-11-20 11:45:06 AM	00:01:00	44.9	56.1	64.4	68.3	68.8	66.6	63.4	58.0	44.9	33.7
19-11-20 11:45:06 AM	19-11-20 11:46:06 AM	00:01:00	42.7	55.8	64.5	68.6	68.6	66.6	63.3	58.0	44.9	34.1
19-11-20 11:46:06 AM	19-11-20 11:47:06 AM	00:01:00	45.4	56.2	64.6	68.5	68.6	66.8	63.4	58.1	45.1	34.1
19-11-20 11:47:06 AM	19-11-20 11:48:06 AM	00:01:00	43.9	55.8	64.4	68.5	68.4	69.6	66.8	61.3	51.4	34.8
19-11-20 11:48:06 AM	19-11-20 11:49:06 AM	00:01:00	43.8	56.4	64.7	68.4	68.7	66.3	63.1	58.1	44.9	34.0
19-11-20 11:49:06 AM	19-11-20 11:50:06 AM	00:01:00	45.2	55.9	64.5	68.7	68.7	66.6	63.2	58.1	44.8	33.9
19-11-20 11:50:06 AM	19-11-20 11:51:06 AM	00:01:00	45.4	56.5	64.9	68.3	68.8	66.4	63.2	58.0	44.7	34.0
19-11-20 11:51:06 AM	19-11-20 11:52:06 AM	00:01:00	45.6	56.1	64.7	68.2	68.7	66.5	63.4	58.2	44.8	34.0
19-11-20 11:52:06 AM	19-11-20 11:53:06 AM	00:01:00	43.4	56.5	64.5	68.3	68.9	66.9	63.6	58.3	44.8	34.0
19-11-20 11:53:06 AM	19-11-20 11:54:06 AM	00:01:00	44.3	56.2	64.4	68.1	68.9	66.6	63.5	58.3	45.0	33.6
Min			**42.7**	**55.3**	**64.3**	**68.0**	**68.3**	**66.2**	**63.0**	**57.8**	**44.5**	**32.9**
Max			**46.5**	**56.9**	**65.1**	**68.7**	**69.0**	**70.5**	**67.0**	**61.3**	**51.4**	**34.8**
Avg			**44.6**	**56.3**	**64.6**	**68.3**	**68.7**	**66.9**	**63.7**	**58.4**	**45.8**	**34.0**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 19/11/2020**
Monitoring Location	**: NML 4 - Princess Sabeeka Oasis: South East of PS 5**
Monitoring Period	**: Weekday Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
19-11-20 10:36:08 AM	19-11-20 10:37:08 AM	00:01:00	60.9	65.7	61.0	65.0	62.5	63.3	62.2	61.4	61.2
19-11-20 10:37:08 AM	19-11-20 10:38:08 AM	00:01:00	60.2	65.0	60.3	64.3	62.0	63.1	61.8	60.7	60.6
19-11-20 10:38:08 AM	19-11-20 10:39:08 AM	00:01:00	60.7	63.8	60.8	63.6	62.1	62.7	62.0	61.0	60.9
19-11-20 10:39:08 AM	19-11-20 10:40:08 AM	00:01:00	59.8	64.1	59.9	64.0	61.6	63.6	61.2	60.3	59.9
19-11-20 10:40:08 AM	19-11-20 10:41:08 AM	00:01:00	60.6	64.2	60.8	64.0	62.5	63.6	62.3	61.6	61.4
19-11-20 10:41:08 AM	19-11-20 10:42:08 AM	00:01:00	60.3	63.3	60.5	63.2	62.0	62.7	62.0	60.9	60.8
19-11-20 10:42:08 AM	19-11-20 10:43:08 AM	00:01:00	61.3	63.1	61.4	63.1	62.3	62.7	62.2	61.6	61.5
19-11-20 10:43:08 AM	19-11-20 10:44:08 AM	00:01:00	60.6	67.8	60.7	66.8	62.7	63.2	62.3	61.5	60.9
19-11-20 10:44:08 AM	19-11-20 10:45:08 AM	00:01:00	61.0	63.4	61.1	63.2	62.2	62.7	62.1	61.5	61.4
19-11-20 10:45:08 AM	19-11-20 10:46:08 AM	00:01:00	60.8	63.1	60.9	62.9	61.9	62.6	61.8	61.1	61.0
19-11-20 10:46:08 AM	19-11-20 10:47:08 AM	00:01:00	60.4	63.0	60.5	62.4	61.3	61.8	61.2	60.8	60.6
19-11-20 10:47:08 AM	19-11-20 10:48:08 AM	00:01:00	60.5	63.7	60.7	63.6	61.9	63.1	61.8	60.9	60.9
19-11-20 10:48:08 AM	19-11-20 10:49:08 AM	00:01:00	60.3	62.7	60.5	62.6	61.3	62.0	61.2	60.7	60.6
19-11-20 10:49:08 AM	19-11-20 10:50:08 AM	00:01:00	60.0	63.3	60.1	63.1	61.3	62.3	61.0	60.3	60.3
19-11-20 10:50:08 AM	19-11-20 10:51:08 AM	00:01:00	60.1	64.6	60.2	63.8	61.1	62.2	60.7	60.3	60.2
19-11-20 10:51:08 AM	19-11-20 10:52:08 AM	00:01:00	60.8	65.3	60.9	64.7	62.1	63.2	61.8	61.1	61.0
19-11-20 10:52:08 AM	19-11-20 10:53:08 AM	00:01:00	59.9	75.1	60.3	74.1	64.0	65.8	61.3	60.5	60.4
19-11-20 10:53:08 AM	19-11-20 10:54:08 AM	00:01:00	60.0	62.8	60.1	62.7	61.1	61.7	61.0	60.4	60.2
19-11-20 10:54:08 AM	19-11-20 10:55:08 AM	00:01:00	60.7	66.0	60.8	65.4	62.4	63.9	62.1	61.1	61.0
19-11-20 10:55:08 AM	19-11-20 10:56:08 AM	00:01:00	60.1	62.8	60.2	62.5	61.3	62.2	61.1	60.5	60.4
19-11-20 10:56:08 AM	19-11-20 10:57:08 AM	00:01:00	60.6	63.5	60.7	63.1	61.6	62.2	61.5	60.9	60.8
19-11-20 10:57:08 AM	19-11-20 10:58:08 AM	00:01:00	59.5	66.1	59.7	65.9	62.3	64.5	62.1	59.8	59.8
19-11-20 10:58:08 AM	19-11-20 10:59:08 AM	00:01:00	59.3	62.4	59.4	62.3	60.6	61.3	60.4	59.6	59.5
19-11-20 10:59:08 AM	19-11-20 11:00:08 AM	00:01:00	59.4	62.2	59.4	61.9	60.6	61.4	60.6	59.7	59.5
19-11-20 11:00:08 AM	19-11-20 11:01:08 AM	00:01:00	58.7	63.5	59.0	62.7	60.2	60.9	59.9	59.4	59.2
19-11-20 11:01:08 AM	19-11-20 11:02:08 AM	00:01:00	59.7	63.2	59.8	62.9	61.2	62.0	61.0	60.5	60.3
19-11-20 11:02:08 AM	19-11-20 11:03:08 AM	00:01:00	60.1	63.2	60.3	62.9	61.7	62.4	61.6	60.8	60.6
19-11-20 11:03:08 AM	19-11-20 11:04:08 AM	00:01:00	59.2	65.6	59.3	65.2	61.4	64.1	60.3	59.5	59.4
19-11-20 11:04:08 AM	19-11-20 11:05:08 AM	00:01:00	58.3	63.9	58.6	63.7	61.2	62.5	61.1	59.4	59.2
19-11-20 11:05:08 AM	19-11-20 11:06:08 AM	00:01:00	59.2	62.2	59.3	62.1	60.6	61.4	60.4	59.7	59.7
Min			**58.3**	**62.2**	**58.6**	**61.9**	**60.2**	**60.9**	**59.9**	**59.4**	**59.2**
Max			**61.3**	**75.1**	**61.4**	**74.1**	**64.0**	**65.8**	**62.3**	**61.6**	**61.5**
Avg			**60.2**	**65.5**	**60.3**	**65.0**	**61.8**	**62.8**	**61.4**	**60.6**	**60.5**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **19/11/2020**
Monitoring Location : **NML 4 - Princess Sabeeka Oasis: South East of PS 5**
Monitoring Period : **Weekday Morning (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
19-11-20 10:36:08 AM	19-11-20 10:37:08 AM	00:01:00	34.3	48.5	51.8	55.7	57.6	55.9	53.5	46.5	34.5	24.4
19-11-20 10:37:08 AM	19-11-20 10:38:08 AM	00:01:00	34.6	47.8	50.8	55.6	56.2	55.5	53.8	47.6	36.0	27.9
19-11-20 10:38:08 AM	19-11-20 10:39:08 AM	00:01:00	34.1	47.1	51.0	55.7	56.2	55.6	53.9	47.4	36.1	28.1
19-11-20 10:39:08 AM	19-11-20 10:40:08 AM	00:01:00	34.3	46.2	51.5	55.8	56.2	54.6	52.7	46.3	35.4	26.0
19-11-20 10:40:08 AM	19-11-20 10:41:08 AM	00:01:00	35.2	49.1	51.9	56.3	57.4	55.1	54.3	47.4	36.5	28.5
19-11-20 10:41:08 AM	19-11-20 10:42:08 AM	00:01:00	35.1	48.2	52.8	55.8	56.7	54.6	52.9	46.8	35.6	27.1
19-11-20 10:42:08 AM	19-11-20 10:43:08 AM	00:01:00	34.3	49.8	52.3	56.0	57.0	55.3	53.2	46.7	34.7	22.3
19-11-20 10:43:08 AM	19-11-20 10:44:08 AM	00:01:00	33.9	47.4	53.2	55.8	57.9	55.6	53.5	47.3	36.0	23.9
19-11-20 10:44:08 AM	19-11-20 10:45:08 AM	00:01:00	34.6	48.9	52.2	55.6	56.5	55.7	53.7	46.8	35.8	28.8
19-11-20 10:45:08 AM	19-11-20 10:46:08 AM	00:01:00	33.6	48.8	52.1	55.6	56.0	55.1	53.1	47.1	35.2	19.5
19-11-20 10:46:08 AM	19-11-20 10:47:08 AM	00:01:00	33.5	46.8	51.4	55.4	55.3	54.3	52.6	46.7	34.9	23.9
19-11-20 10:47:08 AM	19-11-20 10:48:08 AM	00:01:00	34.1	47.9	52.4	56.1	56.4	54.6	53.0	47.8	36.1	25.0
19-11-20 10:48:08 AM	19-11-20 10:49:08 AM	00:01:00	34.5	50.2	51.7	54.5	55.4	54.5	52.7	46.3	34.3	24.8
19-11-20 10:49:08 AM	19-11-20 10:50:08 AM	00:01:00	34.4	47.0	50.5	54.9	55.1	54.9	53.2	46.8	34.8	20.7
19-11-20 10:50:08 AM	19-11-20 10:51:08 AM	00:01:00	34.8	46.6	51.0	54.2	55.0	54.6	53.2	47.0	34.9	23.6
19-11-20 10:51:08 AM	19-11-20 10:52:08 AM	00:01:00	35.3	47.1	50.7	53.6	55.8	55.7	55.8	50.6	37.5	26.6
19-11-20 10:52:08 AM	19-11-20 10:53:08 AM	00:01:00	35.0	47.3	50.6	54.0	56.7	61.1	55.6	47.9	37.2	30.7
19-11-20 10:53:08 AM	19-11-20 10:54:08 AM	00:01:00	34.9	48.2	51.0	55.0	55.2	54.3	52.3	45.6	34.6	28.7
19-11-20 10:54:08 AM	19-11-20 10:55:08 AM	00:01:00	34.1	48.2	51.4	56.0	57.6	55.1	52.3	45.7	32.9	18.3
19-11-20 10:55:08 AM	19-11-20 10:56:08 AM	00:01:00	35.0	46.2	50.2	54.6	56.2	54.8	52.8	46.0	34.8	25.8
19-11-20 10:56:08 AM	19-11-20 10:57:08 AM	00:01:00	34.9	47.4	50.9	54.6	55.8	54.9	54.3	47.8	35.6	26.5
19-11-20 10:57:08 AM	19-11-20 10:58:08 AM	00:01:00	35.0	46.1	50.5	54.0	56.4	56.7	55.4	48.7	36.2	28.3
19-11-20 10:58:08 AM	19-11-20 10:59:08 AM	00:01:00	34.1	46.4	50.5	53.7	55.3	54.7	50.9	43.1	31.2	26.8
19-11-20 10:59:08 AM	19-11-20 11:00:08 AM	00:01:00	34.9	48.0	50.8	53.8	54.9	54.4	51.7	43.6	32.7	28.9
19-11-20 11:00:08 AM	19-11-20 11:01:08 AM	00:01:00	33.7	46.0	49.7	54.0	54.5	54.0	51.3	42.2	29.5	22.9
19-11-20 11:01:08 AM	19-11-20 11:02:08 AM	00:01:00	33.8	48.2	50.5	54.6	56.2	54.8	51.4	43.3	31.5	27.2
19-11-20 11:02:08 AM	19-11-20 11:03:08 AM	00:01:00	34.7	47.0	51.9	55.9	55.9	54.9	52.2	44.0	32.0	28.2
19-11-20 11:03:08 AM	19-11-20 11:04:08 AM	00:01:00	33.5	45.4	51.3	55.4	55.1	54.9	52.6	44.6	30.9	26.5
19-11-20 11:04:08 AM	19-11-20 11:05:08 AM	00:01:00	34.1	45.3	50.2	54.5	56.3	55.1	51.7	43.4	31.7	28.1
19-11-20 11:05:08 AM	19-11-20 11:06:08 AM	00:01:00	33.0	46.1	49.3	53.2	54.6	55.1	52.7	44.4	32.5	27.6
Min			**33.0**	**45.3**	**49.3**	**53.2**	**54.5**	**54.0**	**50.9**	**42.2**	**29.5**	**18.3**
Max			**35.3**	**50.2**	**53.2**	**56.3**	**57.9**	**61.1**	**55.8**	**50.6**	**37.5**	**30.7**
Avg			**34.4**	**47.6**	**51.3**	**55.1**	**56.1**	**55.5**	**53.2**	**46.6**	**34.8**	**26.7**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 19/11/2020**
Monitoring Location	**: NML 5 - Western Boundary of Potline 6**
Monitoring Period	**: Weekday Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
19-11-20 9:26:00 AM	19-11-20 9:27:00 AM	00:01:00	60.7	64.1	60.9	63.5	61.8	62.3	61.7	61.3	61.3
19-11-20 9:27:00 AM	19-11-20 9:28:00 AM	00:01:00	61.4	68.4	61.4	67.5	63.8	65.2	63.7	61.9	61.7
19-11-20 9:28:00 AM	19-11-20 9:29:00 AM	00:01:00	61.1	65.8	61.3	64.9	62.4	63.3	62.1	61.4	61.4
19-11-20 9:29:00 AM	19-11-20 9:30:00 AM	00:01:00	61.0	75.4	61.2	73.7	63.7	65.6	61.7	61.4	61.3
19-11-20 9:30:00 AM	19-11-20 9:31:00 AM	00:01:00	60.6	63.6	61.0	63.2	61.7	62.3	61.5	61.2	61.1
19-11-20 9:31:00 AM	19-11-20 9:32:00 AM	00:01:00	60.6	65.1	60.7	64.7	62.0	63.6	61.5	61.0	60.9
19-11-20 9:32:00 AM	19-11-20 9:33:00 AM	00:01:00	61.2	70.5	61.3	70.2	63.8	66.7	62.0	61.4	61.3
19-11-20 9:33:00 AM	19-11-20 9:34:00 AM	00:01:00	60.8	66.8	60.9	65.8	62.3	63.6	61.9	61.2	61.0
19-11-20 9:34:00 AM	19-11-20 9:35:00 AM	00:01:00	60.6	66.2	60.7	65.5	62.0	63.4	61.5	60.9	60.8
19-11-20 9:35:00 AM	19-11-20 9:36:00 AM	00:01:00	60.3	62.7	60.5	62.3	61.1	61.5	61.0	60.6	60.5
19-11-20 9:36:00 AM	19-11-20 9:37:00 AM	00:01:00	60.5	62.3	60.6	62.1	61.1	61.4	61.0	60.8	60.7
19-11-20 9:37:00 AM	19-11-20 9:38:00 AM	00:01:00	60.1	61.7	60.4	61.5	61.1	61.3	61.0	60.8	60.5
19-11-20 9:38:00 AM	19-11-20 9:39:00 AM	00:01:00	60.7	62.9	60.8	62.7	61.8	62.3	61.6	61.1	60.9
19-11-20 9:39:00 AM	19-11-20 9:40:00 AM	00:01:00	61.0	66.2	61.1	65.9	62.6	65.0	61.7	61.3	61.2
19-11-20 9:40:00 AM	19-11-20 9:41:00 AM	00:01:00	60.6	61.9	60.8	61.7	61.3	61.5	61.2	61.0	61.0
19-11-20 9:41:00 AM	19-11-20 9:42:00 AM	00:01:00	60.5	62.6	60.7	62.3	61.3	61.7	61.2	60.9	60.8
19-11-20 9:42:00 AM	19-11-20 9:43:00 AM	00:01:00	60.8	69.5	60.9	68.6	63.9	67.0	62.3	61.2	60.9
19-11-20 9:43:00 AM	19-11-20 9:44:00 AM	00:01:00	60.4	64.2	60.5	63.9	61.7	63.0	61.2	60.8	60.6
19-11-20 9:44:00 AM	19-11-20 9:45:00 AM	00:01:00	60.9	62.2	61.0	61.9	61.4	61.7	61.4	61.1	61.1
19-11-20 9:45:00 AM	19-11-20 9:46:00 AM	00:01:00	60.4	62.7	60.5	62.4	61.1	61.7	61.0	60.7	60.6
19-11-20 9:46:00 AM	19-11-20 9:47:00 AM	00:01:00	60.7	62.7	60.9	62.6	61.5	62.3	61.4	61.0	60.9
19-11-20 9:47:00 AM	19-11-20 9:48:00 AM	00:01:00	60.3	66.8	60.6	66.2	61.9	62.4	61.4	61.1	61.0
19-11-20 9:48:00 AM	19-11-20 9:49:00 AM	00:01:00	60.4	64.4	60.6	65.0	61.7	62.6	61.4	60.9	60.7
19-11-20 9:49:00 AM	19-11-20 9:50:00 AM	00:01:00	60.7	61.9	60.7	61.7	61.2	61.5	61.2	60.8	60.8
19-11-20 9:50:00 AM	19-11-20 9:51:00 AM	00:01:00	60.8	62.1	60.9	61.9	61.4	61.6	61.3	61.1	61.0
19-11-20 9:51:00 AM	19-11-20 9:52:00 AM	00:01:00	60.5	62.0	60.7	61.7	61.2	61.4	61.1	60.9	60.9
19-11-20 9:52:00 AM	19-11-20 9:53:00 AM	00:01:00	60.7	64.4	60.8	64.2	62.2	63.6	61.8	61.0	60.8
19-11-20 9:53:00 AM	19-11-20 9:54:00 AM	00:01:00	60.7	67.9	60.9	66.9	62.5	64.1	61.8	61.0	60.9
19-11-20 9:54:00 AM	19-11-20 9:55:00 AM	00:01:00	60.4	65.7	60.7	64.5	61.5	62.1	61.1	60.8	60.8
19-11-20 9:55:00 AM	19-11-20 9:56:00 AM	00:01:00	60.6	66.1	60.7	65.1	61.6	62.3	61.2	60.9	60.8
Min			**60.1**	**61.7**	**60.4**	**61.5**	**61.1**	**61.3**	**61.0**	**60.6**	**60.5**
Max			**61.4**	**75.4**	**61.4**	**73.7**	**63.9**	**67.0**	**63.7**	**61.9**	**61.7**
Avg			**60.7**	**66.5**	**60.8**	**65.7**	**62.0**	**63.3**	**61.6**	**61.1**	**60.9**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **19/11/2020**
Monitoring Location : **NML 5 - Western Boundary of Potline 6**
Monitoring Period : **Weekday Morning (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
19-11-20 9:26:00 AM	19-11-20 9:27:00 AM	00:01:00	36.8	47.1	52.7	56.3	55.3	54.3	53.3	48.1	37.8	30.9
19-11-20 9:27:00 AM	19-11-20 9:28:00 AM	00:01:00	38.0	49.2	55.5	58.1	57.5	57.2	53.9	47.5	36.2	30.2
19-11-20 9:28:00 AM	19-11-20 9:29:00 AM	00:01:00	35.6	46.9	53.1	56.7	56.0	55.8	53.5	47.7	36.4	29.5
19-11-20 9:29:00 AM	19-11-20 9:30:00 AM	00:01:00	35.7	46.6	53.2	56.4	55.8	56.8	56.7	55.2	50.5	36.9
19-11-20 9:30:00 AM	19-11-20 9:31:00 AM	00:01:00	34.9	45.8	52.5	56.3	55.1	54.5	53.2	47.8	37.6	29.2
19-11-20 9:31:00 AM	19-11-20 9:32:00 AM	00:01:00	36.0	46.2	52.6	56.5	55.3	55.4	53.2	48.1	38.9	30.0
19-11-20 9:32:00 AM	19-11-20 9:33:00 AM	00:01:00	37.3	47.7	53.6	57.8	57.9	57.0	54.7	50.1	40.2	30.9
19-11-20 9:33:00 AM	19-11-20 9:34:00 AM	00:01:00	37.0	47.4	52.7	56.4	55.5	55.8	54.1	49.4	39.9	31.4
19-11-20 9:34:00 AM	19-11-20 9:35:00 AM	00:01:00	37.6	46.9	52.4	56.0	54.6	55.7	53.3	52.0	40.6	31.9
19-11-20 9:35:00 AM	19-11-20 9:36:00 AM	00:01:00	37.0	46.5	52.2	56.2	54.3	53.9	52.3	46.0	35.2	31.2
19-11-20 9:36:00 AM	19-11-20 9:37:00 AM	00:01:00	38.5	47.2	52.4	56.0	54.3	54.0	52.3	45.9	35.6	32.4
19-11-20 9:37:00 AM	19-11-20 9:38:00 AM	00:01:00	35.9	46.2	52.2	56.0	54.4	53.8	52.1	46.2	35.4	31.1
19-11-20 9:38:00 AM	19-11-20 9:39:00 AM	00:01:00	37.9	46.4	52.9	56.6	55.5	54.5	53.0	46.7	36.1	31.8
19-11-20 9:39:00 AM	19-11-20 9:40:00 AM	00:01:00	36.8	47.3	52.9	56.5	55.8	56.4	55.0	48.6	37.7	31.2
19-11-20 9:40:00 AM	19-11-20 9:41:00 AM	00:01:00	37.1	46.4	52.5	56.0	54.5	53.9	52.9	46.6	35.9	32.0
19-11-20 9:41:00 AM	19-11-20 9:42:00 AM	00:01:00	34.6	46.0	52.2	56.0	54.7	54.0	53.1	46.5	34.7	27.6
19-11-20 9:42:00 AM	19-11-20 9:43:00 AM	00:01:00	34.7	48.5	52.5	56.2	55.7	58.8	57.9	51.3	38.9	29.2
19-11-20 9:43:00 AM	19-11-20 9:44:00 AM	00:01:00	37.7	46.7	52.4	55.7	54.6	54.8	54.5	47.3	35.7	31.9
19-11-20 9:44:00 AM	19-11-20 9:45:00 AM	00:01:00	39.5	47.5	52.3	56.1	54.8	54.0	53.0	46.6	35.9	32.5
19-11-20 9:45:00 AM	19-11-20 9:46:00 AM	00:01:00	34.9	45.6	51.9	55.9	54.3	54.2	52.7	46.2	35.2	30.6
19-11-20 9:46:00 AM	19-11-20 9:47:00 AM	00:01:00	35.0	45.6	52.2	56.1	54.9	54.7	53.2	46.6	35.2	30.0
19-11-20 9:47:00 AM	19-11-20 9:48:00 AM	00:01:00	36.1	46.2	52.4	56.4	55.3	54.7	53.8	47.3	36.4	31.3
19-11-20 9:48:00 AM	19-11-20 9:49:00 AM	00:01:00	39.7	47.2	52.6	56.2	55.3	54.3	53.1	46.7	36.1	32.6
19-11-20 9:49:00 AM	19-11-20 9:50:00 AM	00:01:00	36.1	46.0	52.4	55.7	55.0	53.8	52.6	46.3	35.3	30.9
19-11-20 9:50:00 AM	19-11-20 9:51:00 AM	00:01:00	35.6	46.1	52.5	55.7	55.2	54.1	52.5	46.5	35.5	30.7
19-11-20 9:51:00 AM	19-11-20 9:52:00 AM	00:01:00	34.1	45.7	52.2	55.7	54.8	53.8	52.7	46.5	35.3	29.1
19-11-20 9:52:00 AM	19-11-20 9:53:00 AM	00:01:00	35.4	48.4	53.0	56.1	56.1	55.0	53.8	47.6	36.3	29.0
19-11-20 9:53:00 AM	19-11-20 9:54:00 AM	00:01:00	33.9	48.6	53.4	56.4	55.6	56.0	54.6	48.9	37.3	28.3
19-11-20 9:54:00 AM	19-11-20 9:55:00 AM	00:01:00	37.8	46.7	52.2	56.0	54.8	54.5	52.7	48.3	39.0	31.1
19-11-20 9:55:00 AM	19-11-20 9:56:00 AM	00:01:00	39.7	47.4	52.3	56.0	54.7	55.0	52.5	48.2	39.2	32.9
Min			**33.9**	**45.6**	**51.9**	**55.7**	**54.3**	**53.8**	**52.1**	**45.9**	**34.7**	**27.6**
Max			**39.7**	**49.2**	**55.5**	**58.1**	**57.9**	**58.8**	**57.9**	**55.2**	**50.5**	**36.9**
Avg			**36.9**	**47.0**	**52.7**	**56.3**	**55.3**	**55.2**	**53.8**	**48.5**	**39.5**	**31.3**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 19/11/2020**
Monitoring Location	**: NML 6 - West Boundary of PS5 Block 4**
Monitoring Period	**: Weekday Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
19-11-20 8:50:17 AM	19-11-20 8:51:17 AM	00:01:00	64.0	65.6	64.1	65.4	64.5	64.6	64.4	64.2	64.1
19-11-20 8:51:17 AM	19-11-20 8:52:17 AM	00:01:00	64.8	68.5	64.9	68.0	66.1	67.3	65.7	65.0	64.9
19-11-20 8:52:17 AM	19-11-20 8:53:17 AM	00:01:00	63.6	67.7	63.9	67.5	65.0	67.0	64.5	64.2	63.9
19-11-20 8:53:17 AM	19-11-20 8:54:17 AM	00:01:00	63.8	67.3	63.9	67.0	65.1	65.9	64.8	64.1	64.0
19-11-20 8:54:17 AM	19-11-20 8:55:17 AM	00:01:00	63.6	65.8	63.7	65.6	64.4	64.8	64.3	63.9	63.8
19-11-20 8:55:17 AM	19-11-20 8:56:17 AM	00:01:00	63.4	65.5	63.5	65.2	64.4	64.8	64.3	63.9	63.8
19-11-20 8:56:17 AM	19-11-20 8:57:17 AM	00:01:00	63.7	64.6	63.8	64.5	64.2	64.3	64.1	63.9	63.9
19-11-20 8:57:17 AM	19-11-20 8:58:17 AM	00:01:00	63.6	64.8	63.7	64.8	64.2	64.5	64.2	63.8	63.8
19-11-20 8:58:17 AM	19-11-20 8:59:17 AM	00:01:00	63.7	64.9	63.8	64.8	64.3	64.5	64.3	63.9	63.8
19-11-20 8:59:17 AM	19-11-20 9:00:17 AM	00:01:00	63.8	65.1	63.9	65.1	64.4	64.8	64.3	64.1	64.0
19-11-20 9:00:17 AM	19-11-20 9:01:17 AM	00:01:00	63.9	64.6	64.0	64.6	64.3	64.4	64.3	64.1	64.0
19-11-20 9:01:17 AM	19-11-20 9:02:17 AM	00:01:00	63.8	64.7	63.9	64.6	64.3	64.4	64.2	64.1	64.0
19-11-20 9:02:17 AM	19-11-20 9:03:17 AM	00:01:00	63.4	64.6	63.6	64.6	64.1	64.4	64.1	63.7	63.7
19-11-20 9:03:17 AM	19-11-20 9:04:17 AM	00:01:00	63.8	65.0	63.9	64.8	64.4	64.6	64.3	64.0	63.9
19-11-20 9:04:17 AM	19-11-20 9:05:17 AM	00:01:00	63.6	65.1	63.8	65.0	64.3	64.7	64.2	64.1	64.0
19-11-20 9:05:17 AM	19-11-20 9:06:17 AM	00:01:00	63.4	64.7	63.6	64.6	64.2	64.4	64.1	63.8	63.7
19-11-20 9:06:17 AM	19-11-20 9:07:17 AM	00:01:00	63.6	64.8	63.7	64.7	64.2	64.5	64.2	63.9	63.9
19-11-20 9:07:17 AM	19-11-20 9:08:17 AM	00:01:00	63.6	64.9	63.7	64.9	64.3	64.7	64.1	63.9	63.8
19-11-20 9:08:17 AM	19-11-20 9:09:17 AM	00:01:00	63.6	65.6	63.7	65.2	64.2	64.3	64.1	63.9	63.9
19-11-20 9:09:17 AM	19-11-20 9:10:17 AM	00:01:00	63.8	65.1	63.9	64.9	64.3	64.5	64.3	64.1	64.0
19-11-20 9:10:17 AM	19-11-20 9:11:17 AM	00:01:00	63.6	65.0	63.7	64.7	64.3	64.6	64.2	63.9	63.8
19-11-20 9:11:17 AM	19-11-20 9:12:17 AM	00:01:00	63.3	65.2	63.6	64.9	64.2	64.5	64.1	63.9	63.9
19-11-20 9:12:17 AM	19-11-20 9:13:17 AM	00:01:00	63.6	64.8	63.7	64.7	64.2	64.5	64.2	63.9	63.8
19-11-20 9:13:17 AM	19-11-20 9:14:17 AM	00:01:00	63.6	66.7	63.7	66.0	64.3	64.6	64.2	63.9	63.9
19-11-20 9:14:17 AM	19-11-20 9:15:17 AM	00:01:00	63.7	65.8	63.8	65.4	64.4	64.7	64.3	64.0	63.9
19-11-20 9:15:17 AM	19-11-20 9:16:17 AM	00:01:00	63.5	65.0	63.6	64.9	64.1	64.5	64.0	63.8	63.8
19-11-20 9:16:17 AM	19-11-20 9:17:17 AM	00:01:00	63.6	64.6	63.7	64.5	64.1	64.3	64.1	63.7	63.7
19-11-20 9:17:17 AM	19-11-20 9:18:17 AM	00:01:00	63.6	65.1	63.7	64.9	64.2	64.7	64.1	63.9	63.8
19-11-20 9:18:17 AM	19-11-20 9:19:17 AM	00:01:00	63.3	64.5	63.5	64.4	64.0	64.2	64.0	63.6	63.6
19-11-20 9:19:17 AM	19-11-20 9:20:17 AM	00:01:00	63.6	64.7	63.7	64.6	64.1	64.3	64.1	63.7	63.7
Min			**63.3**	**64.5**	**63.5**	**64.4**	**64.0**	**64.2**	**64.0**	**63.6**	**63.6**
Max			**64.8**	**68.5**	**64.9**	**68.0**	**66.1**	**67.3**	**65.7**	**65.0**	**64.9**
Avg			**63.7**	**65.5**	**63.8**	**65.3**	**64.4**	**64.8**	**64.3**	**64.0**	**63.9**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **19/11/2020**
Monitoring Location : **NML 6 - West Boundary of PS5 Block 4**
Monitoring Period : **Weekday Morning (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
19-11-20 8:50:17 AM	19-11-20 8:51:17 AM	00:01:00	40.9	47.8	52.4	57.2	59.0	59.1	55.8	49.7	37.0	32.0
19-11-20 8:51:17 AM	19-11-20 8:52:17 AM	00:01:00	40.3	50.4	52.5	58.7	60.9	60.8	57.6	50.3	36.6	30.5
19-11-20 8:52:17 AM	19-11-20 8:53:17 AM	00:01:00	39.7	48.8	52.9	57.9	59.5	59.6	56.7	50.0	36.5	30.4
19-11-20 8:53:17 AM	19-11-20 8:54:17 AM	00:01:00	40.3	48.4	52.2	57.7	59.8	59.9	56.1	50.2	37.1	32.1
19-11-20 8:54:17 AM	19-11-20 8:55:17 AM	00:01:00	38.9	47.8	52.0	57.3	58.9	59.2	55.1	49.9	36.8	31.5
19-11-20 8:55:17 AM	19-11-20 8:56:17 AM	00:01:00	39.3	48.0	51.9	57.7	59.0	59.0	55.1	50.1	36.6	31.1
19-11-20 8:56:17 AM	19-11-20 8:57:17 AM	00:01:00	38.6	47.6	51.8	57.2	58.7	58.8	55.3	50.2	36.8	30.8
19-11-20 8:57:17 AM	19-11-20 8:58:17 AM	00:01:00	38.5	47.3	51.9	57.1	58.7	59.0	55.2	50.0	37.2	31.6
19-11-20 8:58:17 AM	19-11-20 8:59:17 AM	00:01:00	38.0	47.8	52.5	57.4	58.8	58.8	55.2	49.7	36.7	29.0
19-11-20 8:59:17 AM	19-11-20 9:00:17 AM	00:01:00	38.2	47.8	52.0	57.3	58.9	59.3	55.4	49.9	37.0	30.3
19-11-20 9:00:17 AM	19-11-20 9:01:17 AM	00:01:00	38.9	47.7	52.0	57.2	58.9	59.1	55.2	49.8	37.0	31.1
19-11-20 9:01:17 AM	19-11-20 9:02:17 AM	00:01:00	39.5	48.1	52.2	57.1	58.9	59.0	55.1	49.7	36.9	31.5
19-11-20 9:02:17 AM	19-11-20 9:03:17 AM	00:01:00	38.8	47.9	51.6	57.1	58.7	58.7	55.3	50.7	37.0	30.6
19-11-20 9:03:17 AM	19-11-20 9:04:17 AM	00:01:00	38.1	47.6	52.1	57.2	58.9	59.2	55.4	50.2	37.1	30.0
19-11-20 9:04:17 AM	19-11-20 9:05:17 AM	00:01:00	39.0	47.7	52.1	57.1	58.9	59.2	55.3	49.9	36.9	30.3
19-11-20 9:05:17 AM	19-11-20 9:06:17 AM	00:01:00	38.5	47.4	51.7	57.1	58.8	58.8	55.1	49.8	36.7	30.1
19-11-20 9:06:17 AM	19-11-20 9:07:17 AM	00:01:00	38.1	47.2	51.8	57.2	58.9	58.9	55.3	50.3	36.8	30.0
19-11-20 9:07:17 AM	19-11-20 9:08:17 AM	00:01:00	38.6	47.6	51.8	57.3	58.9	59.1	55.0	49.9	36.5	30.0
19-11-20 9:08:17 AM	19-11-20 9:09:17 AM	00:01:00	37.9	47.3	51.5	57.0	59.0	59.0	54.9	49.4	36.2	30.5
19-11-20 9:09:17 AM	19-11-20 9:10:17 AM	00:01:00	38.2	47.6	51.8	57.2	59.1	59.2	54.9	49.3	36.3	30.4
19-11-20 9:10:17 AM	19-11-20 9:11:17 AM	00:01:00	38.6	47.7	51.9	57.0	58.9	59.3	54.9	49.1	36.5	31.5
19-11-20 9:11:17 AM	19-11-20 9:12:17 AM	00:01:00	39.0	47.7	51.5	57.1	58.8	59.3	54.7	48.8	36.5	31.6
19-11-20 9:12:17 AM	19-11-20 9:13:17 AM	00:01:00	38.7	47.5	51.6	57.2	58.9	59.2	54.7	48.7	36.1	31.0
19-11-20 9:13:17 AM	19-11-20 9:14:17 AM	00:01:00	38.5	47.6	51.6	57.3	59.2	59.1	55.0	49.4	36.7	30.8
19-11-20 9:14:17 AM	19-11-20 9:15:17 AM	00:01:00	41.6	49.4	52.3	57.2	59.0	59.4	54.7	48.7	37.0	32.7
19-11-20 9:15:17 AM	19-11-20 9:16:17 AM	00:01:00	41.3	48.5	51.9	57.2	59.0	58.7	54.8	48.7	36.2	31.6
19-11-20 9:16:17 AM	19-11-20 9:17:17 AM	00:01:00	38.9	47.2	51.5	57.3	58.8	58.9	54.7	48.5	35.6	29.6
19-11-20 9:17:17 AM	19-11-20 9:18:17 AM	00:01:00	38.5	47.9	52.1	57.2	58.9	58.9	54.9	48.8	36.2	31.2
19-11-20 9:18:17 AM	19-11-20 9:19:17 AM	00:01:00	38.4	47.5	51.6	57.1	58.9	58.6	54.7	48.5	36.2	31.8
19-11-20 9:19:17 AM	19-11-20 9:20:17 AM	00:01:00	39.1	47.4	51.6	57.2	58.9	58.8	54.8	48.6	36.4	32.3
Min			**37.9**	**47.2**	**51.5**	**57.0**	**58.7**	**58.6**	**54.7**	**48.5**	**35.6**	**29.0**
Max			**41.6**	**50.4**	**52.9**	**58.7**	**60.9**	**60.8**	**57.6**	**50.7**	**37.2**	**32.7**
Avg			**39.1**	**47.9**	**52.0**	**57.3**	**59.0**	**59.2**	**55.3**	**49.6**	**36.7**	**31.0**

Project : Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)
Monitoring Date : 20/11/2020
Monitoring Location : NML 1 - Accommodation and Recreational Area North of PS 5
Monitoring Period : Weekday - Night (Logged Broadband Data)

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
20-11-20 1:38:10 AM	20-11-20 1:39:10 AM	00:01:00	64.3	67.1	64.5	67.0	65.5	66.4	65.4	64.8	64.7
20-11-20 1:39:10 AM	20-11-20 1:40:10 AM	00:01:00	64.8	71.0	64.9	70.5	66.3	68.4	65.4	65.0	65.0
20-11-20 1:40:10 AM	20-11-20 1:41:10 AM	00:01:00	64.7	66.0	64.8	65.9	65.4	65.7	65.3	65.0	64.9
20-11-20 1:41:10 AM	20-11-20 1:42:10 AM	00:01:00	64.6	69.6	64.8	69.5	66.2	68.1	65.7	64.9	64.9
20-11-20 1:42:10 AM	20-11-20 1:43:10 AM	00:01:00	64.7	66.1	64.8	66.7	65.3	65.6	65.1	64.9	64.8
20-11-20 1:43:10 AM	20-11-20 1:44:10 AM	00:01:00	64.7	65.9	64.8	65.8	65.3	65.6	65.3	65.0	64.9
20-11-20 1:44:10 AM	20-11-20 1:45:10 AM	00:01:00	64.7	66.3	64.9	66.1	65.4	65.7	65.3	64.9	64.8
20-11-20 1:45:10 AM	20-11-20 1:46:10 AM	00:01:00	64.4	66.4	64.4	66.3	65.2	65.6	65.1	64.6	64.6
20-11-20 1:46:10 AM	20-11-20 1:47:10 AM	00:01:00	64.7	67.2	64.8	66.7	65.5	65.9	65.4	65.0	64.9
20-11-20 1:47:10 AM	20-11-20 1:48:10 AM	00:01:00	64.9	70.8	65.1	70.2	66.3	68.4	65.7	65.2	65.2
20-11-20 1:48:10 AM	20-11-20 1:49:10 AM	00:01:00	64.5	68.1	64.6	68.2	65.3	66.2	65.0	64.6	64.6
20-11-20 1:49:10 AM	20-11-20 1:50:10 AM	00:01:00	63.7	65.9	63.8	65.7	64.6	64.9	64.5	64.0	63.9
20-11-20 1:50:10 AM	20-11-20 1:51:10 AM	00:01:00	63.8	65.1	64.0	65.0	64.7	64.9	64.7	64.2	64.1
20-11-20 1:51:10 AM	20-11-20 1:52:10 AM	00:01:00	64.2	66.5	64.3	66.0	64.7	65.4	64.6	64.3	64.3
20-11-20 1:52:10 AM	20-11-20 1:53:10 AM	00:01:00	63.9	65.4	64.1	65.2	64.7	65.0	64.6	64.3	64.2
20-11-20 1:53:10 AM	20-11-20 1:54:10 AM	00:01:00	64.3	70.3	64.4	70.2	66.2	69.3	65.0	64.5	64.4
20-11-20 1:54:10 AM	20-11-20 1:55:10 AM	00:01:00	64.2	65.5	64.3	65.4	64.9	65.2	64.8	64.5	64.4
20-11-20 1:55:10 AM	20-11-20 1:56:10 AM	00:01:00	64.2	65.4	64.5	65.4	65.0	65.2	64.9	64.6	64.6
20-11-20 1:56:10 AM	20-11-20 1:57:10 AM	00:01:00	64.1	66.7	64.3	66.2	65.0	65.2	65.0	64.6	64.4
20-11-20 1:57:10 AM	20-11-20 1:58:10 AM	00:01:00	64.3	65.8	64.4	65.6	65.0	65.4	65.0	64.6	64.6
20-11-20 1:58:10 AM	20-11-20 1:59:10 AM	00:01:00	64.4	66.4	64.5	66.2	65.2	65.6	65.0	64.6	64.6
20-11-20 1:59:10 AM	20-11-20 2:00:10 AM	00:01:00	64.7	66.1	64.7	65.9	65.2	65.6	65.1	64.9	64.8
20-11-20 2:00:10 AM	20-11-20 2:01:10 AM	00:01:00	64.2	65.6	64.4	65.5	65.0	65.3	65.0	64.6	64.6
20-11-20 2:01:10 AM	20-11-20 2:02:10 AM	00:01:00	64.3	66.0	64.4	65.6	65.0	65.4	65.0	64.7	64.4
20-11-20 2:02:10 AM	20-11-20 2:03:10 AM	00:01:00	64.3	65.3	64.4	65.2	64.8	65.0	64.7	64.5	64.4
20-11-20 2:03:10 AM	20-11-20 2:04:10 AM	00:01:00	64.0	66.0	64.1	65.7	64.9	65.4	64.9	64.3	64.2
20-11-20 2:04:10 AM	20-11-20 2:05:10 AM	00:01:00	64.5	66.1	64.6	65.8	65.2	65.6	65.1	64.8	64.7
20-11-20 2:05:10 AM	20-11-20 2:06:10 AM	00:01:00	64.3	66.0	64.5	65.7	65.1	65.5	65.1	64.6	64.5
20-11-20 2:06:10 AM	20-11-20 2:07:10 AM	00:01:00	64.4	66.2	64.5	65.8	65.1	65.5	65.1	64.7	64.5
20-11-20 2:07:10 AM	20-11-20 2:08:10 AM	00:01:00	64.0	65.6	64.0	65.4	64.8	65.2	64.9	64.2	64.1
Min			**63.7**	**65.1**	**63.8**	**65.0**	**64.6**	**64.9**	**64.5**	**64.0**	**63.9**
Max			**64.9**	**71.0**	**65.1**	**70.5**	**66.3**	**69.3**	**65.7**	**65.2**	**65.2**
Avg			**64.4**	**67.0**	**64.5**	**66.8**	**65.3**	**66.0**	**65.1**	**64.7**	**64.6**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 20/11/2020**
Monitoring Location	**: NML 1 - Accommodation and Recreational Area North of PS 5**
Monitoring Period	**: Weekday - Night (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
20-11-20 1:38:10 AM	20-11-20 1:39:10 AM	00:01:00	33.5	50.5	54.7	57.8	56.8	59.2	59.8	54.8	36.2	19.0
20-11-20 1:39:10 AM	20-11-20 1:40:10 AM	00:01:00	33.5	50.4	54.3	57.7	59.3	60.6	59.9	54.7	35.8	18.1
20-11-20 1:40:10 AM	20-11-20 1:41:10 AM	00:01:00	33.3	50.8	54.3	57.9	56.0	59.5	59.6	54.5	35.5	18.0
20-11-20 1:41:10 AM	20-11-20 1:42:10 AM	00:01:00	33.7	50.5	54.7	59.5	58.3	59.9	60.0	55.0	37.5	19.2
20-11-20 1:42:10 AM	20-11-20 1:43:10 AM	00:01:00	33.6	50.5	54.4	58.0	55.7	59.2	59.6	54.4	34.9	18.1
20-11-20 1:43:10 AM	20-11-20 1:44:10 AM	00:01:00	33.7	48.6	54.3	57.4	55.9	59.8	59.8	54.7	35.1	17.6
20-11-20 1:44:10 AM	20-11-20 1:45:10 AM	00:01:00	33.5	50.4	54.3	57.5	55.7	59.7	59.7	54.6	35.0	17.9
20-11-20 1:45:10 AM	20-11-20 1:46:10 AM	00:01:00	33.3	49.7	54.3	57.6	55.3	59.7	59.6	54.2	34.7	17.6
20-11-20 1:46:10 AM	20-11-20 1:47:10 AM	00:01:00	33.2	49.9	54.2	57.8	55.7	59.8	59.8	55.1	37.2	17.8
20-11-20 1:47:10 AM	20-11-20 1:48:10 AM	00:01:00	33.6	51.1	55.5	59.3	57.9	59.9	60.1	55.1	37.3	20.5
20-11-20 1:48:10 AM	20-11-20 1:49:10 AM	00:01:00	33.6	50.4	54.4	57.9	55.7	59.7	59.5	54.4	40.0	19.2
20-11-20 1:49:10 AM	20-11-20 1:50:10 AM	00:01:00	34.0	49.1	54.0	57.3	54.7	58.8	58.8	53.8	34.4	17.7
20-11-20 1:50:10 AM	20-11-20 1:51:10 AM	00:01:00	33.4	50.4	54.1	57.3	54.9	58.6	59.0	53.9	34.9	18.3
20-11-20 1:51:10 AM	20-11-20 1:52:10 AM	00:01:00	33.5	50.6	54.0	57.3	54.9	58.5	59.1	54.5	36.3	18.2
20-11-20 1:52:10 AM	20-11-20 1:53:10 AM	00:01:00	33.0	49.6	53.9	57.5	54.7	58.5	59.1	54.2	34.8	17.6
20-11-20 1:53:10 AM	20-11-20 1:54:10 AM	00:01:00	33.2	51.6	54.8	60.0	58.5	59.1	59.5	54.8	37.2	20.1
20-11-20 1:54:10 AM	20-11-20 1:55:10 AM	00:01:00	34.0	50.1	54.3	57.6	55.2	58.5	59.4	54.3	35.1	18.0
20-11-20 1:55:10 AM	20-11-20 1:56:10 AM	00:01:00	33.2	50.2	54.1	57.5	55.3	58.9	59.5	54.4	35.0	18.4
20-11-20 1:56:10 AM	20-11-20 1:57:10 AM	00:01:00	33.4	50.0	54.1	57.5	55.4	59.1	59.4	54.7	36.7	17.9
20-11-20 1:57:10 AM	20-11-20 1:58:10 AM	00:01:00	33.6	50.0	54.2	57.6	55.3	59.2	59.4	54.3	34.9	18.1
20-11-20 1:58:10 AM	20-11-20 1:59:10 AM	00:01:00	33.7	50.2	54.3	57.6	55.4	59.2	59.7	54.5	35.2	18.4
20-11-20 1:59:10 AM	20-11-20 2:00:10 AM	00:01:00	33.9	50.7	54.3	57.3	55.2	59.5	59.8	54.5	35.2	18.6
20-11-20 2:00:10 AM	20-11-20 2:01:10 AM	00:01:00	33.3	50.3	54.0	57.4	55.2	59.4	59.3	54.2	34.9	17.9
20-11-20 2:01:10 AM	20-11-20 2:02:10 AM	00:01:00	33.7	50.7	54.1	57.5	55.3	59.2	59.2	54.6	36.5	17.9
20-11-20 2:02:10 AM	20-11-20 2:03:10 AM	00:01:00	33.3	49.5	54.1	57.4	55.1	59.1	59.0	54.1	34.8	17.7
20-11-20 2:03:10 AM	20-11-20 2:04:10 AM	00:01:00	34.0	49.7	54.2	57.3	55.2	58.9	59.3	54.3	35.0	17.5
20-11-20 2:04:10 AM	20-11-20 2:05:10 AM	00:01:00	34.5	51.1	54.5	57.5	55.5	59.2	59.5	54.3	35.0	18.4
20-11-20 2:05:10 AM	20-11-20 2:06:10 AM	00:01:00	33.2	50.0	54.1	57.5	55.5	59.2	59.6	54.4	35.0	17.5
20-11-20 2:06:10 AM	20-11-20 2:07:10 AM	00:01:00	33.5	50.1	54.1	57.5	55.1	59.3	59.6	54.7	36.1	18.0
20-11-20 2:07:10 AM	20-11-20 2:08:10 AM	00:01:00	33.6	49.8	53.9	57.3	55.1	58.8	59.4	54.1	34.8	18.2
Min			**33.0**	**48.6**	**53.9**	**57.3**	**54.7**	**58.5**	**58.8**	**53.8**	**34.4**	**17.5**
Max			**34.5**	**51.6**	**55.5**	**60.0**	**59.3**	**60.6**	**60.1**	**55.1**	**40.0**	**20.5**
Avg			**33.6**	**50.3**	**54.3**	**57.8**	**56.0**	**59.3**	**59.5**	**54.5**	**35.9**	**18.3**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **20/11/2020**
Monitoring Location : **NML 2 - North East Boundary of PS 5**
Monitoring Period : **Weekday Night (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
20-11-20 12:45:35 AM	20-11-20 12:46:35 AM	00:01:00	70.1	70.6	70.2	70.5	70.4	70.5	70.4	70.3	70.3
20-11-20 12:46:35 AM	20-11-20 12:47:35 AM	00:01:00	70.1	77.1	70.2	76.3	71.0	70.8	70.6	70.3	70.2
20-11-20 12:47:35 AM	20-11-20 12:48:35 AM	00:01:00	69.8	70.6	70.0	70.6	70.4	70.5	70.4	70.2	70.2
20-11-20 12:48:35 AM	20-11-20 12:49:35 AM	00:01:00	70.1	70.9	70.1	70.8	70.5	70.7	70.5	70.2	70.1
20-11-20 12:49:35 AM	20-11-20 12:50:35 AM	00:01:00	70.0	70.9	70.1	70.8	70.5	70.7	70.5	70.2	70.1
20-11-20 12:50:35 AM	20-11-20 12:51:35 AM	00:01:00	70.0	70.7	70.0	70.6	70.4	70.6	70.4	70.1	70.1
20-11-20 12:51:35 AM	20-11-20 12:52:35 AM	00:01:00	69.9	78.2	70.0	77.3	71.1	71.4	70.2	70.1	70.0
20-11-20 12:52:35 AM	20-11-20 12:53:35 AM	00:01:00	70.0	70.9	70.1	70.8	70.6	70.7	70.5	70.3	70.2
20-11-20 12:53:35 AM	20-11-20 12:54:35 AM	00:01:00	70.2	70.7	70.2	70.6	70.4	70.5	70.4	70.3	70.2
20-11-20 12:54:35 AM	20-11-20 12:55:35 AM	00:01:00	70.0	70.6	70.1	70.5	70.2	70.3	70.2	70.1	70.0
20-11-20 12:55:35 AM	20-11-20 12:56:35 AM	00:01:00	70.2	71.0	70.2	70.8	70.4	70.5	70.4	70.3	70.2
20-11-20 12:56:35 AM	20-11-20 12:57:35 AM	00:01:00	70.1	78.0	70.2	77.3	71.1	70.9	70.4	70.3	70.3
20-11-20 12:57:35 AM	20-11-20 12:58:35 AM	00:01:00	70.1	70.7	70.1	70.6	70.4	70.5	70.3	70.1	70.1
20-11-20 12:58:35 AM	20-11-20 12:59:35 AM	00:01:00	70.2	71.0	70.2	70.9	70.6	70.7	70.5	70.3	70.2
20-11-20 12:59:35 AM	20-11-20 1:00:35 AM	00:01:00	70.2	71.0	70.2	70.9	70.5	70.6	70.4	70.3	70.2
20-11-20 1:00:35 AM	20-11-20 1:01:35 AM	00:01:00	70.0	70.6	70.1	70.6	70.3	70.4	70.3	70.2	70.1
20-11-20 1:01:35 AM	20-11-20 1:02:35 AM	00:01:00	70.1	78.2	70.2	77.6	71.3	71.4	70.5	70.3	70.3
20-11-20 1:02:35 AM	20-11-20 1:03:35 AM	00:01:00	70.1	70.8	70.1	70.8	70.5	70.6	70.5	70.2	70.2
20-11-20 1:03:35 AM	20-11-20 1:04:35 AM	00:01:00	70.0	70.8	70.1	70.8	70.4	70.6	70.4	70.2	70.1
20-11-20 1:04:35 AM	20-11-20 1:05:35 AM	00:01:00	69.9	70.8	70.0	70.7	70.4	70.5	70.4	70.0	70.0
20-11-20 1:05:35 AM	20-11-20 1:06:35 AM	00:01:00	70.1	71.0	70.2	70.9	70.5	70.8	70.4	70.2	70.2
20-11-20 1:06:35 AM	20-11-20 1:07:35 AM	00:01:00	70.1	78.0	70.1	77.4	71.2	71.2	70.4	70.2	70.1
20-11-20 1:07:35 AM	20-11-20 1:08:35 AM	00:01:00	69.9	70.9	69.9	70.8	70.3	70.6	70.3	69.9	69.9
20-11-20 1:08:35 AM	20-11-20 1:09:35 AM	00:01:00	70.0	71.0	70.2	70.9	70.6	70.7	70.5	70.3	70.3
20-11-20 1:09:35 AM	20-11-20 1:10:35 AM	00:01:00	69.9	70.7	70.0	70.6	70.3	70.4	70.3	70.1	70.0
20-11-20 1:10:35 AM	20-11-20 1:11:35 AM	00:01:00	70.0	70.7	70.0	70.7	70.3	70.5	70.3	70.1	70.0
20-11-20 1:11:35 AM	20-11-20 1:12:35 AM	00:01:00	70.2	76.9	70.2	76.4	71.0	71.0	70.4	70.2	70.2
20-11-20 1:12:35 AM	20-11-20 1:13:35 AM	00:01:00	69.8	71.0	69.9	70.9	70.4	70.6	70.4	69.9	69.9
20-11-20 1:13:35 AM	20-11-20 1:14:35 AM	00:01:00	69.9	70.7	69.9	70.6	70.3	70.5	70.3	70.0	70.0
20-11-20 1:14:35 AM	20-11-20 1:15:35 AM	00:01:00	70.1	70.9	70.2	70.9	70.5	70.7	70.5	70.2	70.2
Min			**69.8**	**70.6**	**69.9**	**70.5**	**70.2**	**70.3**	**70.2**	**69.9**	**69.9**
Max			**70.2**	**78.2**	**70.2**	**77.6**	**71.3**	**71.4**	**70.6**	**70.3**	**70.3**
Avg			**70.0**	**73.3**	**70.1**	**72.9**	**70.6**	**70.7**	**70.4**	**70.2**	**70.1**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **20/11/2020**
Monitoring Location : **NML 2 - North East Boundary of PS 5**
Monitoring Period : **Weekday Night (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
20-11-20 12:45:35 AM	20-11-20 12:46:35 AM	00:01:00	40.0	55.6	56.9	57.9	62.8	64.8	64.9	61.2	53.7	32.4
20-11-20 12:46:35 AM	20-11-20 12:47:35 AM	00:01:00	39.8	56.7	56.8	58.1	62.6	65.0	65.4	63.2	57.0	35.9
20-11-20 12:47:35 AM	20-11-20 12:48:35 AM	00:01:00	39.8	55.5	56.7	58.1	62.5	64.9	65.0	61.3	53.7	32.4
20-11-20 12:48:35 AM	20-11-20 12:49:35 AM	00:01:00	40.0	55.0	56.5	58.1	62.6	65.0	65.2	61.4	53.7	32.2
20-11-20 12:49:35 AM	20-11-20 12:50:35 AM	00:01:00	40.9	57.1	57.2	58.2	62.5	64.9	65.0	61.2	53.8	32.8
20-11-20 12:50:35 AM	20-11-20 12:51:35 AM	00:01:00	40.5	56.1	56.8	58.2	62.4	64.9	65.0	61.1	54.0	32.9
20-11-20 12:51:35 AM	20-11-20 12:52:35 AM	00:01:00	40.2	54.6	56.5	58.0	62.4	64.8	65.7	63.9	58.0	36.7
20-11-20 12:52:35 AM	20-11-20 12:53:35 AM	00:01:00	40.2	57.3	57.1	58.0	62.5	64.8	65.1	61.3	54.1	33.2
20-11-20 12:53:35 AM	20-11-20 12:54:35 AM	00:01:00	40.5	56.6	56.8	58.0	62.5	64.7	65.1	61.2	53.9	33.0
20-11-20 12:54:35 AM	20-11-20 12:55:35 AM	00:01:00	40.5	54.7	56.3	58.0	62.4	64.6	64.9	61.1	53.6	32.1
20-11-20 12:55:35 AM	20-11-20 12:56:35 AM	00:01:00	40.0	56.4	57.1	58.0	62.5	64.7	65.1	61.2	53.8	32.6
20-11-20 12:56:35 AM	20-11-20 12:57:35 AM	00:01:00	40.7	56.6	56.7	58.0	62.6	64.8	65.6	63.8	57.8	36.7
20-11-20 12:57:35 AM	20-11-20 12:58:35 AM	00:01:00	40.4	54.9	56.2	58.2	62.6	64.8	65.0	61.2	53.8	32.7
20-11-20 12:58:35 AM	20-11-20 12:59:35 AM	00:01:00	39.9	56.6	56.6	58.0	62.7	64.9	65.1	61.3	53.8	32.7
20-11-20 12:59:35 AM	20-11-20 1:00:35 AM	00:01:00	41.2	57.3	56.8	58.2	62.5	64.8	64.9	61.2	53.8	32.9
20-11-20 1:00:35 AM	20-11-20 1:01:35 AM	00:01:00	39.3	54.6	56.5	58.0	62.5	64.9	65.0	61.2	53.6	32.1
20-11-20 1:01:35 AM	20-11-20 1:02:35 AM	00:01:00	40.6	56.3	56.9	58.0	62.5	64.9	65.8	64.2	58.3	37.5
20-11-20 1:02:35 AM	20-11-20 1:03:35 AM	00:01:00	39.5	57.6	57.1	57.9	62.4	64.7	65.0	61.3	53.9	32.7
20-11-20 1:03:35 AM	20-11-20 1:04:35 AM	00:01:00	40.6	55.3	56.6	58.1	62.6	64.8	65.1	61.4	53.9	32.5
20-11-20 1:04:35 AM	20-11-20 1:05:35 AM	00:01:00	39.9	55.3	56.5	58.0	62.5	64.8	65.0	61.3	53.9	32.5
20-11-20 1:05:35 AM	20-11-20 1:06:35 AM	00:01:00	40.2	57.6	57.1	58.0	62.4	64.7	65.0	61.3	53.9	32.9
20-11-20 1:06:35 AM	20-11-20 1:07:35 AM	00:01:00	40.7	55.9	56.9	58.3	62.6	64.8	65.7	64.0	58.0	37.1
20-11-20 1:07:35 AM	20-11-20 1:08:35 AM	00:01:00	40.0	55.1	56.5	58.1	62.5	64.8	65.0	61.0	53.7	32.3
20-11-20 1:08:35 AM	20-11-20 1:09:35 AM	00:01:00	40.3	57.3	56.9	58.0	62.5	64.8	65.2	61.3	53.9	32.9
20-11-20 1:09:35 AM	20-11-20 1:10:35 AM	00:01:00	40.3	56.6	56.7	57.9	62.4	64.5	64.9	61.0	53.7	32.8
20-11-20 1:10:35 AM	20-11-20 1:11:35 AM	00:01:00	41.3	54.4	56.5	58.1	62.5	64.7	65.1	61.2	53.8	32.9
20-11-20 1:11:35 AM	20-11-20 1:12:35 AM	00:01:00	40.6	57.3	57.0	58.0	62.5	64.6	65.5	63.5	57.4	36.5
20-11-20 1:12:35 AM	20-11-20 1:13:35 AM	00:01:00	40.3	56.5	56.7	58.0	62.5	64.6	65.0	61.2	54.1	33.3
20-11-20 1:13:35 AM	20-11-20 1:14:35 AM	00:01:00	41.3	55.1	56.3	58.0	62.4	64.7	65.1	61.2	54.2	33.1
20-11-20 1:14:35 AM	20-11-20 1:15:35 AM	00:01:00	40.5	57.6	56.9	58.1	62.6	64.8	65.0	61.2	54.2	33.4
Min			**39.3**	**54.4**	**56.2**	**57.9**	**62.4**	**64.5**	**64.9**	**61.0**	**53.6**	**32.1**
Max			**41.3**	**57.6**	**57.2**	**58.3**	**62.8**	**65.0**	**65.8**	**64.2**	**58.3**	**37.5**
Avg			**40.4**	**56.2**	**56.7**	**58.1**	**62.5**	**64.8**	**65.2**	**61.9**	**55.0**	**33.9**

Project : Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)
Monitoring Date : 19/11/2020
Monitoring Location : NML 3 - Block 4 Site - South of PS 5 Block 3
Monitoring Period : Weekday NIght (Logged Broadband Data)

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
19-11-20 10:44:38 PM	19-11-20 10:45:38 PM	00:01:00	72.3	73.5	72.4	73.3	72.9	73.2	72.8	72.5	72.4
19-11-20 10:45:38 PM	19-11-20 10:46:38 PM	00:01:00	72.5	73.7	72.7	73.4	73.1	73.2	73.0	72.8	72.7
19-11-20 10:46:38 PM	19-11-20 10:47:38 PM	00:01:00	72.3	73.3	72.5	73.2	73.0	73.2	73.0	72.7	72.7
19-11-20 10:47:38 PM	19-11-20 10:48:38 PM	00:01:00	72.5	73.9	72.5	73.7	73.0	73.3	73.0	72.7	72.6
19-11-20 10:48:38 PM	19-11-20 10:49:38 PM	00:01:00	72.5	73.5	72.5	73.5	73.0	73.2	73.0	72.6	72.5
19-11-20 10:49:38 PM	19-11-20 10:50:38 PM	00:01:00	72.4	73.7	72.5	73.6	73.1	73.4	73.0	72.8	72.7
19-11-20 10:50:38 PM	19-11-20 10:51:38 PM	00:01:00	72.9	73.9	73.0	73.8	73.4	73.6	73.3	73.1	73.1
19-11-20 10:51:38 PM	19-11-20 10:52:38 PM	00:01:00	72.9	73.9	73.1	73.7	73.4	73.5	73.3	73.1	73.1
19-11-20 10:52:38 PM	19-11-20 10:53:38 PM	00:01:00	72.8	73.9	73.0	73.9	73.4	73.6	73.3	73.0	73.0
19-11-20 10:53:38 PM	19-11-20 10:54:38 PM	00:01:00	72.6	73.8	72.7	73.7	73.1	73.4	73.0	72.8	72.7
19-11-20 10:54:38 PM	19-11-20 10:55:38 PM	00:01:00	72.7	73.9	72.8	73.7	73.1	73.3	73.1	72.9	72.9
19-11-20 10:55:38 PM	19-11-20 10:56:38 PM	00:01:00	72.7	73.8	72.8	73.7	73.2	73.4	73.1	72.9	72.9
19-11-20 10:56:38 PM	19-11-20 10:57:38 PM	00:01:00	72.7	73.6	72.8	73.5	73.2	73.3	73.1	72.9	72.9
19-11-20 10:57:38 PM	19-11-20 10:58:38 PM	00:01:00	72.7	74.0	72.8	73.9	73.4	73.6	73.4	73.2	73.1
19-11-20 10:58:38 PM	19-11-20 10:59:38 PM	00:01:00	72.7	73.8	72.9	73.7	73.2	73.4	73.1	72.9	72.9
19-11-20 10:59:38 PM	19-11-20 11:00:38 PM	00:01:00	72.7	74.0	72.8	73.9	73.4	73.7	73.3	73.1	73.0
19-11-20 11:00:38 PM	19-11-20 11:01:38 PM	00:01:00	72.8	73.9	73.0	73.8	73.3	73.5	73.2	73.0	73.0
19-11-20 11:01:38 PM	19-11-20 11:02:38 PM	00:01:00	72.7	73.7	72.8	73.6	73.2	73.4	73.2	73.0	72.9
19-11-20 11:02:38 PM	19-11-20 11:03:38 PM	00:01:00	72.7	74.0	72.8	73.9	73.3	73.6	73.3	73.0	73.0
19-11-20 11:03:38 PM	19-11-20 11:04:38 PM	00:01:00	72.8	74.1	72.9	74.0	73.4	73.7	73.3	73.1	73.0
19-11-20 11:04:38 PM	19-11-20 11:05:38 PM	00:01:00	72.7	73.6	72.9	73.6	73.2	73.4	73.2	73.0	72.9
19-11-20 11:05:38 PM	19-11-20 11:06:38 PM	00:01:00	73.0	74.1	73.0	74.0	73.5	73.8	73.4	73.1	73.1
19-11-20 11:06:38 PM	19-11-20 11:07:38 PM	00:01:00	72.6	73.8	72.7	73.7	73.3	73.5	73.2	72.9	72.8
19-11-20 11:07:38 PM	19-11-20 11:08:38 PM	00:01:00	72.5	73.6	72.5	73.5	73.0	73.3	72.9	72.6	72.6
19-11-20 11:08:38 PM	19-11-20 11:09:38 PM	00:01:00	72.6	73.4	72.7	73.4	73.0	73.2	72.9	72.7	72.7
19-11-20 11:09:38 PM	19-11-20 11:10:38 PM	00:01:00	72.4	73.8	72.6	73.6	72.9	73.2	72.8	72.6	72.6
19-11-20 11:10:38 PM	19-11-20 11:11:38 PM	00:01:00	72.3	73.5	72.5	73.4	72.9	73.2	72.8	72.6	72.5
19-11-20 11:11:38 PM	19-11-20 11:12:38 PM	00:01:00	72.2	73.5	72.4	73.3	72.9	73.1	72.9	72.6	72.5
19-11-20 11:12:38 PM	19-11-20 11:13:38 PM	00:01:00	72.2	73.6	72.4	73.4	72.8	73.0	72.8	72.6	72.4
19-11-20 11:13:38 PM	19-11-20 11:14:38 PM	00:01:00	72.3	73.4	72.4	73.3	72.8	72.9	72.7	72.5	72.5
Min			**72.2**	**73.3**	**72.4**	**73.2**	**72.8**	**72.9**	**72.7**	**72.5**	**72.4**
Max			**73.0**	**74.1**	**73.1**	**74.0**	**73.5**	**73.8**	**73.4**	**73.2**	**73.1**
Avg			**72.6**	**73.7**	**72.7**	**73.6**	**73.2**	**73.4**	**73.1**	**72.8**	**72.8**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **19/11/2020**
Monitoring Location : **NML 3 - Block 4 Site - South of PS 5 Block 3**
Monitoring Period : **Weekday NIght (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
19-11-20 10:44:38 PM	19-11-20 10:45:38 PM	00:01:00	39.4	55.5	63.6	66.8	68.0	65.2	62.9	58.0	44.7	30.6
19-11-20 10:45:38 PM	19-11-20 10:46:38 PM	00:01:00	41.5	56.5	63.6	66.9	68.0	65.6	63.2	58.2	44.9	31.5
19-11-20 10:46:38 PM	19-11-20 10:47:38 PM	00:01:00	41.3	55.8	63.8	66.9	68.0	65.6	63.3	58.2	44.8	31.0
19-11-20 10:47:38 PM	19-11-20 10:48:38 PM	00:01:00	41.0	55.7	63.5	66.9	68.1	65.7	63.3	58.2	45.0	31.1
19-11-20 10:48:38 PM	19-11-20 10:49:38 PM	00:01:00	41.6	56.0	63.6	66.9	68.0	65.6	63.3	58.3	44.7	31.3
19-11-20 10:49:38 PM	19-11-20 10:50:38 PM	00:01:00	40.0	55.8	63.5	66.8	68.0	66.1	63.5	58.5	44.8	30.8
19-11-20 10:50:38 PM	19-11-20 10:51:38 PM	00:01:00	40.8	57.2	63.6	67.0	68.2	66.3	63.7	58.7	45.1	31.6
19-11-20 10:51:38 PM	19-11-20 10:52:38 PM	00:01:00	41.1	56.0	63.8	67.1	68.2	66.4	63.6	58.6	45.2	32.4
19-11-20 10:52:38 PM	19-11-20 10:53:38 PM	00:01:00	42.6	56.1	63.8	67.2	68.2	66.4	63.5	58.4	45.0	32.0
19-11-20 10:53:38 PM	19-11-20 10:54:38 PM	00:01:00	41.8	55.5	63.5	67.0	68.1	65.9	63.3	58.3	44.8	31.0
19-11-20 10:54:38 PM	19-11-20 10:55:38 PM	00:01:00	42.2	56.6	63.7	66.9	68.1	66.0	63.3	58.3	44.9	31.0
19-11-20 10:55:38 PM	19-11-20 10:56:38 PM	00:01:00	40.9	56.0	63.7	67.0	68.2	66.0	63.3	58.2	44.9	31.3
19-11-20 10:56:38 PM	19-11-20 10:57:38 PM	00:01:00	40.9	56.2	63.9	67.1	68.1	65.9	63.1	58.2	45.0	31.7
19-11-20 10:57:38 PM	19-11-20 10:58:38 PM	00:01:00	41.6	56.5	63.7	67.3	68.4	66.3	63.5	58.5	45.1	32.1
19-11-20 10:58:38 PM	19-11-20 10:59:38 PM	00:01:00	40.2	55.4	63.6	67.1	68.2	66.2	63.3	58.3	45.0	31.5
19-11-20 10:59:38 PM	19-11-20 11:00:38 PM	00:01:00	41.2	56.0	63.8	67.2	68.3	66.5	63.6	58.5	45.1	31.7
19-11-20 11:00:38 PM	19-11-20 11:01:38 PM	00:01:00	41.2	56.6	63.5	67.1	68.3	66.1	63.2	58.3	45.2	31.5
19-11-20 11:01:38 PM	19-11-20 11:02:38 PM	00:01:00	41.0	56.1	63.8	67.1	68.4	65.9	62.9	58.1	45.1	31.5
19-11-20 11:02:38 PM	19-11-20 11:03:38 PM	00:01:00	40.8	56.8	63.9	67.1	68.5	66.1	63.1	58.2	45.1	32.2
19-11-20 11:03:38 PM	19-11-20 11:04:38 PM	00:01:00	41.3	56.8	63.9	67.1	68.6	66.1	63.1	58.0	45.0	32.1
19-11-20 11:04:38 PM	19-11-20 11:05:38 PM	00:01:00	41.3	55.8	63.8	67.0	68.7	65.7	62.7	57.8	44.9	31.1
19-11-20 11:05:38 PM	19-11-20 11:06:38 PM	00:01:00	40.6	56.9	64.0	67.1	69.1	65.9	63.1	58.0	45.0	31.5
19-11-20 11:06:38 PM	19-11-20 11:07:38 PM	00:01:00	40.8	56.0	63.5	67.0	68.8	65.8	62.8	57.8	45.0	31.1
19-11-20 11:07:38 PM	19-11-20 11:08:38 PM	00:01:00	41.8	56.2	63.5	66.9	68.2	65.8	62.7	57.7	44.9	31.2
19-11-20 11:08:38 PM	19-11-20 11:09:38 PM	00:01:00	41.5	56.0	63.4	66.8	68.2	65.6	62.7	57.7	44.8	32.1
19-11-20 11:09:38 PM	19-11-20 11:10:38 PM	00:01:00	39.7	55.7	63.1	66.8	68.1	65.6	62.8	57.8	44.9	31.4
19-11-20 11:10:38 PM	19-11-20 11:11:38 PM	00:01:00	39.8	55.4	62.9	66.9	68.0	65.7	62.7	57.7	44.8	31.6
19-11-20 11:11:38 PM	19-11-20 11:12:38 PM	00:01:00	41.1	55.9	63.2	66.8	68.0	65.7	62.8	57.8	44.8	32.2
19-11-20 11:12:38 PM	19-11-20 11:13:38 PM	00:01:00	41.0	56.5	63.3	66.9	67.8	65.5	62.6	57.7	44.9	30.5
19-11-20 11:13:38 PM	19-11-20 11:14:38 PM	00:01:00	40.4	55.8	63.0	66.9	67.8	65.3	62.7	57.7	44.8	30.4
Min			**39.4**	**55.4**	**62.9**	**66.8**	**67.8**	**65.2**	**62.6**	**57.7**	**44.7**	**30.4**
Max			**42.6**	**57.2**	**64.0**	**67.3**	**69.1**	**66.5**	**63.7**	**58.7**	**45.2**	**32.4**
Avg			**41.1**	**56.1**	**63.6**	**67.0**	**68.2**	**65.9**	**63.1**	**58.1**	**44.9**	**31.5**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 19/11/2020**
Monitoring Location	**: NML 4 - Princess Sabeeka Oasis: South East of PS 5**
Monitoring Period	**: Weekday Night (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
19-11-20 10:00:56 PM	19-11-20 10:01:56 PM	00:01:00	58.5	61.9	58.9	61.7	59.7	60.7	59.4	58.9	58.9
19-11-20 10:01:56 PM	19-11-20 10:02:56 PM	00:01:00	57.9	60.6	58.0	60.4	59.3	60.1	59.1	58.4	58.2
19-11-20 10:02:56 PM	19-11-20 10:03:56 PM	00:01:00	59.8	63.4	59.9	63.2	60.9	61.9	60.7	60.1	59.9
19-11-20 10:03:56 PM	19-11-20 10:04:56 PM	00:01:00	60.1	63.6	60.2	63.2	61.7	62.7	61.8	60.3	60.2
19-11-20 10:04:56 PM	19-11-20 10:05:56 PM	00:01:00	58.6	63.6	58.8	63.0	60.3	61.7	60.1	59.3	59.1
19-11-20 10:05:56 PM	19-11-20 10:06:56 PM	00:01:00	59.2	61.2	59.4	61.0	60.2	60.8	60.0	59.6	59.5
19-11-20 10:06:56 PM	19-11-20 10:07:56 PM	00:01:00	58.6	61.2	58.8	61.1	60.2	60.9	60.2	59.3	59.1
19-11-20 10:07:56 PM	19-11-20 10:08:56 PM	00:01:00	58.1	61.1	58.2	60.7	59.7	60.6	59.6	58.7	58.6
19-11-20 10:08:56 PM	19-11-20 10:09:56 PM	00:01:00	57.0	59.2	57.2	59.1	58.1	58.7	58.1	57.5	57.3
19-11-20 10:09:56 PM	19-11-20 10:10:56 PM	00:01:00	57.5	60.7	57.6	60.6	58.9	59.6	58.8	57.9	57.8
19-11-20 10:10:56 PM	19-11-20 10:11:56 PM	00:01:00	58.4	61.9	58.5	61.8	60.3	61.5	60.1	59.2	58.6
19-11-20 10:11:56 PM	19-11-20 10:12:56 PM	00:01:00	58.9	62.7	59.1	62.5	60.5	61.4	60.4	59.2	59.1
19-11-20 10:12:56 PM	19-11-20 10:13:56 PM	00:01:00	59.0	62.9	59.1	62.2	60.6	61.6	60.5	59.4	59.1
19-11-20 10:13:56 PM	19-11-20 10:14:56 PM	00:01:00	59.8	62.5	59.9	62.1	61.1	61.8	61.0	60.2	60.0
19-11-20 10:14:56 PM	19-11-20 10:15:56 PM	00:01:00	59.5	67.2	59.7	66.0	61.2	61.5	60.8	60.1	59.9
19-11-20 10:15:56 PM	19-11-20 10:16:56 PM	00:01:00	60.2	63.2	60.2	63.0	61.6	62.6	61.5	60.6	60.4
19-11-20 10:16:56 PM	19-11-20 10:17:56 PM	00:01:00	60.1	62.7	60.3	62.7	61.2	61.7	61.1	60.5	60.4
19-11-20 10:17:56 PM	19-11-20 10:18:56 PM	00:01:00	60.7	63.2	60.8	63.1	61.6	62.4	61.3	60.9	60.8
19-11-20 10:18:56 PM	19-11-20 10:19:56 PM	00:01:00	61.0	63.2	61.1	63.2	62.1	62.6	62.0	61.5	61.4
19-11-20 10:19:56 PM	19-11-20 10:20:56 PM	00:01:00	61.7	63.1	61.8	63.0	62.3	62.8	62.1	61.8	61.8
19-11-20 10:20:56 PM	19-11-20 10:21:56 PM	00:01:00	60.9	63.2	61.0	63.1	62.1	62.6	62.0	61.6	61.4
19-11-20 10:21:56 PM	19-11-20 10:22:56 PM	00:01:00	60.3	62.2	60.5	62.2	61.2	61.9	61.0	60.7	60.6
19-11-20 10:22:56 PM	19-11-20 10:23:56 PM	00:01:00	60.1	62.1	60.4	61.9	61.1	61.5	61.1	60.6	60.4
19-11-20 10:23:56 PM	19-11-20 10:24:56 PM	00:01:00	60.0	62.1	60.2	61.9	61.0	61.6	60.9	60.4	60.3
19-11-20 10:24:56 PM	19-11-20 10:25:56 PM	00:01:00	59.5	61.9	59.6	61.6	60.5	61.2	60.3	59.8	59.6
19-11-20 10:25:56 PM	19-11-20 10:26:56 PM	00:01:00	60.1	61.5	60.2	61.3	60.8	61.2	60.8	60.4	60.3
19-11-20 10:26:56 PM	19-11-20 10:27:56 PM	00:01:00	60.2	61.8	60.3	61.6	60.9	61.3	60.9	60.4	60.3
19-11-20 10:27:56 PM	19-11-20 10:28:56 PM	00:01:00	60.6	62.8	60.7	62.3	61.4	62.0	61.3	60.8	60.7
19-11-20 10:28:56 PM	19-11-20 10:29:56 PM	00:01:00	59.8	63.1	59.9	63.1	61.6	62.5	61.6	60.5	60.3
19-11-20 10:29:56 PM	19-11-20 10:30:56 PM	00:01:00	60.3	75.2	60.5	74.2	66.7	70.9	61.5	60.6	60.5
Min			**57.0**	**59.2**	**57.2**	**59.1**	**58.1**	**58.7**	**58.1**	**57.5**	**57.3**
Max			**61.7**	**75.2**	**61.8**	**74.2**	**66.7**	**70.9**	**62.1**	**61.8**	**61.8**
Avg			**59.7**	**64.6**	**59.8**	**64.0**	**61.3**	**62.6**	**60.8**	**60.1**	**59.9**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **19/11/2020**
Monitoring Location : **NML 4 - Princess Sabeeka Oasis: South East of PS 5**
Monitoring Period : **Weekday Night (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
19-11-20 10:00:56 PM	19-11-20 10:01:56 PM	00:01:00	34.6	43.9	51.0	53.6	53.2	53.1	50.4	45.3	31.4	23.3
19-11-20 10:01:56 PM	19-11-20 10:02:56 PM	00:01:00	30.0	44.0	50.4	53.2	53.3	52.7	49.5	44.4	30.7	19.7
19-11-20 10:02:56 PM	19-11-20 10:03:56 PM	00:01:00	30.5	45.0	51.8	54.5	55.6	54.5	51.0	45.1	30.7	19.8
19-11-20 10:03:56 PM	19-11-20 10:04:56 PM	00:01:00	31.5	46.0	52.5	55.6	56.3	55.4	51.5	44.3	30.7	20.2
19-11-20 10:04:56 PM	19-11-20 10:05:56 PM	00:01:00	30.6	43.1	50.9	54.6	55.3	53.5	49.3	43.2	29.6	18.5
19-11-20 10:05:56 PM	19-11-20 10:06:56 PM	00:01:00	30.4	43.3	50.2	53.5	54.4	54.5	50.8	44.0	30.1	18.0
19-11-20 10:06:56 PM	19-11-20 10:07:56 PM	00:01:00	30.8	43.8	50.6	53.8	55.0	54.1	50.4	42.4	29.3	18.3
19-11-20 10:07:56 PM	19-11-20 10:08:56 PM	00:01:00	30.5	43.3	49.7	53.5	53.8	53.7	50.7	42.4	29.3	17.8
19-11-20 10:08:56 PM	19-11-20 10:09:56 PM	00:01:00	30.4	42.5	49.1	52.2	52.4	51.7	47.9	40.2	28.3	17.7
19-11-20 10:09:56 PM	19-11-20 10:10:56 PM	00:01:00	30.7	43.0	48.7	51.9	53.0	53.7	49.6	41.2	29.2	17.9
19-11-20 10:10:56 PM	19-11-20 10:11:56 PM	00:01:00	30.8	44.6	50.3	52.9	54.2	54.8	52.1	42.6	29.3	17.9
19-11-20 10:11:56 PM	19-11-20 10:12:56 PM	00:01:00	30.6	44.4	50.1	53.5	54.7	55.0	51.4	43.0	29.3	19.2
19-11-20 10:12:56 PM	19-11-20 10:13:56 PM	00:01:00	31.6	44.8	50.5	53.5	54.6	55.0	52.2	43.2	30.3	18.1
19-11-20 10:13:56 PM	19-11-20 10:14:56 PM	00:01:00	31.6	44.1	50.2	53.5	55.0	55.8	53.1	45.2	33.8	23.7
19-11-20 10:14:56 PM	19-11-20 10:15:56 PM	00:01:00	31.7	46.9	49.7	53.7	54.5	55.4	53.0	49.3	44.8	30.6
19-11-20 10:15:56 PM	19-11-20 10:16:56 PM	00:01:00	31.0	45.1	50.4	54.1	55.4	56.4	53.7	45.0	30.7	19.5
19-11-20 10:16:56 PM	19-11-20 10:17:56 PM	00:01:00	31.0	44.6	49.5	53.9	55.1	56.0	53.3	44.2	30.3	21.0
19-11-20 10:17:56 PM	19-11-20 10:18:56 PM	00:01:00	31.8	44.7	50.1	54.0	56.3	56.1	53.2	44.0	30.3	20.2
19-11-20 10:18:56 PM	19-11-20 10:19:56 PM	00:01:00	31.6	45.3	51.8	55.1	56.8	56.4	53.1	44.5	33.2	18.7
19-11-20 10:19:56 PM	19-11-20 10:20:56 PM	00:01:00	32.0	46.1	53.9	55.8	56.1	56.4	52.9	43.6	30.3	18.3
19-11-20 10:20:56 PM	19-11-20 10:21:56 PM	00:01:00	31.7	46.4	53.2	56.1	56.3	55.7	52.3	43.1	30.0	17.8
19-11-20 10:21:56 PM	19-11-20 10:22:56 PM	00:01:00	31.7	44.6	50.6	54.2	55.5	55.8	52.7	43.3	30.2	18.4
19-11-20 10:22:56 PM	19-11-20 10:23:56 PM	00:01:00	31.2	44.7	49.4	54.2	55.2	55.7	52.4	43.4	30.7	18.8
19-11-20 10:23:56 PM	19-11-20 10:24:56 PM	00:01:00	31.7	46.1	49.8	53.7	55.3	55.5	52.4	43.6	30.6	18.7
19-11-20 10:24:56 PM	19-11-20 10:25:56 PM	00:01:00	30.9	44.8	51.0	53.6	55.1	54.5	51.2	42.9	29.6	17.7
19-11-20 10:25:56 PM	19-11-20 10:26:56 PM	00:01:00	30.8	44.2	49.3	53.2	54.5	55.8	53.2	43.4	29.7	17.6
19-11-20 10:26:56 PM	19-11-20 10:27:56 PM	00:01:00	31.0	45.1	50.0	53.3	55.4	55.5	52.4	43.2	30.0	17.8
19-11-20 10:27:56 PM	19-11-20 10:28:56 PM	00:01:00	31.4	46.0	50.3	54.1	56.0	55.7	52.7	44.1	32.6	19.0
19-11-20 10:28:56 PM	19-11-20 10:29:56 PM	00:01:00	30.8	45.4	52.3	55.5	55.5	55.7	52.6	42.9	28.9	17.8
19-11-20 10:29:56 PM	19-11-20 10:30:56 PM	00:01:00	30.7	44.6	50.5	54.0	65.2	58.7	54.6	44.3	29.7	17.8
Min			**30.0**	**42.5**	**48.7**	**51.9**	**52.4**	**51.7**	**47.9**	**40.2**	**28.3**	**17.6**
Max			**34.6**	**46.9**	**53.9**	**56.1**	**65.2**	**58.7**	**54.6**	**49.3**	**44.8**	**30.6**
Avg			**31.3**	**44.8**	**50.8**	**54.0**	**56.3**	**55.3**	**52.1**	**44.0**	**33.2**	**20.8**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **19/11/2020**
Monitoring Location : **NML 5 - Western Boundary of Potline 6**
Monitoring Period : **Weekday Night (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
19-11-20 11:35:08 PM	19-11-20 11:36:08 PM	00:01:00	59.3	63.1	59.5	62.7	60.9	61.8	61.0	59.6	59.5
19-11-20 11:36:08 PM	19-11-20 11:37:08 PM	00:01:00	59.6	62.0	59.6	61.8	60.6	61.4	60.6	59.8	59.6
19-11-20 11:37:08 PM	19-11-20 11:38:08 PM	00:01:00	59.1	62.0	59.2	61.5	60.3	61.1	60.3	59.5	59.3
19-11-20 11:38:08 PM	19-11-20 11:39:08 PM	00:01:00	59.7	63.1	59.8	62.8	60.9	61.7	60.8	60.0	60.0
19-11-20 11:39:08 PM	19-11-20 11:40:08 PM	00:01:00	59.4	62.1	59.5	62.0	60.7	61.6	60.5	59.7	59.6
19-11-20 11:40:08 PM	19-11-20 11:41:08 PM	00:01:00	59.8	63.8	59.9	63.6	60.8	61.9	60.4	60.1	60.0
19-11-20 11:41:08 PM	19-11-20 11:42:08 PM	00:01:00	59.6	62.6	59.8	61.7	60.2	60.6	60.1	59.8	59.8
19-11-20 11:42:08 PM	19-11-20 11:43:08 PM	00:01:00	59.2	61.5	59.4	60.9	59.9	60.2	59.8	59.5	59.5
19-11-20 11:43:08 PM	19-11-20 11:44:08 PM	00:01:00	59.5	65.4	59.7	65.3	61.1	64.4	60.2	59.8	59.7
19-11-20 11:44:08 PM	19-11-20 11:45:08 PM	00:01:00	59.4	61.1	59.5	61.0	60.2	60.6	60.1	59.7	59.6
19-11-20 11:45:08 PM	19-11-20 11:46:08 PM	00:01:00	59.5	65.1	59.6	64.7	60.8	61.4	60.5	59.8	59.7
19-11-20 11:46:08 PM	19-11-20 11:47:08 PM	00:01:00	60.2	63.3	60.3	63.8	61.3	61.7	61.1	60.7	60.5
19-11-20 11:47:08 PM	19-11-20 11:48:08 PM	00:01:00	60.1	66.5	60.2	65.9	62.0	63.9	61.1	60.5	60.4
19-11-20 11:48:08 PM	19-11-20 11:49:08 PM	00:01:00	59.9	62.9	60.0	62.2	60.7	61.3	60.5	60.1	60.0
19-11-20 11:49:08 PM	19-11-20 11:50:08 PM	00:01:00	59.6	62.1	59.7	61.6	60.6	61.0	60.5	59.9	59.8
19-11-20 11:50:08 PM	19-11-20 11:51:08 PM	00:01:00	59.6	61.6	59.7	61.4	60.4	61.0	60.3	59.9	59.9
19-11-20 11:51:08 PM	19-11-20 11:52:08 PM	00:01:00	59.3	64.0	59.4	62.9	60.0	60.4	59.8	59.5	59.5
19-11-20 11:52:08 PM	19-11-20 11:53:08 PM	00:01:00	59.4	62.0	59.4	61.7	60.5	61.0	60.4	59.7	59.5
19-11-20 11:53:08 PM	19-11-20 11:54:08 PM	00:01:00	58.7	60.7	58.8	60.6	59.8	60.4	59.7	59.2	59.2
19-11-20 11:54:08 PM	19-11-20 11:55:08 PM	00:01:00	59.8	62.5	59.9	62.2	60.7	61.3	60.5	60.0	60.0
19-11-20 11:55:08 PM	19-11-20 11:56:08 PM	00:01:00	59.0	61.9	59.1	61.7	60.7	61.4	60.9	59.4	59.2
19-11-20 11:56:08 PM	19-11-20 11:57:08 PM	00:01:00	59.2	63.0	59.3	62.1	60.4	61.0	60.3	59.7	59.5
19-11-20 11:57:08 PM	19-11-20 11:58:08 PM	00:01:00	59.3	62.1	59.5	61.9	60.4	61.1	60.4	59.6	59.6
19-11-20 11:58:08 PM	19-11-20 11:59:08 PM	00:01:00	59.2	64.2	59.3	63.3	60.7	61.3	60.6	59.8	59.7
19-11-20 11:59:08 PM	20-11-20 12:00:08 AM	00:01:00	58.7	62.3	58.7	61.4	59.6	60.0	59.5	59.0	58.8
20-11-20 12:00:08 AM	20-11-20 12:01:08 AM	00:01:00	59.0	61.1	59.1	60.9	59.9	60.5	59.9	59.3	59.1
20-11-20 12:01:08 AM	20-11-20 12:02:08 AM	00:01:00	59.3	61.7	59.4	61.5	60.4	61.1	60.4	59.5	59.4
20-11-20 12:02:08 AM	20-11-20 12:03:08 AM	00:01:00	58.8	66.1	58.9	65.8	61.3	64.6	59.8	59.3	59.1
20-11-20 12:03:08 AM	20-11-20 12:04:08 AM	00:01:00	59.0	64.4	59.0	64.2	60.3	61.9	59.7	59.3	59.1
20-11-20 12:04:08 AM	20-11-20 12:05:08 AM	00:01:00	59.3	65.8	59.5	64.6	61.6	64.0	60.7	59.7	59.6
Min			**58.7**	**60.7**	**58.7**	**60.6**	**59.6**	**60.0**	**59.5**	**59.0**	**58.8**
Max			**60.2**	**66.5**	**60.3**	**65.9**	**62.0**	**64.6**	**61.1**	**60.7**	**60.5**
Avg			**59.4**	**63.3**	**59.5**	**62.9**	**60.6**	**61.7**	**60.4**	**59.7**	**59.6**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **19/11/2020**
Monitoring Location : **NML 5 - Western Boundary of Potline 6**
Monitoring Period : **Weekday Night (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
19-11-20 11:35:08 PM	19-11-20 11:36:08 PM	00:01:00	33.6	47.0	51.1	54.3	56.1	53.4	52.4	47.6	34.0	19.2
19-11-20 11:36:08 PM	19-11-20 11:37:08 PM	00:01:00	33.0	46.1	51.2	54.1	55.8	53.1	51.9	46.8	31.9	20.2
19-11-20 11:37:08 PM	19-11-20 11:38:08 PM	00:01:00	36.1	45.7	50.2	53.8	55.7	52.7	51.5	47.2	33.2	20.4
19-11-20 11:38:08 PM	19-11-20 11:39:08 PM	00:01:00	37.2	45.8	50.6	54.3	56.2	53.6	52.4	47.1	33.5	19.7
19-11-20 11:39:08 PM	19-11-20 11:40:08 PM	00:01:00	34.2	46.4	50.7	54.2	55.5	53.5	52.2	47.2	33.7	22.6
19-11-20 11:40:08 PM	19-11-20 11:41:08 PM	00:01:00	33.7	46.4	50.7	53.5	56.3	53.2	52.2	47.3	32.5	21.5
19-11-20 11:41:08 PM	19-11-20 11:42:08 PM	00:01:00	33.3	46.2	50.7	53.3	54.9	52.6	51.9	47.2	35.3	20.0
19-11-20 11:42:08 PM	19-11-20 11:43:08 PM	00:01:00	33.3	46.1	50.5	52.2	54.6	52.5	52.0	47.2	33.8	18.4
19-11-20 11:43:08 PM	19-11-20 11:44:08 PM	00:01:00	33.0	45.3	50.6	54.0	55.5	54.1	53.0	48.7	35.5	18.4
19-11-20 11:44:08 PM	19-11-20 11:45:08 PM	00:01:00	33.1	45.3	53.0	52.7	54.5	52.9	51.9	46.7	31.9	17.1
19-11-20 11:45:08 PM	19-11-20 11:46:08 PM	00:01:00	33.2	45.7	51.1	54.0	55.7	53.2	52.7	47.3	34.9	17.8
19-11-20 11:46:08 PM	19-11-20 11:47:08 PM	00:01:00	33.7	45.6	52.3	54.3	56.3	53.8	53.0	47.8	33.6	17.3
19-11-20 11:47:08 PM	19-11-20 11:48:08 PM	00:01:00	33.5	46.2	52.2	55.1	57.1	54.4	53.8	49.1	35.3	19.4
19-11-20 11:48:08 PM	19-11-20 11:49:08 PM	00:01:00	33.4	45.7	51.2	53.6	56.2	52.9	51.9	47.3	34.5	18.6
19-11-20 11:49:08 PM	19-11-20 11:50:08 PM	00:01:00	33.1	46.3	52.5	53.6	55.4	52.9	52.1	47.5	34.0	17.7
19-11-20 11:50:08 PM	19-11-20 11:51:08 PM	00:01:00	33.4	46.1	50.8	53.5	55.5	52.8	51.8	47.4	32.3	17.1
19-11-20 11:51:08 PM	19-11-20 11:52:08 PM	00:01:00	33.1	45.7	51.0	52.9	55.0	52.6	51.5	47.1	34.5	19.3
19-11-20 11:52:08 PM	19-11-20 11:53:08 PM	00:01:00	34.0	45.8	51.2	53.6	55.1	53.0	52.1	47.2	31.6	19.2
19-11-20 11:53:08 PM	19-11-20 11:54:08 PM	00:01:00	33.9	45.8	50.7	52.2	54.6	52.4	51.5	47.0	32.7	17.7
19-11-20 11:54:08 PM	19-11-20 11:55:08 PM	00:01:00	36.1	46.4	51.9	53.3	54.9	53.5	52.6	47.4	32.4	21.9
19-11-20 11:55:08 PM	19-11-20 11:56:08 PM	00:01:00	35.5	46.5	51.8	53.2	54.6	53.9	52.7	47.1	32.7	22.3
19-11-20 11:56:08 PM	19-11-20 11:57:08 PM	00:01:00	35.0	46.5	51.5	53.2	54.6	53.4	52.3	47.0	31.8	17.2
19-11-20 11:57:08 PM	19-11-20 11:58:08 PM	00:01:00	33.7	47.7	51.9	54.0	54.5	52.9	51.8	46.6	31.9	18.3
19-11-20 11:58:08 PM	19-11-20 11:59:08 PM	00:01:00	33.6	47.4	52.1	54.5	54.9	53.1	52.0	46.7	32.3	19.4
19-11-20 11:59:08 PM	20-11-20 12:00:08 AM	00:01:00	34.9	45.9	50.4	52.4	54.2	52.0	50.9	46.4	31.6	20.2
20-11-20 12:00:08 AM	20-11-20 12:01:08 AM	00:01:00	34.7	46.6	50.8	52.4	54.6	52.7	51.7	46.9	32.1	19.2
20-11-20 12:01:08 AM	20-11-20 12:02:08 AM	00:01:00	34.3	47.0	51.0	52.9	54.6	53.9	52.4	47.1	32.6	20.8
20-11-20 12:02:08 AM	20-11-20 12:03:08 AM	00:01:00	33.0	47.5	51.2	52.9	54.5	54.5	55.4	50.3	32.9	17.1
20-11-20 12:03:08 AM	20-11-20 12:04:08 AM	00:01:00	36.6	46.4	51.1	52.2	54.4	53.2	53.0	47.9	32.3	18.1
20-11-20 12:04:08 AM	20-11-20 12:05:08 AM	00:01:00	34.2	47.4	53.6	53.4	55.3	54.5	55.0	49.7	33.1	18.4
Min			**33.0**	**45.3**	**50.2**	**52.2**	**54.2**	**52.0**	**50.9**	**46.4**	**31.6**	**17.1**
Max			**37.2**	**47.7**	**53.6**	**55.1**	**57.1**	**54.5**	**55.4**	**50.3**	**35.5**	**22.6**
Avg			**34.3**	**46.3**	**51.4**	**53.5**	**55.3**	**53.3**	**52.5**	**47.6**	**33.3**	**19.4**

Project	: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)
Monitoring Date	: 20/11/2020
Monitoring Location	: NML 6 - West Boundary of PS5 Block 4
Monitoring Period	: Weekday Night (Logged Broadband Data)

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
20-11-20 12:10:51 AM	20-11-20 12:11:51 AM	00:01:00	64.2	65.3	64.3	65.2	64.7	64.9	64.6	64.4	64.3
20-11-20 12:11:51 AM	20-11-20 12:12:51 AM	00:01:00	63.8	65.7	63.9	65.6	64.6	65.3	64.4	64.1	64.0
20-11-20 12:12:51 AM	20-11-20 12:13:51 AM	00:01:00	64.1	65.4	64.2	65.4	64.8	65.2	64.7	64.3	64.2
20-11-20 12:13:51 AM	20-11-20 12:14:51 AM	00:01:00	63.6	65.2	63.7	65.1	64.5	64.9	64.5	63.9	63.9
20-11-20 12:14:51 AM	20-11-20 12:15:51 AM	00:01:00	63.8	65.8	63.9	65.6	64.5	65.0	64.3	64.0	63.9
20-11-20 12:15:51 AM	20-11-20 12:16:51 AM	00:01:00	63.9	65.6	63.9	65.4	64.6	65.2	64.4	64.1	64.0
20-11-20 12:16:51 AM	20-11-20 12:17:51 AM	00:01:00	64.2	65.6	64.2	65.4	64.7	65.2	64.6	64.4	64.3
20-11-20 12:17:51 AM	20-11-20 12:18:51 AM	00:01:00	64.5	65.4	64.5	65.3	64.9	65.1	64.8	64.6	64.5
20-11-20 12:18:51 AM	20-11-20 12:19:51 AM	00:01:00	64.3	66.1	64.4	65.8	65.0	65.3	64.9	64.6	64.5
20-11-20 12:19:51 AM	20-11-20 12:20:51 AM	00:01:00	64.1	66.0	64.2	65.6	64.9	65.3	64.8	64.4	64.4
20-11-20 12:20:51 AM	20-11-20 12:21:51 AM	00:01:00	63.9	65.7	64.0	65.5	64.6	65.0	64.6	64.1	64.1
20-11-20 12:21:51 AM	20-11-20 12:22:51 AM	00:01:00	63.8	65.5	63.9	65.3	64.5	65.0	64.4	64.0	63.9
20-11-20 12:22:51 AM	20-11-20 12:23:51 AM	00:01:00	64.1	65.7	64.1	65.4	64.7	65.0	64.6	64.3	64.2
20-11-20 12:23:51 AM	20-11-20 12:24:51 AM	00:01:00	64.0	65.5	64.0	65.2	64.7	65.0	64.7	64.4	64.1
20-11-20 12:24:51 AM	20-11-20 12:25:51 AM	00:01:00	63.9	65.8	64.1	65.6	65.0	65.5	64.9	64.5	64.3
20-11-20 12:25:51 AM	20-11-20 12:26:51 AM	00:01:00	64.2	66.1	64.4	65.9	65.0	65.4	64.9	64.5	64.4
20-11-20 12:26:51 AM	20-11-20 12:27:51 AM	00:01:00	63.8	66.3	64.1	66.1	64.7	65.1	64.5	64.3	64.2
20-11-20 12:27:51 AM	20-11-20 12:28:51 AM	00:01:00	64.3	65.9	64.4	65.7	65.0	65.4	65.0	64.5	64.5
20-11-20 12:28:51 AM	20-11-20 12:29:51 AM	00:01:00	64.2	66.6	64.4	66.4	65.1	65.5	64.9	64.6	64.5
20-11-20 12:29:51 AM	20-11-20 12:30:51 AM	00:01:00	64.0	67.1	64.2	66.9	64.9	65.4	64.7	64.2	64.2
20-11-20 12:30:51 AM	20-11-20 12:31:51 AM	00:01:00	63.8	65.2	63.9	65.1	64.5	64.8	64.4	64.1	64.0
20-11-20 12:31:51 AM	20-11-20 12:32:51 AM	00:01:00	64.0	65.3	64.1	65.1	64.5	64.8	64.4	64.1	64.1
20-11-20 12:32:51 AM	20-11-20 12:33:51 AM	00:01:00	63.4	65.5	63.7	65.3	64.4	64.7	64.4	63.9	63.7
20-11-20 12:33:51 AM	20-11-20 12:34:51 AM	00:01:00	64.0	65.3	64.1	65.2	64.6	64.8	64.5	64.2	64.2
20-11-20 12:34:51 AM	20-11-20 12:35:51 AM	00:01:00	64.0	65.3	64.2	65.3	64.7	65.1	64.6	64.3	64.3
20-11-20 12:35:51 AM	20-11-20 12:36:51 AM	00:01:00	63.7	64.9	63.7	64.8	64.3	64.5	64.3	63.9	63.9
20-11-20 12:36:51 AM	20-11-20 12:37:51 AM	00:01:00	63.7	65.0	63.8	64.9	64.3	64.6	64.2	64.0	63.9
20-11-20 12:37:51 AM	20-11-20 12:38:51 AM	00:01:00	63.6	65.3	63.7	65.1	64.3	64.7	64.2	63.9	63.8
20-11-20 12:38:51 AM	20-11-20 12:39:51 AM	00:01:00	63.7	65.8	63.8	65.4	64.2	64.5	64.1	63.9	63.9
20-11-20 12:39:51 AM	20-11-20 12:40:51 AM	00:01:00	63.7	64.6	63.8	64.6	64.1	64.4	64.1	63.8	63.8
Min			**63.4**	**64.6**	**63.7**	**64.6**	**64.1**	**64.4**	**64.1**	**63.8**	**63.7**
Max			**64.5**	**67.1**	**64.5**	**66.9**	**65.1**	**65.5**	**65.0**	**64.6**	**64.5**
Avg			**64.0**	**65.6**	**64.1**	**65.5**	**64.7**	**65.0**	**64.6**	**64.2**	**64.1**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **20/11/2020**
Monitoring Location : **NML 6 - West Boundary of PS5 Block 4**
Monitoring Period : **Weekday Night (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
20-11-20 12:10:51 AM	20-11-20 12:11:51 AM	00:01:00	36.6	47.8	52.5	57.0	59.4	59.6	56.1	49.6	34.2	21.9
20-11-20 12:11:51 AM	20-11-20 12:12:51 AM	00:01:00	36.2	47.8	52.3	57.1	59.4	59.6	55.8	49.1	33.9	21.9
20-11-20 12:12:51 AM	20-11-20 12:13:51 AM	00:01:00	36.2	47.9	52.4	57.1	59.4	59.9	56.0	49.2	34.2	22.0
20-11-20 12:13:51 AM	20-11-20 12:14:51 AM	00:01:00	36.3	47.8	52.4	56.8	59.3	59.4	55.8	49.3	34.1	22.5
20-11-20 12:14:51 AM	20-11-20 12:15:51 AM	00:01:00	36.9	48.0	52.5	56.6	59.2	59.5	55.8	49.1	33.9	22.0
20-11-20 12:15:51 AM	20-11-20 12:16:51 AM	00:01:00	36.4	48.1	52.6	56.6	59.2	59.7	55.8	49.6	37.4	22.1
20-11-20 12:16:51 AM	20-11-20 12:17:51 AM	00:01:00	36.5	47.9	52.4	57.0	59.3	59.8	56.1	50.3	34.7	22.1
20-11-20 12:17:51 AM	20-11-20 12:18:51 AM	00:01:00	37.2	47.8	52.5	57.5	59.6	59.7	56.1	50.8	35.0	21.6
20-11-20 12:18:51 AM	20-11-20 12:19:51 AM	00:01:00	37.6	47.8	52.4	57.1	59.9	59.8	56.3	51.1	35.5	21.8
20-11-20 12:19:51 AM	20-11-20 12:20:51 AM	00:01:00	36.6	48.2	52.4	56.8	59.7	60.1	56.0	49.6	34.9	21.5
20-11-20 12:20:51 AM	20-11-20 12:21:51 AM	00:01:00	36.1	47.9	52.2	56.7	59.5	59.6	56.0	49.5	34.7	22.0
20-11-20 12:21:51 AM	20-11-20 12:22:51 AM	00:01:00	36.7	47.8	52.2	57.0	59.4	59.3	55.7	49.3	34.7	22.0
20-11-20 12:22:51 AM	20-11-20 12:23:51 AM	00:01:00	37.2	47.9	52.3	57.2	59.7	59.4	55.9	49.4	34.4	21.8
20-11-20 12:23:51 AM	20-11-20 12:24:51 AM	00:01:00	36.2	47.5	52.2	56.7	59.7	59.8	56.0	49.5	34.8	22.7
20-11-20 12:24:51 AM	20-11-20 12:25:51 AM	00:01:00	36.2	47.5	52.4	56.9	59.8	60.4	55.8	49.5	34.9	23.6
20-11-20 12:25:51 AM	20-11-20 12:26:51 AM	00:01:00	36.3	47.7	52.3	57.2	59.9	60.2	56.0	49.6	34.5	21.6
20-11-20 12:26:51 AM	20-11-20 12:27:51 AM	00:01:00	37.1	47.5	51.9	56.8	59.6	59.9	55.9	49.4	34.6	23.1
20-11-20 12:27:51 AM	20-11-20 12:28:51 AM	00:01:00	36.7	47.5	52.2	57.1	60.0	60.2	56.2	50.0	35.5	23.1
20-11-20 12:28:51 AM	20-11-20 12:29:51 AM	00:01:00	37.1	47.9	52.1	57.2	59.8	60.2	56.2	50.0	35.6	22.3
20-11-20 12:29:51 AM	20-11-20 12:30:51 AM	00:01:00	37.2	47.3	52.1	56.8	59.6	60.3	55.8	49.7	35.4	21.8
20-11-20 12:30:51 AM	20-11-20 12:31:51 AM	00:01:00	37.5	47.5	51.9	56.5	59.2	59.7	55.7	49.5	34.8	22.4
20-11-20 12:31:51 AM	20-11-20 12:32:51 AM	00:01:00	37.1	47.3	52.0	56.5	59.3	59.6	55.7	50.0	35.0	22.2
20-11-20 12:32:51 AM	20-11-20 12:33:51 AM	00:01:00	36.6	47.4	52.0	56.5	59.0	59.5	55.6	49.9	35.2	21.7
20-11-20 12:33:51 AM	20-11-20 12:34:51 AM	00:01:00	37.2	47.1	51.9	56.7	59.2	59.7	56.0	50.2	34.7	22.2
20-11-20 12:34:51 AM	20-11-20 12:35:51 AM	00:01:00	36.7	47.7	52.0	56.5	59.3	60.0	56.2	50.1	34.8	21.9
20-11-20 12:35:51 AM	20-11-20 12:36:51 AM	00:01:00	37.2	47.5	51.9	56.4	59.1	59.4	55.5	49.9	34.7	22.2
20-11-20 12:36:51 AM	20-11-20 12:37:51 AM	00:01:00	36.8	47.5	51.8	56.4	58.7	59.7	55.7	50.1	35.2	22.9
20-11-20 12:37:51 AM	20-11-20 12:38:51 AM	00:01:00	36.8	47.3	51.8	56.3	58.5	59.5	56.1	50.6	35.3	22.1
20-11-20 12:38:51 AM	20-11-20 12:39:51 AM	00:01:00	37.0	47.2	51.7	56.1	58.6	59.4	56.1	50.5	35.1	23.0
20-11-20 12:39:51 AM	20-11-20 12:40:51 AM	00:01:00	36.9	47.3	52.0	56.0	58.6	59.3	55.9	50.4	35.3	24.8
Min			**36.1**	**47.1**	**51.7**	**56.0**	**58.5**	**59.3**	**55.5**	**49.1**	**33.9**	**21.5**
Max			**37.6**	**48.2**	**52.6**	**57.5**	**60.0**	**60.4**	**56.3**	**51.1**	**37.4**	**24.8**
Avg			**36.8**	**47.7**	**52.2**	**56.8**	**59.4**	**59.8**	**55.9**	**49.9**	**35.0**	**22.4**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **20/11/2020**
Monitoring Location : **NML 1 - Accommodation and Recreational Area North of PS 5**
Monitoring Period : **Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
20-11-20 6:59:28 AM	20-11-20 7:00:28 AM	00:01:00	65.4	67.3	65.5	67.1	66.3	66.9	66.2	65.7	65.5
20-11-20 7:00:28 AM	20-11-20 7:01:28 AM	00:01:00	65.2	70.9	65.3	70.7	68.0	70.0	67.1	65.7	65.6
20-11-20 7:01:28 AM	20-11-20 7:02:28 AM	00:01:00	65.8	67.8	66.0	67.9	66.7	67.7	66.5	66.1	66.0
20-11-20 7:02:28 AM	20-11-20 7:03:28 AM	00:01:00	65.7	69.9	65.8	69.7	67.0	68.1	66.5	66.2	66.1
20-11-20 7:03:28 AM	20-11-20 7:04:28 AM	00:01:00	65.4	67.4	65.7	67.1	66.5	67.0	66.4	66.1	65.8
20-11-20 7:04:28 AM	20-11-20 7:05:28 AM	00:01:00	66.0	67.8	66.1	67.7	66.7	67.2	66.5	66.1	66.1
20-11-20 7:05:28 AM	20-11-20 7:06:28 AM	00:01:00	65.9	68.4	66.0	68.1	66.9	67.7	66.7	66.4	66.1
20-11-20 7:06:28 AM	20-11-20 7:07:28 AM	00:01:00	66.1	70.4	66.3	69.8	67.5	68.5	67.2	66.5	66.5
20-11-20 7:07:28 AM	20-11-20 7:08:28 AM	00:01:00	66.3	69.3	66.5	69.2	67.4	68.3	67.2	66.7	66.6
20-11-20 7:08:28 AM	20-11-20 7:09:28 AM	00:01:00	66.2	68.3	66.3	68.2	67.0	67.4	66.9	66.4	66.4
20-11-20 7:09:28 AM	20-11-20 7:10:28 AM	00:01:00	65.9	69.5	66.0	68.7	67.0	67.6	66.9	66.4	66.1
20-11-20 7:10:28 AM	20-11-20 7:11:28 AM	00:01:00	66.0	69.2	66.1	68.8	67.4	68.2	67.3	66.4	66.3
20-11-20 7:11:28 AM	20-11-20 7:12:28 AM	00:01:00	66.3	69.1	66.4	68.8	67.4	68.2	67.3	66.6	66.5
20-11-20 7:12:28 AM	20-11-20 7:13:28 AM	00:01:00	66.2	69.9	66.4	69.2	67.5	68.3	67.4	66.6	66.5
20-11-20 7:13:28 AM	20-11-20 7:14:28 AM	00:01:00	65.6	68.8	65.9	68.6	67.1	68.0	67.0	66.3	66.1
20-11-20 7:14:28 AM	20-11-20 7:15:28 AM	00:01:00	65.9	70.0	66.2	69.7	67.5	68.4	67.4	66.6	66.4
20-11-20 7:15:28 AM	20-11-20 7:16:28 AM	00:01:00	66.7	72.6	66.8	72.2	68.8	71.0	67.9	67.3	66.9
20-11-20 7:16:28 AM	20-11-20 7:17:28 AM	00:01:00	66.5	70.7	66.6	70.3	67.9	68.9	67.7	66.7	66.6
20-11-20 7:17:28 AM	20-11-20 7:18:28 AM	00:01:00	66.2	69.9	66.4	69.7	68.0	69.1	67.7	66.8	66.8
20-11-20 7:18:28 AM	20-11-20 7:19:28 AM	00:01:00	66.5	68.8	66.7	68.4	67.4	67.9	67.3	66.8	66.8
20-11-20 7:19:28 AM	20-11-20 7:20:28 AM	00:01:00	66.3	69.2	66.3	69.0	67.6	68.3	67.4	66.7	66.6
20-11-20 7:20:28 AM	20-11-20 7:21:28 AM	00:01:00	66.3	69.1	66.5	68.4	67.3	67.9	67.2	66.8	66.7
20-11-20 7:21:28 AM	20-11-20 7:22:28 AM	00:01:00	66.5	70.4	66.8	70.2	67.9	68.8	67.6	67.1	67.1
20-11-20 7:22:28 AM	20-11-20 7:23:28 AM	00:01:00	66.5	68.3	66.5	68.1	67.2	67.7	67.1	66.8	66.6
20-11-20 7:23:28 AM	20-11-20 7:24:28 AM	00:01:00	66.4	70.2	66.6	70.0	67.6	68.6	67.4	66.8	66.7
20-11-20 7:24:28 AM	20-11-20 7:25:28 AM	00:01:00	66.4	69.4	66.6	69.1	67.9	68.6	67.8	67.0	66.8
20-11-20 7:25:28 AM	20-11-20 7:26:28 AM	00:01:00	66.5	69.8	66.7	69.4	67.9	68.6	67.8	67.1	66.9
20-11-20 7:26:28 AM	20-11-20 7:27:28 AM	00:01:00	66.7	68.7	66.8	68.7	67.6	68.3	67.5	67.1	66.9
20-11-20 7:27:28 AM	20-11-20 7:28:28 AM	00:01:00	66.5	68.9	66.6	68.7	67.1	67.6	67.0	66.7	66.6
20-11-20 7:28:28 AM	20-11-20 7:29:28 AM	00:01:00	66.7	69.5	66.8	69.3	67.5	68.1	67.3	66.9	66.8
Min			**65.2**	**67.3**	**65.3**	**67.1**	**66.3**	**66.9**	**66.2**	**65.7**	**65.5**
Max			**66.7**	**72.6**	**66.8**	**72.2**	**68.8**	**71.0**	**67.9**	**67.3**	**67.1**
Avg			**66.2**	**69.5**	**66.3**	**69.2**	**67.4**	**68.3**	**67.2**	**66.6**	**66.5**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **20/11/2020**
Monitoring Location : **NML 1 - Accommodation and Recreational Area North of PS 5**
Monitoring Period : **Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
20-11-20 6:59:28 AM	20-11-20 7:00:28 AM	00:01:00	34.5	50.5	54.9	57.8	58.4	61.0	60.3	54.7	35.9	20.0
20-11-20 7:00:28 AM	20-11-20 7:01:28 AM	00:01:00	34.5	50.7	56.0	60.1	63.3	61.5	60.4	54.7	37.2	21.7
20-11-20 7:01:28 AM	20-11-20 7:02:28 AM	00:01:00	33.9	50.5	54.6	58.4	59.9	61.2	60.2	55.1	37.2	19.6
20-11-20 7:02:28 AM	20-11-20 7:03:28 AM	00:01:00	34.6	51.2	55.4	58.9	59.9	61.2	60.5	55.1	38.9	22.9
20-11-20 7:03:28 AM	20-11-20 7:04:28 AM	00:01:00	34.6	50.4	54.6	58.2	58.7	61.1	60.4	55.0	36.1	19.8
20-11-20 7:04:28 AM	20-11-20 7:05:28 AM	00:01:00	34.8	50.2	54.6	57.9	59.1	61.2	60.5	55.4	36.5	19.5
20-11-20 7:05:28 AM	20-11-20 7:06:28 AM	00:01:00	34.2	50.7	55.3	58.4	59.4	61.3	60.6	55.7	36.8	19.9
20-11-20 7:06:28 AM	20-11-20 7:07:28 AM	00:01:00	34.9	51.1	55.3	59.1	60.6	61.6	60.9	56.5	44.8	28.9
20-11-20 7:07:28 AM	20-11-20 7:08:28 AM	00:01:00	34.7	50.8	55.6	59.4	60.4	61.8	60.7	55.6	38.0	22.2
20-11-20 7:08:28 AM	20-11-20 7:09:28 AM	00:01:00	34.4	50.2	55.1	58.4	59.7	61.5	60.6	55.5	36.5	21.0
20-11-20 7:09:28 AM	20-11-20 7:10:28 AM	00:01:00	34.2	50.1	55.0	58.7	59.5	61.6	60.6	55.9	36.5	22.5
20-11-20 7:10:28 AM	20-11-20 7:11:28 AM	00:01:00	33.9	50.4	54.9	58.8	60.1	62.1	60.8	55.4	36.3	22.5
20-11-20 7:11:28 AM	20-11-20 7:12:28 AM	00:01:00	34.0	50.3	55.1	59.0	60.1	62.0	60.9	56.0	39.8	20.9
20-11-20 7:12:28 AM	20-11-20 7:13:28 AM	00:01:00	34.5	50.5	55.3	58.9	60.3	62.3	60.7	55.6	36.5	21.1
20-11-20 7:13:28 AM	20-11-20 7:14:28 AM	00:01:00	34.7	50.0	55.3	58.7	59.7	61.7	60.6	55.7	36.5	20.4
20-11-20 7:14:28 AM	20-11-20 7:15:28 AM	00:01:00	34.4	50.6	55.4	59.4	60.0	62.4	61.1	55.8	37.4	21.6
20-11-20 7:15:28 AM	20-11-20 7:16:28 AM	00:01:00	35.3	52.0	56.1	61.8	61.8	62.4	61.4	57.0	40.3	23.2
20-11-20 7:16:28 AM	20-11-20 7:17:28 AM	00:01:00	35.8	52.1	55.8	60.7	61.1	61.9	60.7	56.1	39.2	22.5
20-11-20 7:17:28 AM	20-11-20 7:18:28 AM	00:01:00	34.4	51.0	55.3	59.7	61.4	62.4	61.0	55.9	37.5	21.5
20-11-20 7:18:28 AM	20-11-20 7:19:28 AM	00:01:00	34.0	50.6	55.0	59.6	60.3	61.8	60.7	55.7	37.3	21.3
20-11-20 7:19:28 AM	20-11-20 7:20:28 AM	00:01:00	34.0	50.7	54.8	59.5	60.7	62.1	60.6	55.6	37.0	21.7
20-11-20 7:20:28 AM	20-11-20 7:21:28 AM	00:01:00	34.6	52.5	55.2	59.6	60.1	61.5	60.5	55.7	39.2	24.0
20-11-20 7:21:28 AM	20-11-20 7:22:28 AM	00:01:00	35.0	51.2	55.9	60.1	60.8	62.1	61.3	56.5	39.4	23.6
20-11-20 7:22:28 AM	20-11-20 7:23:28 AM	00:01:00	34.7	50.5	55.2	59.3	59.8	61.5	60.9	56.0	36.5	22.6
20-11-20 7:23:28 AM	20-11-20 7:24:28 AM	00:01:00	34.9	51.5	56.1	59.8	60.5	61.8	61.0	55.8	37.5	23.6
20-11-20 7:24:28 AM	20-11-20 7:25:28 AM	00:01:00	34.5	51.5	55.5	59.5	61.0	62.2	61.2	56.1	37.5	25.0
20-11-20 7:25:28 AM	20-11-20 7:26:28 AM	00:01:00	35.0	52.2	55.6	59.1	61.1	62.6	60.9	55.9	36.8	25.4
20-11-20 7:26:28 AM	20-11-20 7:27:28 AM	00:01:00	34.4	51.2	55.1	59.5	60.8	62.2	60.6	55.9	37.9	24.3
20-11-20 7:27:28 AM	20-11-20 7:28:28 AM	00:01:00	34.7	50.5	55.4	59.4	59.8	61.3	60.5	55.7	36.3	24.4
20-11-20 7:28:28 AM	20-11-20 7:29:28 AM	00:01:00	34.9	50.6	55.9	59.8	60.1	61.7	61.1	56.1	37.7	24.8
Min			**33.9**	**50.0**	**54.6**	**57.8**	**58.4**	**61.0**	**60.2**	**54.7**	**35.9**	**19.5**
Max			**35.8**	**52.5**	**56.1**	**61.8**	**63.3**	**62.6**	**61.4**	**57.0**	**44.8**	**28.9**
Avg			**34.6**	**50.9**	**55.3**	**59.3**	**60.4**	**61.8**	**60.7**	**55.8**	**38.2**	**23.0**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 20/11/2020**
Monitoring Location	**: NML 2 - North East Boundary of PS 5**
Monitoring Period	**: Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
20-11-20 10:24:34 AM	20-11-20 10:25:34 AM	00:01:00	70.1	72.1	70.2	71.5	70.5	70.7	70.3	70.2	70.1
20-11-20 10:25:34 AM	20-11-20 10:26:34 AM	00:01:00	70.4	71.4	70.6	71.3	70.9	71.2	70.9	70.7	70.6
20-11-20 10:26:34 AM	20-11-20 10:27:34 AM	00:01:00	70.3	79.1	70.4	77.6	71.5	71.8	70.9	70.6	70.5
20-11-20 10:27:34 AM	20-11-20 10:28:34 AM	00:01:00	70.0	71.0	70.0	70.9	70.4	70.6	70.4	70.1	70.1
20-11-20 10:28:34 AM	20-11-20 10:29:34 AM	00:01:00	70.1	71.7	70.3	71.6	70.7	71.0	70.6	70.3	70.2
20-11-20 10:29:34 AM	20-11-20 10:30:34 AM	00:01:00	70.2	71.8	70.4	71.7	71.1	71.5	71.0	70.5	70.5
20-11-20 10:30:34 AM	20-11-20 10:31:34 AM	00:01:00	69.7	71.4	69.8	71.3	70.5	70.9	70.3	70.0	69.9
20-11-20 10:31:34 AM	20-11-20 10:32:34 AM	00:01:00	70.3	79.2	70.3	77.6	71.6	71.7	71.1	70.3	70.3
20-11-20 10:32:34 AM	20-11-20 10:33:34 AM	00:01:00	69.9	72.1	70.0	71.8	70.9	71.3	70.9	70.2	70.2
20-11-20 10:33:34 AM	20-11-20 10:34:34 AM	00:01:00	70.1	71.1	70.2	71.0	70.6	70.9	70.6	70.2	70.2
20-11-20 10:34:34 AM	20-11-20 10:35:34 AM	00:01:00	70.2	71.9	70.2	71.7	71.1	71.5	71.1	70.5	70.4
20-11-20 10:35:34 AM	20-11-20 10:36:34 AM	00:01:00	70.1	71.2	70.2	71.2	70.7	71.0	70.7	70.3	70.2
20-11-20 10:36:34 AM	20-11-20 10:37:34 AM	00:01:00	70.4	78.4	70.5	76.9	71.5	71.6	71.1	70.6	70.5
20-11-20 10:37:34 AM	20-11-20 10:38:34 AM	00:01:00	69.7	72.1	69.9	72.0	70.8	71.1	70.7	70.1	70.0
20-11-20 10:38:34 AM	20-11-20 10:39:34 AM	00:01:00	70.0	71.2	70.1	71.1	70.6	70.9	70.4	70.2	70.1
20-11-20 10:39:34 AM	20-11-20 10:40:34 AM	00:01:00	70.2	71.4	70.3	71.3	70.8	71.2	70.6	70.5	70.4
20-11-20 10:40:34 AM	20-11-20 10:41:34 AM	00:01:00	70.3	71.7	70.3	71.6	71.0	71.3	71.0	70.5	70.5
20-11-20 10:41:34 AM	20-11-20 10:42:34 AM	00:01:00	70.2	79.9	70.2	78.4	71.5	72.0	70.8	70.3	70.3
20-11-20 10:42:34 AM	20-11-20 10:43:34 AM	00:01:00	70.0	71.3	70.2	71.3	70.6	70.9	70.5	70.2	70.2
20-11-20 10:43:34 AM	20-11-20 10:44:34 AM	00:01:00	70.4	71.5	70.6	71.4	71.0	71.2	71.0	70.7	70.7
20-11-20 10:44:34 AM	20-11-20 10:45:34 AM	00:01:00	70.1	72.2	70.2	72.1	71.0	71.4	70.8	70.4	70.3
20-11-20 10:45:34 AM	20-11-20 10:46:34 AM	00:01:00	70.0	71.2	70.1	71.1	70.7	70.9	70.7	70.2	70.2
20-11-20 10:46:34 AM	20-11-20 10:47:34 AM	00:01:00	69.9	77.9	70.0	76.4	71.3	71.5	71.1	70.0	70.0
20-11-20 10:47:34 AM	20-11-20 10:48:34 AM	00:01:00	69.9	71.8	70.0	71.7	70.8	71.4	70.8	70.1	70.1
20-11-20 10:48:34 AM	20-11-20 10:49:34 AM	00:01:00	70.1	71.4	70.2	71.4	70.7	71.1	70.6	70.3	70.3
20-11-20 10:49:34 AM	20-11-20 10:50:34 AM	00:01:00	70.5	71.9	70.7	71.6	71.1	71.3	71.0	70.7	70.7
20-11-20 10:50:34 AM	20-11-20 10:51:34 AM	00:01:00	70.1	71.8	70.2	71.7	70.8	71.4	70.7	70.3	70.3
20-11-20 10:51:34 AM	20-11-20 10:52:34 AM	00:01:00	70.5	79.6	70.6	78.2	71.7	72.2	70.9	70.7	70.6
20-11-20 10:52:34 AM	20-11-20 10:53:34 AM	00:01:00	70.2	72.0	70.3	71.7	71.2	71.5	71.2	70.6	70.4
20-11-20 10:53:34 AM	20-11-20 10:54:34 AM	00:01:00	69.9	71.3	70.1	71.2	70.7	70.9	70.7	70.3	70.2
Min			**69.7**	**71.0**	**69.8**	**70.9**	**70.4**	**70.6**	**70.3**	**70.0**	**69.9**
Max			**70.5**	**79.9**	**70.7**	**78.4**	**71.7**	**72.2**	**71.2**	**70.7**	**70.7**
Avg			**70.1**	**74.4**	**70.2**	**73.6**	**71.0**	**71.3**	**70.8**	**70.4**	**70.3**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **20/11/2020**
Monitoring Location : **NML 2 - North East Boundary of PS 5**
Monitoring Period : **Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
20-11-20 10:24:34 AM	20-11-20 10:25:34 AM	00:01:00	41.3	59.5	57.2	58.8	63.0	64.3	64.6	60.5	53.0	34.0
20-11-20 10:25:34 AM	20-11-20 10:26:34 AM	00:01:00	40.5	62.2	58.6	58.7	63.0	64.2	64.9	61.0	53.4	34.8
20-11-20 10:26:34 AM	20-11-20 10:27:34 AM	00:01:00	41.6	62.4	58.7	58.4	62.9	64.3	65.3	63.4	57.4	37.6
20-11-20 10:27:34 AM	20-11-20 10:28:34 AM	00:01:00	41.3	59.7	57.0	58.0	62.7	64.3	64.8	60.9	53.3	34.3
20-11-20 10:28:34 AM	20-11-20 10:29:34 AM	00:01:00	41.2	60.3	57.8	58.4	63.0	64.3	64.8	60.9	53.1	34.2
20-11-20 10:29:34 AM	20-11-20 10:30:34 AM	00:01:00	40.3	62.3	58.8	58.4	63.0	64.4	64.9	61.0	53.4	34.6
20-11-20 10:30:34 AM	20-11-20 10:31:34 AM	00:01:00	40.2	59.3	56.7	58.3	62.9	64.3	64.8	60.9	53.3	33.6
20-11-20 10:31:34 AM	20-11-20 10:32:34 AM	00:01:00	40.8	61.5	58.1	58.5	63.1	64.4	65.6	64.0	58.0	38.1
20-11-20 10:32:34 AM	20-11-20 10:33:34 AM	00:01:00	41.2	61.9	58.4	58.4	62.9	64.2	64.8	60.9	53.1	34.1
20-11-20 10:33:34 AM	20-11-20 10:34:34 AM	00:01:00	40.3	59.7	56.9	58.4	63.0	64.5	64.8	61.0	53.4	33.8
20-11-20 10:34:34 AM	20-11-20 10:35:34 AM	00:01:00	40.6	62.4	59.1	58.3	62.9	64.5	65.1	61.2	53.3	34.3
20-11-20 10:35:34 AM	20-11-20 10:36:34 AM	00:01:00	41.1	59.7	56.8	58.3	63.0	64.5	65.1	61.2	53.3	34.2
20-11-20 10:36:34 AM	20-11-20 10:37:34 AM	00:01:00	40.6	61.9	58.8	58.4	63.0	64.5	65.4	63.3	56.8	36.7
20-11-20 10:37:34 AM	20-11-20 10:38:34 AM	00:01:00	41.0	62.1	58.5	58.5	62.6	64.1	64.6	60.6	53.2	33.9
20-11-20 10:38:34 AM	20-11-20 10:39:34 AM	00:01:00	40.8	59.4	56.8	58.3	62.9	64.5	64.9	60.9	53.0	33.3
20-11-20 10:39:34 AM	20-11-20 10:40:34 AM	00:01:00	40.6	61.5	58.1	58.3	62.8	64.4	64.8	60.9	52.9	33.7
20-11-20 10:40:34 AM	20-11-20 10:41:34 AM	00:01:00	40.9	62.5	58.9	58.6	62.8	64.4	64.8	60.7	52.7	34.0
20-11-20 10:41:34 AM	20-11-20 10:42:34 AM	00:01:00	40.0	59.7	57.4	58.5	63.0	64.6	65.8	64.5	58.1	37.6
20-11-20 10:42:34 AM	20-11-20 10:43:34 AM	00:01:00	40.5	59.7	57.2	58.7	62.9	64.5	64.9	60.8	52.7	33.3
20-11-20 10:43:34 AM	20-11-20 10:44:34 AM	00:01:00	40.3	62.5	59.5	58.5	62.8	64.2	64.9	61.0	53.5	34.2
20-11-20 10:44:34 AM	20-11-20 10:45:34 AM	00:01:00	40.4	61.1	59.3	58.4	63.0	64.5	65.0	61.2	53.4	33.7
20-11-20 10:45:34 AM	20-11-20 10:46:34 AM	00:01:00	40.2	59.6	58.5	58.4	63.0	64.4	65.0	61.1	53.3	33.6
20-11-20 10:46:34 AM	20-11-20 10:47:34 AM	00:01:00	41.1	61.8	59.4	58.5	62.8	64.3	65.3	62.9	56.4	36.4
20-11-20 10:47:34 AM	20-11-20 10:48:34 AM	00:01:00	40.3	60.7	59.1	58.6	62.9	64.3	65.0	61.0	52.8	33.6
20-11-20 10:48:34 AM	20-11-20 10:49:34 AM	00:01:00	40.0	59.7	58.3	58.5	62.7	64.4	65.1	61.1	52.9	33.7
20-11-20 10:49:34 AM	20-11-20 10:50:34 AM	00:01:00	40.7	62.1	59.8	58.5	62.6	64.5	65.1	61.2	53.1	34.3
20-11-20 10:50:34 AM	20-11-20 10:51:34 AM	00:01:00	40.6	61.1	58.7	58.6	62.9	64.3	65.1	61.1	53.1	33.9
20-11-20 10:51:34 AM	20-11-20 10:52:34 AM	00:01:00	40.9	60.5	58.8	59.2	63.0	64.6	65.9	64.4	58.3	38.0
20-11-20 10:52:34 AM	20-11-20 10:53:34 AM	00:01:00	41.6	62.8	60.1	58.8	62.8	64.3	65.1	61.1	53.1	34.4
20-11-20 10:53:34 AM	20-11-20 10:54:34 AM	00:01:00	40.4	59.6	58.4	58.5	62.8	64.3	65.1	61.2	53.3	33.9
Min			**40.0**	**59.3**	**56.7**	**58.0**	**62.6**	**64.1**	**64.6**	**60.5**	**52.7**	**33.3**
Max			**41.6**	**62.8**	**60.1**	**59.2**	**63.1**	**64.6**	**65.9**	**64.5**	**58.3**	**38.1**
Avg			**40.7**	**61.1**	**58.4**	**58.5**	**62.9**	**64.4**	**65.1**	**61.7**	**54.5**	**34.9**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 20/11/2020**
Monitoring Location	**: NML 3 - Block 4 Site - South of PS 5 Block 3**
Monitoring Period	**: Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
20-11-20 8:27:39 AM	20-11-20 8:28:39 AM	00:01:00	72.0	74.5	72.1	74.3	72.9	73.5	72.7	72.3	72.2
20-11-20 8:28:39 AM	20-11-20 8:29:39 AM	00:01:00	71.9	73.2	72.1	73.0	72.5	72.7	72.5	72.2	72.2
20-11-20 8:29:39 AM	20-11-20 8:30:39 AM	00:01:00	71.9	72.9	72.0	72.8	72.4	72.6	72.3	72.1	72.1
20-11-20 8:30:39 AM	20-11-20 8:31:39 AM	00:01:00	71.9	73.2	72.0	73.1	72.5	72.7	72.5	72.2	72.2
20-11-20 8:31:39 AM	20-11-20 8:32:39 AM	00:01:00	71.8	72.9	71.8	72.8	72.3	72.6	72.2	71.9	71.8
20-11-20 8:32:39 AM	20-11-20 8:33:39 AM	00:01:00	71.5	72.7	71.7	72.6	72.2	72.4	72.2	71.9	71.8
20-11-20 8:33:39 AM	20-11-20 8:34:39 AM	00:01:00	71.9	74.3	72.1	73.9	72.6	73.0	72.5	72.2	72.1
20-11-20 8:34:39 AM	20-11-20 8:35:39 AM	00:01:00	71.9	73.9	72.0	73.6	72.4	72.6	72.3	72.0	72.0
20-11-20 8:35:39 AM	20-11-20 8:36:39 AM	00:01:00	71.9	72.7	72.0	72.7	72.4	72.6	72.3	72.1	72.1
20-11-20 8:36:39 AM	20-11-20 8:37:39 AM	00:01:00	71.9	72.9	72.0	72.7	72.4	72.6	72.3	72.1	72.0
20-11-20 8:37:39 AM	20-11-20 8:38:39 AM	00:01:00	72.0	73.1	72.1	73.0	72.5	72.7	72.4	72.1	72.1
20-11-20 8:38:39 AM	20-11-20 8:39:39 AM	00:01:00	71.7	72.8	71.8	72.7	72.2	72.5	72.2	71.9	71.9
20-11-20 8:39:39 AM	20-11-20 8:40:39 AM	00:01:00	71.6	73.0	71.7	72.9	72.3	72.5	72.3	72.0	71.9
20-11-20 8:40:39 AM	20-11-20 8:41:39 AM	00:01:00	72.0	72.9	72.0	72.8	72.3	72.5	72.2	72.1	72.1
20-11-20 8:41:39 AM	20-11-20 8:42:39 AM	00:01:00	71.7	73.1	71.9	72.9	72.4	72.6	72.3	72.1	72.0
20-11-20 8:42:39 AM	20-11-20 8:43:39 AM	00:01:00	72.1	73.1	72.1	72.9	72.5	72.6	72.4	72.2	72.2
20-11-20 8:43:39 AM	20-11-20 8:44:39 AM	00:01:00	72.0	73.2	72.1	73.1	72.5	72.8	72.5	72.2	72.1
20-11-20 8:44:39 AM	20-11-20 8:45:39 AM	00:01:00	71.7	73.1	71.8	72.8	72.3	72.6	72.3	72.0	72.0
20-11-20 8:45:39 AM	20-11-20 8:46:39 AM	00:01:00	71.8	73.5	72.0	73.3	72.5	72.8	72.3	72.1	72.0
20-11-20 8:46:39 AM	20-11-20 8:47:39 AM	00:01:00	71.8	73.8	72.1	73.5	72.5	72.7	72.4	72.2	72.2
20-11-20 8:47:39 AM	20-11-20 8:48:39 AM	00:01:00	71.6	72.8	71.7	72.7	72.3	72.5	72.3	71.9	71.8
20-11-20 8:48:39 AM	20-11-20 8:49:39 AM	00:01:00	71.9	73.2	72.0	73.1	72.6	73.0	72.5	72.2	72.0
20-11-20 8:49:39 AM	20-11-20 8:50:39 AM	00:01:00	72.1	73.2	72.1	73.1	72.6	72.7	72.5	72.3	72.3
20-11-20 8:50:39 AM	20-11-20 8:51:39 AM	00:01:00	71.9	72.9	72.0	72.8	72.4	72.5	72.3	72.1	72.0
20-11-20 8:51:39 AM	20-11-20 8:52:39 AM	00:01:00	72.1	73.4	72.1	73.2	72.6	72.7	72.5	72.3	72.2
20-11-20 8:52:39 AM	20-11-20 8:53:39 AM	00:01:00	72.0	73.9	72.0	73.8	72.7	73.1	72.7	72.2	72.1
20-11-20 8:53:39 AM	20-11-20 8:54:39 AM	00:01:00	72.1	73.2	72.1	73.1	72.6	72.9	72.5	72.2	72.2
20-11-20 8:54:39 AM	20-11-20 8:55:39 AM	00:01:00	72.0	73.3	72.0	73.0	72.5	72.8	72.4	72.2	72.1
20-11-20 8:55:39 AM	20-11-20 8:56:39 AM	00:01:00	71.7	72.8	71.9	72.8	72.3	72.6	72.2	72.0	71.9
20-11-20 8:56:39 AM	20-11-20 8:57:39 AM	00:01:00	71.8	73.1	71.9	72.9	72.4	72.7	72.4	71.9	71.9
Min			**71.5**	**72.7**	**71.7**	**72.6**	**72.2**	**72.4**	**72.2**	**71.9**	**71.8**
Max			**72.1**	**74.5**	**72.1**	**74.3**	**72.9**	**73.5**	**72.7**	**72.3**	**72.3**
Avg			**71.9**	**73.2**	**72.0**	**73.1**	**72.5**	**72.7**	**72.4**	**72.1**	**72.1**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **20/11/2020**
Monitoring Location : **NML 3 - Block 4 Site - South of PS 5 Block 3**
Monitoring Period : **Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
20-11-20 8:27:39 AM	20-11-20 8:28:39 AM	00:01:00	40.1	55.3	63.5	66.6	67.5	66.1	63.5	58.2	44.6	30.6
20-11-20 8:28:39 AM	20-11-20 8:29:39 AM	00:01:00	40.2	55.3	63.0	66.5	67.3	65.5	62.8	57.9	44.4	30.4
20-11-20 8:29:39 AM	20-11-20 8:30:39 AM	00:01:00	40.3	55.9	63.1	66.4	67.1	65.2	62.5	57.6	44.3	30.6
20-11-20 8:30:39 AM	20-11-20 8:31:39 AM	00:01:00	39.5	55.9	62.9	66.4	67.2	65.6	62.9	57.7	44.1	30.3
20-11-20 8:31:39 AM	20-11-20 8:32:39 AM	00:01:00	39.3	55.1	62.7	66.1	67.0	65.3	62.7	57.4	43.9	29.8
20-11-20 8:32:39 AM	20-11-20 8:33:39 AM	00:01:00	39.1	54.5	62.7	66.2	67.0	65.2	62.5	57.3	44.0	30.0
20-11-20 8:33:39 AM	20-11-20 8:34:39 AM	00:01:00	38.8	54.9	62.8	66.4	67.3	65.9	63.4	57.7	44.3	30.0
20-11-20 8:34:39 AM	20-11-20 8:35:39 AM	00:01:00	38.9	54.7	63.0	66.4	67.2	65.3	62.6	57.3	44.2	30.0
20-11-20 8:35:39 AM	20-11-20 8:36:39 AM	00:01:00	39.4	55.7	62.9	66.4	67.1	65.3	62.5	57.3	44.1	30.4
20-11-20 8:36:39 AM	20-11-20 8:37:39 AM	00:01:00	39.5	55.7	62.9	66.3	67.2	65.1	62.4	57.3	44.2	30.4
20-11-20 8:37:39 AM	20-11-20 8:38:39 AM	00:01:00	38.9	54.6	63.1	66.4	67.2	65.5	62.7	57.4	44.3	30.6
20-11-20 8:38:39 AM	20-11-20 8:39:39 AM	00:01:00	38.9	54.7	63.0	66.2	67.0	65.1	62.3	57.2	44.2	30.5
20-11-20 8:39:39 AM	20-11-20 8:40:39 AM	00:01:00	40.0	55.3	63.0	66.3	67.0	65.3	62.6	57.3	44.2	30.8
20-11-20 8:40:39 AM	20-11-20 8:41:39 AM	00:01:00	39.3	54.6	63.0	66.2	67.1	65.2	62.4	57.2	44.2	30.7
20-11-20 8:41:39 AM	20-11-20 8:42:39 AM	00:01:00	39.5	55.4	62.9	66.4	67.2	65.2	62.5	57.3	44.2	30.8
20-11-20 8:42:39 AM	20-11-20 8:43:39 AM	00:01:00	39.4	55.4	62.8	66.5	67.2	65.5	62.7	57.4	44.1	30.6
20-11-20 8:43:39 AM	20-11-20 8:44:39 AM	00:01:00	38.9	55.4	63.0	66.5	67.2	65.6	62.7	57.3	44.1	30.7
20-11-20 8:44:39 AM	20-11-20 8:45:39 AM	00:01:00	39.7	55.6	62.9	66.3	67.1	65.3	62.4	57.3	44.2	30.8
20-11-20 8:45:39 AM	20-11-20 8:46:39 AM	00:01:00	39.1	55.7	63.0	66.4	67.3	65.5	62.5	57.4	44.3	30.9
20-11-20 8:46:39 AM	20-11-20 8:47:39 AM	00:01:00	39.3	54.8	62.8	66.4	67.3	65.6	62.9	57.5	44.2	30.7
20-11-20 8:47:39 AM	20-11-20 8:48:39 AM	00:01:00	39.0	55.0	63.0	66.3	67.0	65.2	62.4	57.3	44.1	30.7
20-11-20 8:48:39 AM	20-11-20 8:49:39 AM	00:01:00	39.3	55.7	63.0	66.5	67.4	65.6	62.8	57.4	44.1	31.1
20-11-20 8:49:39 AM	20-11-20 8:50:39 AM	00:01:00	39.4	56.0	63.1	66.6	67.3	65.4	62.6	57.4	44.4	31.3
20-11-20 8:50:39 AM	20-11-20 8:51:39 AM	00:01:00	39.7	54.9	62.9	66.5	67.0	65.3	62.5	57.3	44.2	30.8
20-11-20 8:51:39 AM	20-11-20 8:52:39 AM	00:01:00	39.3	55.0	62.9	66.6	67.1	65.7	63.0	57.5	44.2	31.0
20-11-20 8:52:39 AM	20-11-20 8:53:39 AM	00:01:00	39.4	54.5	63.2	66.6	67.4	66.0	63.3	57.7	44.2	31.2
20-11-20 8:53:39 AM	20-11-20 8:54:39 AM	00:01:00	39.2	55.4	63.2	66.5	67.3	65.7	62.8	57.5	44.5	31.3
20-11-20 8:54:39 AM	20-11-20 8:55:39 AM	00:01:00	39.2	56.2	62.9	66.6	67.1	65.5	62.5	57.4	44.5	31.2
20-11-20 8:55:39 AM	20-11-20 8:56:39 AM	00:01:00	38.9	55.1	63.0	66.4	66.9	65.2	62.3	57.3	44.5	31.1
20-11-20 8:56:39 AM	20-11-20 8:57:39 AM	00:01:00	38.6	55.2	63.3	66.3	67.3	65.0	62.9	57.4	44.2	31.4
Min			**38.6**	**54.5**	**62.7**	**66.1**	**66.9**	**65.0**	**62.3**	**57.2**	**43.9**	**29.8**
Max			**40.3**	**56.2**	**63.5**	**66.6**	**67.5**	**66.1**	**63.5**	**58.2**	**44.6**	**31.4**
Avg			**39.4**	**55.3**	**63.0**	**66.4**	**67.2**	**65.4**	**62.7**	**57.4**	**44.2**	**30.7**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 20/11/2020**
Monitoring Location	**: NML 4 - Princess Sabeeka Oasis: South East of PS 5**
Monitoring Period	**: Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
20-11-20 7:43:56 AM	20-11-20 7:44:56 AM	00:01:00	56.7	59.8	56.8	59.3	58.1	58.9	57.9	57.1	56.8
20-11-20 7:44:56 AM	20-11-20 7:45:56 AM	00:01:00	56.9	59.8	57.1	59.7	58.4	59.3	58.3	57.3	57.2
20-11-20 7:45:56 AM	20-11-20 7:46:56 AM	00:01:00	55.2	59.8	55.6	59.4	57.5	58.6	57.6	56.1	56.0
20-11-20 7:46:56 AM	20-11-20 7:47:56 AM	00:01:00	56.5	62.2	56.5	61.4	58.2	59.8	57.7	57.0	56.9
20-11-20 7:47:56 AM	20-11-20 7:48:56 AM	00:01:00	56.1	59.4	56.4	59.3	57.7	58.7	57.5	56.5	56.5
20-11-20 7:48:56 AM	20-11-20 7:49:56 AM	00:01:00	55.7	59.6	56.0	59.3	57.3	58.5	57.1	56.3	56.0
20-11-20 7:49:56 AM	20-11-20 7:50:56 AM	00:01:00	55.5	60.4	55.6	60.1	57.6	59.4	56.7	55.7	55.6
20-11-20 7:50:56 AM	20-11-20 7:51:56 AM	00:01:00	56.3	59.2	56.4	59.2	57.6	58.8	57.1	56.6	56.5
20-11-20 7:51:56 AM	20-11-20 7:52:56 AM	00:01:00	55.2	57.9	55.3	57.7	56.3	57.4	56.4	55.4	55.3
20-11-20 7:52:56 AM	20-11-20 7:53:56 AM	00:01:00	54.8	63.0	55.3	62.6	58.8	61.3	58.5	55.5	55.3
20-11-20 7:53:56 AM	20-11-20 7:54:56 AM	00:01:00	55.2	64.4	56.0	63.3	59.7	61.6	59.0	57.0	56.6
20-11-20 7:54:56 AM	20-11-20 7:55:56 AM	00:01:00	55.6	66.2	56.2	65.4	62.0	64.7	61.5	56.9	56.8
20-11-20 7:55:56 AM	20-11-20 7:56:56 AM	00:01:00	56.1	69.9	57.5	68.6	62.5	64.9	61.6	58.9	58.2
20-11-20 7:56:56 AM	20-11-20 7:57:56 AM	00:01:00	55.4	67.5	55.7	66.8	59.3	62.4	56.5	56.1	56.0
20-11-20 7:57:56 AM	20-11-20 7:58:56 AM	00:01:00	55.2	58.7	55.4	58.1	56.2	56.7	56.1	55.6	55.5
20-11-20 7:58:56 AM	20-11-20 7:59:56 AM	00:01:00	54.9	59.4	55.0	58.7	56.2	57.1	56.1	55.4	55.2
20-11-20 7:59:56 AM	20-11-20 8:00:56 AM	00:01:00	54.9	62.5	55.1	61.1	56.6	57.7	56.2	55.5	55.4
20-11-20 8:00:56 AM	20-11-20 8:01:56 AM	00:01:00	56.0	59.8	56.2	59.4	57.4	58.6	57.1	56.4	56.2
20-11-20 8:01:56 AM	20-11-20 8:02:56 AM	00:01:00	54.9	72.0	55.2	71.3	60.1	59.2	57.5	55.7	55.4
20-11-20 8:02:56 AM	20-11-20 8:03:56 AM	00:01:00	55.1	65.3	55.2	64.5	59.8	63.2	58.2	55.5	55.3
20-11-20 8:03:56 AM	20-11-20 8:04:56 AM	00:01:00	55.1	63.4	55.5	62.6	59.5	61.3	59.2	57.2	56.9
20-11-20 8:04:56 AM	20-11-20 8:05:56 AM	00:01:00	54.7	61.8	55.6	61.3	58.2	59.8	58.0	56.3	55.9
20-11-20 8:05:56 AM	20-11-20 8:06:56 AM	00:01:00	54.1	60.4	54.6	60.0	57.5	59.0	57.2	55.7	55.1
20-11-20 8:06:56 AM	20-11-20 8:07:56 AM	00:01:00	54.4	62.5	54.8	62.0	59.1	60.6	59.2	56.1	55.3
20-11-20 8:07:56 AM	20-11-20 8:08:56 AM	00:01:00	54.4	61.0	54.6	60.3	57.8	59.5	57.8	55.8	55.3
20-11-20 8:08:56 AM	20-11-20 8:09:56 AM	00:01:00	54.7	57.3	54.8	57.2	56.1	56.9	56.0	55.2	55.1
20-11-20 8:09:56 AM	20-11-20 8:10:56 AM	00:01:00	55.2	59.3	55.4	59.2	57.1	58.7	56.8	55.7	55.5
20-11-20 8:10:56 AM	20-11-20 8:11:56 AM	00:01:00	54.3	57.6	54.5	57.3	56.1	56.7	56.0	55.0	54.8
20-11-20 8:11:56 AM	20-11-20 8:12:56 AM	00:01:00	56.0	60.1	56.1	59.5	57.4	58.4	57.2	56.7	56.6
20-11-20 8:12:56 AM	20-11-20 8:13:56 AM	00:01:00	54.6	58.5	54.8	58.4	56.1	57.6	55.6	54.9	54.8
Min			**54.1**	**57.3**	**54.5**	**57.2**	**56.1**	**56.7**	**55.6**	**54.9**	**54.8**
Max			**56.9**	**72.0**	**57.5**	**71.3**	**62.5**	**64.9**	**61.6**	**58.9**	**58.2**
Avg			**55.4**	**63.6**	**55.7**	**62.8**	**58.4**	**60.1**	**57.9**	**56.3**	**56.0**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **20/11/2020**
Monitoring Location : **NML 4 - Princess Sabeeka Oasis: South East of PS 5**
Monitoring Period : **Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
20-11-20 7:43:56 AM	20-11-20 7:44:56 AM	00:01:00	32.2	44.7	47.2	49.9	48.6	50.1	53.3	49.0	36.0	18.4
20-11-20 7:44:56 AM	20-11-20 7:45:56 AM	00:01:00	31.8	42.6	47.3	51.9	49.3	50.7	53.8	48.1	35.5	18.4
20-11-20 7:45:56 AM	20-11-20 7:46:56 AM	00:01:00	31.7	42.9	46.3	50.0	48.1	49.3	53.1	48.0	35.2	18.2
20-11-20 7:46:56 AM	20-11-20 7:47:56 AM	00:01:00	35.2	44.3	48.6	50.4	50.0	51.8	51.6	46.9	36.9	20.9
20-11-20 7:47:56 AM	20-11-20 7:48:56 AM	00:01:00	34.8	42.9	48.0	50.1	49.0	50.7	52.0	47.0	35.2	18.8
20-11-20 7:48:56 AM	20-11-20 7:49:56 AM	00:01:00	35.2	42.7	48.7	51.2	48.9	50.4	50.6	44.7	33.1	18.2
20-11-20 7:49:56 AM	20-11-20 7:50:56 AM	00:01:00	35.1	43.0	47.2	52.1	49.3	51.0	50.3	45.0	33.4	18.2
20-11-20 7:50:56 AM	20-11-20 7:51:56 AM	00:01:00	35.0	43.3	48.3	50.5	49.8	51.2	50.7	44.4	33.0	18.3
20-11-20 7:51:56 AM	20-11-20 7:52:56 AM	00:01:00	34.9	43.5	46.8	49.4	48.8	49.9	48.9	44.1	33.2	18.3
20-11-20 7:52:56 AM	20-11-20 7:53:56 AM	00:01:00	34.2	42.5	46.3	49.5	48.2	50.0	56.3	45.6	36.9	18.8
20-11-20 7:53:56 AM	20-11-20 7:54:56 AM	00:01:00	33.9	43.6	47.1	51.1	49.2	51.0	56.9	46.6	38.2	18.9
20-11-20 7:54:56 AM	20-11-20 7:55:56 AM	00:01:00	34.2	43.6	49.8	50.7	49.1	51.2	60.6	45.4	37.0	19.1
20-11-20 7:55:56 AM	20-11-20 7:56:56 AM	00:01:00	34.3	43.6	47.8	50.9	49.9	52.4	61.2	46.0	38.8	19.8
20-11-20 7:56:56 AM	20-11-20 7:57:56 AM	00:01:00	33.9	42.2	46.9	50.3	49.0	51.2	56.6	45.3	38.1	19.2
20-11-20 7:57:56 AM	20-11-20 7:58:56 AM	00:01:00	33.2	43.2	46.7	49.9	48.5	49.5	49.0	43.8	33.2	18.3
20-11-20 7:58:56 AM	20-11-20 7:59:56 AM	00:01:00	33.9	42.3	46.8	50.4	48.5	49.4	48.8	43.9	33.2	18.4
20-11-20 7:59:56 AM	20-11-20 8:00:56 AM	00:01:00	34.2	42.3	46.5	50.3	48.6	50.2	49.1	45.6	34.4	18.8
20-11-20 8:00:56 AM	20-11-20 8:01:56 AM	00:01:00	33.7	45.1	47.4	51.0	49.9	51.2	49.6	44.1	34.2	19.0
20-11-20 8:01:56 AM	20-11-20 8:02:56 AM	00:01:00	31.9	45.5	48.1	52.2	50.4	51.3	52.9	55.3	42.5	28.9
20-11-20 8:02:56 AM	20-11-20 8:03:56 AM	00:01:00	31.8	42.3	46.1	49.7	48.4	52.7	57.2	46.3	36.6	18.6
20-11-20 8:03:56 AM	20-11-20 8:04:56 AM	00:01:00	31.9	42.4	48.0	49.8	48.4	51.0	55.5	52.4	37.1	18.9
20-11-20 8:04:56 AM	20-11-20 8:05:56 AM	00:01:00	31.2	41.4	46.1	50.0	48.2	50.5	54.2	49.2	35.0	18.4
20-11-20 8:05:56 AM	20-11-20 8:06:56 AM	00:01:00	31.4	41.8	46.0	49.5	48.1	50.7	53.3	44.5	33.2	18.1
20-11-20 8:06:56 AM	20-11-20 8:07:56 AM	00:01:00	32.3	45.1	46.4	51.2	49.1	51.1	55.0	50.5	35.8	18.8
20-11-20 8:07:56 AM	20-11-20 8:08:56 AM	00:01:00	32.0	44.3	46.7	50.0	48.4	51.0	52.9	47.8	34.1	18.3
20-11-20 8:08:56 AM	20-11-20 8:09:56 AM	00:01:00	32.2	43.0	47.9	49.8	48.1	48.8	48.9	44.9	32.8	18.2
20-11-20 8:09:56 AM	20-11-20 8:10:56 AM	00:01:00	32.4	44.6	47.2	50.8	49.5	51.0	49.4	43.3	32.6	17.9
20-11-20 8:10:56 AM	20-11-20 8:11:56 AM	00:01:00	32.2	42.8	47.3	49.9	48.6	49.1	47.9	42.5	32.0	17.9
20-11-20 8:11:56 AM	20-11-20 8:12:56 AM	00:01:00	32.3	43.2	50.3	50.6	49.0	49.8	50.7	47.7	36.7	18.1
20-11-20 8:12:56 AM	20-11-20 8:13:56 AM	00:01:00	31.3	42.7	47.2	50.0	48.7	49.2	48.1	42.9	32.6	18.2
Min			**31.2**	**41.4**	**46.0**	**49.4**	**48.1**	**48.8**	**47.9**	**42.5**	**32.0**	**17.9**
Max			**35.2**	**45.5**	**50.3**	**52.2**	**50.4**	**52.7**	**61.2**	**55.3**	**42.5**	**28.9**
Avg			**33.3**	**43.4**	**47.5**	**50.5**	**49.0**	**50.7**	**54.3**	**47.6**	**36.0**	**19.9**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 20/11/2020**
Monitoring Location	**: NML 5 - Western Boundary of Potline 6**
Monitoring Period	**: Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
20-11-20 9:16:18 AM	20-11-20 9:17:18 AM	00:01:00	58.3	60.0	58.4	59.8	59.0	59.3	58.9	58.5	58.5
20-11-20 9:17:18 AM	20-11-20 9:18:18 AM	00:01:00	57.6	59.2	57.7	59.0	58.4	58.7	58.4	57.9	57.8
20-11-20 9:18:18 AM	20-11-20 9:19:18 AM	00:01:00	57.8	64.1	57.9	62.7	58.9	59.5	58.6	58.1	58.1
20-11-20 9:19:18 AM	20-11-20 9:20:18 AM	00:01:00	57.4	63.9	57.6	63.4	59.2	60.8	58.8	57.8	57.6
20-11-20 9:20:18 AM	20-11-20 9:21:18 AM	00:01:00	58.3	67.6	58.4	67.4	61.3	64.9	59.2	58.6	58.5
20-11-20 9:21:18 AM	20-11-20 9:22:18 AM	00:01:00	57.8	59.3	57.9	59.3	58.4	58.8	58.3	58.0	58.0
20-11-20 9:22:18 AM	20-11-20 9:23:18 AM	00:01:00	58.1	59.8	58.2	59.8	58.9	59.4	58.8	58.4	58.3
20-11-20 9:23:18 AM	20-11-20 9:24:18 AM	00:01:00	57.7	59.2	57.8	59.2	58.4	58.7	58.4	57.9	57.8
20-11-20 9:24:18 AM	20-11-20 9:25:18 AM	00:01:00	57.2	59.1	57.3	59.0	58.1	58.7	58.0	57.5	57.4
20-11-20 9:25:18 AM	20-11-20 9:26:18 AM	00:01:00	57.5	59.2	57.6	59.1	58.3	58.7	58.2	57.9	57.7
20-11-20 9:26:18 AM	20-11-20 9:27:18 AM	00:01:00	57.3	59.5	57.5	59.4	58.6	59.2	58.5	57.9	57.7
20-11-20 9:27:18 AM	20-11-20 9:28:18 AM	00:01:00	57.9	69.4	58.1	69.0	61.5	66.0	58.8	58.4	58.4
20-11-20 9:28:18 AM	20-11-20 9:29:18 AM	00:01:00	57.9	59.7	58.0	59.5	58.8	59.1	58.8	58.2	58.1
20-11-20 9:29:18 AM	20-11-20 9:30:18 AM	00:01:00	57.9	61.4	58.0	61.1	58.8	59.6	58.6	58.1	58.1
20-11-20 9:30:18 AM	20-11-20 9:31:18 AM	00:01:00	57.9	60.7	58.0	60.4	58.6	58.9	58.4	58.1	58.1
20-11-20 9:31:18 AM	20-11-20 9:32:18 AM	00:01:00	58.0	59.4	58.1	59.3	58.7	59.1	58.6	58.2	58.2
20-11-20 9:32:18 AM	20-11-20 9:33:18 AM	00:01:00	57.5	59.3	57.6	59.2	58.3	58.9	58.1	57.7	57.7
20-11-20 9:33:18 AM	20-11-20 9:34:18 AM	00:01:00	56.9	58.8	57.0	58.6	57.8	58.3	57.7	57.4	57.3
20-11-20 9:34:18 AM	20-11-20 9:35:18 AM	00:01:00	57.5	65.1	57.6	64.8	60.1	63.8	58.6	58.0	57.9
20-11-20 9:35:18 AM	20-11-20 9:36:18 AM	00:01:00	57.4	59.2	57.5	58.9	58.2	58.6	58.2	57.7	57.7
20-11-20 9:36:18 AM	20-11-20 9:37:18 AM	00:01:00	57.8	60.1	57.9	60.0	58.9	59.7	58.8	58.3	58.2
20-11-20 9:37:18 AM	20-11-20 9:38:18 AM	00:01:00	59.1	61.0	59.3	60.8	59.9	60.2	59.8	59.6	59.4
20-11-20 9:38:18 AM	20-11-20 9:39:18 AM	00:01:00	57.5	59.8	57.6	59.6	58.6	59.2	58.6	57.9	57.8
20-11-20 9:39:18 AM	20-11-20 9:40:18 AM	00:01:00	57.5	59.2	57.6	58.9	58.1	58.4	58.0	57.7	57.6
20-11-20 9:40:18 AM	20-11-20 9:41:18 AM	00:01:00	57.7	60.0	57.7	59.6	58.4	58.6	58.3	58.0	57.9
20-11-20 9:41:18 AM	20-11-20 9:42:18 AM	00:01:00	57.4	59.3	57.5	59.0	58.3	58.5	58.2	57.9	57.6
20-11-20 9:42:18 AM	20-11-20 9:43:18 AM	00:01:00	57.6	63.4	57.7	63.1	59.7	62.2	58.8	58.0	57.9
20-11-20 9:43:18 AM	20-11-20 9:44:18 AM	00:01:00	57.3	59.3	57.3	59.1	58.2	58.6	58.1	57.7	57.5
20-11-20 9:44:18 AM	20-11-20 9:45:18 AM	00:01:00	57.3	58.9	57.4	58.7	57.9	58.4	57.8	57.5	57.4
20-11-20 9:45:18 AM	20-11-20 9:46:18 AM	00:01:00	56.9	59.1	57.1	59.0	58.1	58.6	57.9	57.6	57.5
Min			**56.9**	**58.8**	**57.0**	**58.6**	**57.8**	**58.3**	**57.7**	**57.4**	**57.3**
Max			**59.1**	**69.4**	**59.3**	**69.0**	**61.5**	**66.0**	**59.8**	**59.6**	**59.4**
Avg			**57.7**	**62.0**	**57.8**	**61.6**	**58.9**	**60.3**	**58.5**	**58.0**	**57.9**

Project : **Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date : **20/11/2020**
Monitoring Location : **NML 5 - Western Boundary of Potline 6**
Monitoring Period : **Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
20-11-20 9:16:18 AM	20-11-20 9:17:18 AM	00:01:00	34.6	44.5	50.3	52.3	53.5	51.7	50.6	45.5	32.6	20.9
20-11-20 9:17:18 AM	20-11-20 9:18:18 AM	00:01:00	34.5	44.4	49.3	51.8	52.5	51.2	50.1	45.3	32.5	21.1
20-11-20 9:18:18 AM	20-11-20 9:19:18 AM	00:01:00	34.5	45.3	49.9	52.4	53.1	51.4	50.4	45.5	32.1	23.5
20-11-20 9:19:18 AM	20-11-20 9:20:18 AM	00:01:00	34.9	45.0	49.8	52.0	53.5	52.7	50.8	46.3	33.7	22.1
20-11-20 9:20:18 AM	20-11-20 9:21:18 AM	00:01:00	34.9	45.3	51.9	52.4	54.5	55.1	55.1	49.7	39.7	27.7
20-11-20 9:21:18 AM	20-11-20 9:22:18 AM	00:01:00	34.9	45.1	49.2	51.5	52.6	50.9	50.4	45.8	32.1	21.7
20-11-20 9:22:18 AM	20-11-20 9:23:18 AM	00:01:00	34.6	44.8	49.1	51.4	53.8	51.4	50.6	46.0	32.3	19.9
20-11-20 9:23:18 AM	20-11-20 9:24:18 AM	00:01:00	34.9	44.9	48.6	51.8	52.7	50.7	50.1	45.4	31.8	18.6
20-11-20 9:24:18 AM	20-11-20 9:25:18 AM	00:01:00	34.8	44.2	48.3	51.3	52.3	50.3	50.4	45.9	32.3	22.7
20-11-20 9:25:18 AM	20-11-20 9:26:18 AM	00:01:00	34.4	44.4	48.5	51.4	52.8	50.8	50.3	45.9	32.0	22.1
20-11-20 9:26:18 AM	20-11-20 9:27:18 AM	00:01:00	34.4	44.9	49.0	52.0	52.9	51.2	50.5	45.9	32.2	19.8
20-11-20 9:27:18 AM	20-11-20 9:28:18 AM	00:01:00	34.2	46.2	50.5	52.9	54.9	55.8	54.8	50.0	39.1	26.9
20-11-20 9:28:18 AM	20-11-20 9:29:18 AM	00:01:00	34.9	45.0	51.9	51.7	52.5	51.0	51.1	46.8	33.3	26.3
20-11-20 9:29:18 AM	20-11-20 9:30:18 AM	00:01:00	34.4	44.7	49.0	51.8	52.8	51.7	51.0	46.8	32.9	21.8
20-11-20 9:30:18 AM	20-11-20 9:31:18 AM	00:01:00	34.3	44.6	48.8	51.6	52.8	51.4	50.8	46.2	31.9	17.4
20-11-20 9:31:18 AM	20-11-20 9:32:18 AM	00:01:00	34.7	44.6	49.1	51.4	53.1	51.1	50.9	46.6	32.2	20.9
20-11-20 9:32:18 AM	20-11-20 9:33:18 AM	00:01:00	34.9	44.1	48.4	51.7	52.4	50.6	50.3	46.1	32.1	21.0
20-11-20 9:33:18 AM	20-11-20 9:34:18 AM	00:01:00	34.9	43.7	47.5	51.3	51.9	50.1	49.9	46.2	32.8	24.3
20-11-20 9:34:18 AM	20-11-20 9:35:18 AM	00:01:00	35.0	45.0	48.9	53.0	54.5	53.7	51.9	47.8	35.2	23.8
20-11-20 9:35:18 AM	20-11-20 9:36:18 AM	00:01:00	34.6	44.0	48.3	51.6	52.5	50.8	49.8	45.7	32.7	23.7
20-11-20 9:36:18 AM	20-11-20 9:37:18 AM	00:01:00	34.7	44.4	49.5	52.3	53.5	51.7	50.4	45.4	31.8	20.1
20-11-20 9:37:18 AM	20-11-20 9:38:18 AM	00:01:00	34.8	44.7	49.8	53.0	54.9	52.7	50.7	45.9	32.1	18.9
20-11-20 9:38:18 AM	20-11-20 9:39:18 AM	00:01:00	34.7	45.3	50.1	51.8	52.5	50.9	50.2	45.7	32.2	21.1
20-11-20 9:39:18 AM	20-11-20 9:40:18 AM	00:01:00	34.7	44.6	48.6	51.6	52.3	50.3	49.9	45.4	32.2	19.0
20-11-20 9:40:18 AM	20-11-20 9:41:18 AM	00:01:00	35.0	45.3	48.7	51.9	52.6	50.7	50.3	45.3	31.9	18.6
20-11-20 9:41:18 AM	20-11-20 9:42:18 AM	00:01:00	35.0	44.4	49.0	52.0	52.4	50.7	49.7	45.0	32.2	23.1
20-11-20 9:42:18 AM	20-11-20 9:43:18 AM	00:01:00	35.7	45.9	50.0	53.0	54.5	52.9	50.4	44.9	32.3	25.1
20-11-20 9:43:18 AM	20-11-20 9:44:18 AM	00:01:00	34.8	45.0	49.2	51.8	52.4	50.4	49.4	44.7	32.4	24.5
20-11-20 9:44:18 AM	20-11-20 9:45:18 AM	00:01:00	34.8	45.1	48.6	51.5	52.4	50.3	49.1	44.2	31.8	24.4
20-11-20 9:45:18 AM	20-11-20 9:46:18 AM	00:01:00	35.0	45.2	48.9	51.7	52.2	50.1	50.3	44.3	33.4	27.1
Min			**34.2**	**43.7**	**47.5**	**51.3**	**51.9**	**50.1**	**49.1**	**44.2**	**31.8**	**17.4**
Max			**35.7**	**46.2**	**51.9**	**53.0**	**54.9**	**55.8**	**55.1**	**50.0**	**39.7**	**27.7**
Avg			**34.8**	**44.9**	**49.4**	**52.0**	**53.1**	**51.7**	**50.9**	**46.2**	**33.5**	**23.1**

Project	**: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)**
Monitoring Date	**: 20/11/2020**
Monitoring Location	**: NML 6 - West Boundary of PS5 Block 4**
Monitoring Period	**: Weekend - Morning (Logged Broadband Data)**

Start Time	End Time	Duration	LAF min	LAFMax	LAS min	LASMax	LAeq	L10	L50	L90	L95
20-11-20 9:50:30 AM	20-11-20 9:51:30 AM	00:01:00	63.3	64.7	63.3	64.5	63.8	64.2	63.7	63.4	63.3
20-11-20 9:51:30 AM	20-11-20 9:52:30 AM	00:01:00	63.1	64.8	63.2	64.5	63.7	63.9	63.6	63.3	63.2
20-11-20 9:52:30 AM	20-11-20 9:53:30 AM	00:01:00	63.1	64.6	63.2	64.3	63.6	63.9	63.5	63.2	63.2
20-11-20 9:53:30 AM	20-11-20 9:54:30 AM	00:01:00	63.2	64.8	63.3	64.7	64.0	64.4	63.9	63.5	63.4
20-11-20 9:54:30 AM	20-11-20 9:55:30 AM	00:01:00	62.9	64.8	63.0	64.7	63.6	63.9	63.5	63.1	63.0
20-11-20 9:55:30 AM	20-11-20 9:56:30 AM	00:01:00	62.7	64.5	62.8	64.3	63.5	63.7	63.4	63.0	62.9
20-11-20 9:56:30 AM	20-11-20 9:57:30 AM	00:01:00	62.9	64.2	63.0	64.1	63.6	63.8	63.5	63.2	63.1
20-11-20 9:57:30 AM	20-11-20 9:58:30 AM	00:01:00	62.8	65.2	62.9	65.0	63.7	64.4	63.5	63.2	63.1
20-11-20 9:58:30 AM	20-11-20 9:59:30 AM	00:01:00	62.8	64.6	62.9	64.4	63.6	64.0	63.5	63.2	63.2
20-11-20 9:59:30 AM	20-11-20 10:00:30 AM	00:01:00	63.0	64.5	63.1	64.4	63.8	64.1	63.7	63.3	63.3
20-11-20 10:00:30 AM	20-11-20 10:01:30 AM	00:01:00	62.7	64.4	63.0	64.3	63.6	63.9	63.6	63.3	63.2
20-11-20 10:01:30 AM	20-11-20 10:02:30 AM	00:01:00	62.7	64.7	62.8	64.5	63.7	64.1	63.7	63.1	63.0
20-11-20 10:02:30 AM	20-11-20 10:03:30 AM	00:01:00	62.6	64.2	62.6	64.1	63.4	63.8	63.3	62.9	62.7
20-11-20 10:03:30 AM	20-11-20 10:04:30 AM	00:01:00	62.6	64.3	62.7	64.1	63.2	63.5	63.1	62.8	62.7
20-11-20 10:04:30 AM	20-11-20 10:05:30 AM	00:01:00	62.7	64.6	62.8	64.3	63.5	63.9	63.3	63.0	62.9
20-11-20 10:05:30 AM	20-11-20 10:06:30 AM	00:01:00	62.2	65.2	62.4	65.0	63.6	64.2	63.5	62.9	62.7
20-11-20 10:06:30 AM	20-11-20 10:07:30 AM	00:01:00	62.5	64.6	62.6	64.2	63.3	63.8	63.3	62.7	62.6
20-11-20 10:07:30 AM	20-11-20 10:08:30 AM	00:01:00	62.4	64.1	62.6	63.8	63.2	63.6	63.2	62.8	62.7
20-11-20 10:08:30 AM	20-11-20 10:09:30 AM	00:01:00	62.8	64.9	62.9	64.8	63.7	64.1	63.6	63.1	63.0
20-11-20 10:09:30 AM	20-11-20 10:10:30 AM	00:01:00	62.6	64.7	62.7	64.5	63.5	63.9	63.4	63.0	62.8
20-11-20 10:10:30 AM	20-11-20 10:11:30 AM	00:01:00	62.7	64.2	62.8	63.9	63.3	63.5	63.2	63.0	62.9
20-11-20 10:11:30 AM	20-11-20 10:12:30 AM	00:01:00	62.3	64.5	62.4	64.2	63.1	63.3	63.0	62.7	62.6
20-11-20 10:12:30 AM	20-11-20 10:13:30 AM	00:01:00	62.5	64.3	62.5	64.0	63.1	63.4	63.1	62.7	62.6
20-11-20 10:13:30 AM	20-11-20 10:14:30 AM	00:01:00	62.9	64.4	63.0	64.3	63.5	63.9	63.4	63.0	63.0
20-11-20 10:14:30 AM	20-11-20 10:15:30 AM	00:01:00	62.7	64.2	62.8	64.2	63.4	63.7	63.3	63.0	62.9
20-11-20 10:15:30 AM	20-11-20 10:16:30 AM	00:01:00	62.2	65.2	62.7	64.8	63.3	63.8	63.2	62.9	62.8
20-11-20 10:16:30 AM	20-11-20 10:17:30 AM	00:01:00	62.3	65.0	62.4	64.8	63.6	64.2	63.7	63.0	62.7
20-11-20 10:17:30 AM	20-11-20 10:18:30 AM	00:01:00	62.7	64.9	62.8	64.6	63.6	64.1	63.5	63.0	63.0
20-11-20 10:18:30 AM	20-11-20 10:19:30 AM	00:01:00	62.9	64.6	63.0	64.5	63.5	63.9	63.4	63.0	63.0
20-11-20 10:19:30 AM	20-11-20 10:20:30 AM	00:01:00	62.9	64.5	63.0	64.3	63.5	63.9	63.4	63.1	63.0
Min			**62.2**	**64.1**	**62.4**	**63.8**	**63.1**	**63.3**	**63.0**	**62.7**	**62.6**
Max			**63.3**	**65.2**	**63.3**	**65.0**	**64.0**	**64.4**	**63.9**	**63.5**	**63.4**
Avg			**62.7**	**64.6**	**62.8**	**64.4**	**63.5**	**63.9**	**63.4**	**63.1**	**63.0**

Project	: Aluminium Bahrain BSC - Power Station 5 Block 4 (Baseline Noise Monitoring Campaign, November 2020)
Monitoring Date	: 20/11/2020
Monitoring Location	: NML 6 - West Boundary of PS5 Block 4
Monitoring Period	: Weekend - Morning (Logged Broadband Data)

Start Time	End Time	Duration	Leq (31.5Hz A)	Leq (63Hz A)	Leq (125Hz A)	Leq (250Hz A)	Leq (500Hz A)	Leq (1kHz A)	Leq (2kHz A)	Leq (4kHz A)	Leq (8kHz A)	Leq (16kHz A)
20-11-20 9:50:30 AM	20-11-20 9:51:30 AM	00:01:00	37.3	46.8	51.8	56.1	59.1	58.3	54.7	48.9	36.5	30.5
20-11-20 9:51:30 AM	20-11-20 9:52:30 AM	00:01:00	37.2	46.7	51.9	56.1	59.0	57.9	54.8	48.9	36.2	29.3
20-11-20 9:52:30 AM	20-11-20 9:53:30 AM	00:01:00	37.6	47.0	51.9	56.1	58.8	57.8	54.9	48.7	35.6	29.3
20-11-20 9:53:30 AM	20-11-20 9:54:30 AM	00:01:00	37.2	47.5	52.0	56.1	59.6	58.1	55.4	49.2	35.7	27.9
20-11-20 9:54:30 AM	20-11-20 9:55:30 AM	00:01:00	37.0	46.7	51.4	56.0	58.8	57.8	55.0	49.2	35.4	25.3
20-11-20 9:55:30 AM	20-11-20 9:56:30 AM	00:01:00	37.0	46.9	51.4	55.7	58.6	57.7	55.1	49.6	35.6	27.5
20-11-20 9:56:30 AM	20-11-20 9:57:30 AM	00:01:00	37.0	46.7	51.5	55.9	58.8	57.9	55.0	49.3	35.4	25.0
20-11-20 9:57:30 AM	20-11-20 9:58:30 AM	00:01:00	37.9	46.9	51.5	55.7	59.0	58.0	55.4	49.5	35.8	26.9
20-11-20 9:58:30 AM	20-11-20 9:59:30 AM	00:01:00	37.8	47.0	51.7	56.0	59.1	57.7	54.9	49.2	35.8	26.5
20-11-20 9:59:30 AM	20-11-20 10:00:30 AM	00:01:00	37.2	46.5	51.8	55.9	59.2	58.0	55.2	49.3	35.8	27.8
20-11-20 10:00:30 AM	20-11-20 10:01:30 AM	00:01:00	37.4	46.7	51.8	55.9	59.2	57.7	55.0	49.0	35.4	24.3
20-11-20 10:01:30 AM	20-11-20 10:02:30 AM	00:01:00	37.2	46.6	51.8	55.7	59.3	58.1	54.6	49.0	35.8	26.0
20-11-20 10:02:30 AM	20-11-20 10:03:30 AM	00:01:00	36.7	46.7	51.6	55.5	58.7	57.6	54.7	49.3	36.3	28.5
20-11-20 10:03:30 AM	20-11-20 10:04:30 AM	00:01:00	36.4	46.8	51.7	55.5	57.8	57.6	55.0	49.3	35.8	27.1
20-11-20 10:04:30 AM	20-11-20 10:05:30 AM	00:01:00	36.2	47.1	51.8	55.7	57.9	57.9	55.5	49.6	35.5	26.8
20-11-20 10:05:30 AM	20-11-20 10:06:30 AM	00:01:00	36.5	46.7	51.5	55.9	58.5	58.0	55.1	48.8	34.9	26.1
20-11-20 10:06:30 AM	20-11-20 10:07:30 AM	00:01:00	36.9	46.9	51.4	55.4	58.4	57.9	54.7	48.5	35.7	29.6
20-11-20 10:07:30 AM	20-11-20 10:08:30 AM	00:01:00	37.1	46.9	51.7	55.8	58.2	57.6	54.4	48.5	36.2	31.4
20-11-20 10:08:30 AM	20-11-20 10:09:30 AM	00:01:00	36.7	46.3	51.5	56.3	58.7	58.0	54.8	48.9	35.2	24.9
20-11-20 10:09:30 AM	20-11-20 10:10:30 AM	00:01:00	36.5	47.0	52.0	56.6	58.2	57.6	54.5	48.6	34.9	24.7
20-11-20 10:10:30 AM	20-11-20 10:11:30 AM	00:01:00	36.9	46.4	51.7	56.0	58.0	57.7	54.7	48.5	34.9	24.9
20-11-20 10:11:30 AM	20-11-20 10:12:30 AM	00:01:00	37.1	46.4	51.4	55.8	58.1	57.2	54.1	48.3	34.6	25.7
20-11-20 10:12:30 AM	20-11-20 10:13:30 AM	00:01:00	36.7	47.1	51.5	56.2	58.1	57.1	53.9	48.0	35.1	27.2
20-11-20 10:13:30 AM	20-11-20 10:14:30 AM	00:01:00	37.6	47.2	51.6	55.7	58.9	57.9	54.5	48.6	36.2	30.4
20-11-20 10:14:30 AM	20-11-20 10:15:30 AM	00:01:00	37.8	47.2	51.8	55.8	58.4	57.7	54.6	48.6	36.6	31.7
20-11-20 10:15:30 AM	20-11-20 10:16:30 AM	00:01:00	36.7	46.6	51.7	55.8	58.2	57.8	54.7	48.4	36.1	30.4
20-11-20 10:16:30 AM	20-11-20 10:17:30 AM	00:01:00	36.8	47.1	51.9	55.7	58.5	58.1	55.4	48.7	36.0	29.9
20-11-20 10:17:30 AM	20-11-20 10:18:30 AM	00:01:00	36.4	46.9	51.9	56.4	58.9	57.7	54.3	48.3	34.4	23.0
20-11-20 10:18:30 AM	20-11-20 10:19:30 AM	00:01:00	36.0	46.6	51.9	55.9	58.4	58.0	54.9	48.4	34.4	22.6
20-11-20 10:19:30 AM	20-11-20 10:20:30 AM	00:01:00	36.5	46.9	51.9	56.3	58.5	57.9	54.3	48.2	34.5	22.1
Min			**36.0**	**46.3**	**51.4**	**55.4**	**57.8**	**57.1**	**53.9**	**48.0**	**34.4**	**22.1**
Max			**37.9**	**47.5**	**52.0**	**56.6**	**59.6**	**58.3**	**55.5**	**49.6**	**36.6**	**31.7**
Avg			**37.0**	**46.8**	**51.7**	**55.9**	**58.7**	**57.8**	**54.8**	**48.9**	**35.6**	**27.8**

Appendix K: Stakeholder Consultation – Minutes of Meetings

30th December 2021

Ref No. ENV-RJC-PS5BLK4/KI-SC-MOM/02/2021

MINUTES OF MEETING

Call to Order

In line with Environmental and Social Impact Assessment (ESIA) study for construction and operation of Powers Station 5 (PS5) - Block 4 of Aluminium Bahrain (Alba), and as per the directives of Supreme council for Environment (SCE), an online stakeholder meeting was held with Kymera International via Microsoft Teams on 30th December 2021 at 11:00 AM.

Attendees:

- Mr. Sayed Salah Aqeel Alhassan, Acting ESG Manager, Aluminium Bahrain B.S.C.
- Mr. Sayed Amer, Acting Power Station Expansion Project Manager, Aluminium Bahrain B.S.C.
- Mr. Ahmed Nasser, Engineering and Maintenance Manager, Kymera International
- Mr. Hassan Abdulla, Production and Administration Manager, Kymera International
- Mr. Rajith Chandran, Environmental Manager, Envirotech Consultancy S.P.C
- Mr. Minhajuddin Ahmed Faruqi, Senior Environmental Specialist, Envirotech Consultancy S.P.C.

Proceedings:

1. 1. Mr. Sayed Salah and Mr. Sayed Amer explained about the existing Power Station 5 of Alba which was developed as part of Potline 6 and the present need for expansion of PS5. He described that the proposed Block 4 will be developed towards south of the existing PS5 within the Alba premises and the plant will have less greenhouse gases in comparison to the older plants.
2. Mr. Sayed Amer explained that the new power station 5 block 4 will help Alba in reducing air emissions especially Oxides of Nitrogen (<15 ppm) and Sulphur Dioxide. He emphasized on Alba's commitment to reduce emissions.
3. Mr. Ahmed Nasser informed that Kymera is using Alba North Gate to transport the raw materials from Alba to the plant and enquired whether the gate will be closed during the construction or operation phase. Mr. Sayed Amer ensured that the expansion project will not utilize the North Gate and it will remain open for the customers. He further informed that the gate situated at West of Alba

will be utilized for site access during construction and operational phases. An access map is attached with this Minutes of Meeting.

4. Mr. Ahmed Nasser informed that Kymera observed brown spots in their premises and vehicles. Further he said that in the last two months, the phenomenon is not observed.
5. Mr. Sayed Salah explained that Alba was also a victim of the brown spot deposition and as per the instructions from the Supreme Council for Environment Alba appointed an Environmental Consultant to study the phenomenon. The scope of the study was given by the SCE to the appointed consultant. The consultant did an extensive study in the area and collected samples from different locations and analyzed. A formal report was then submitted to the SCE as well as Alba. The report concludes that the depositions observed in the area are not generates from the operation of Aluminium Smelters. Mr. Sayed Salah shared a summary of the report to Kymera.
6. Mr. Ahmed Nasser had no other specific observations and concluded that Kymera International do not have any objection to establishment of Power Station 5 - Block 4 of Alba.

Prepared by:

for **Minhajuddin Ahmed Faruqi**
Senior Environmental Specialist
Envirotech Consultancy S.P.C.

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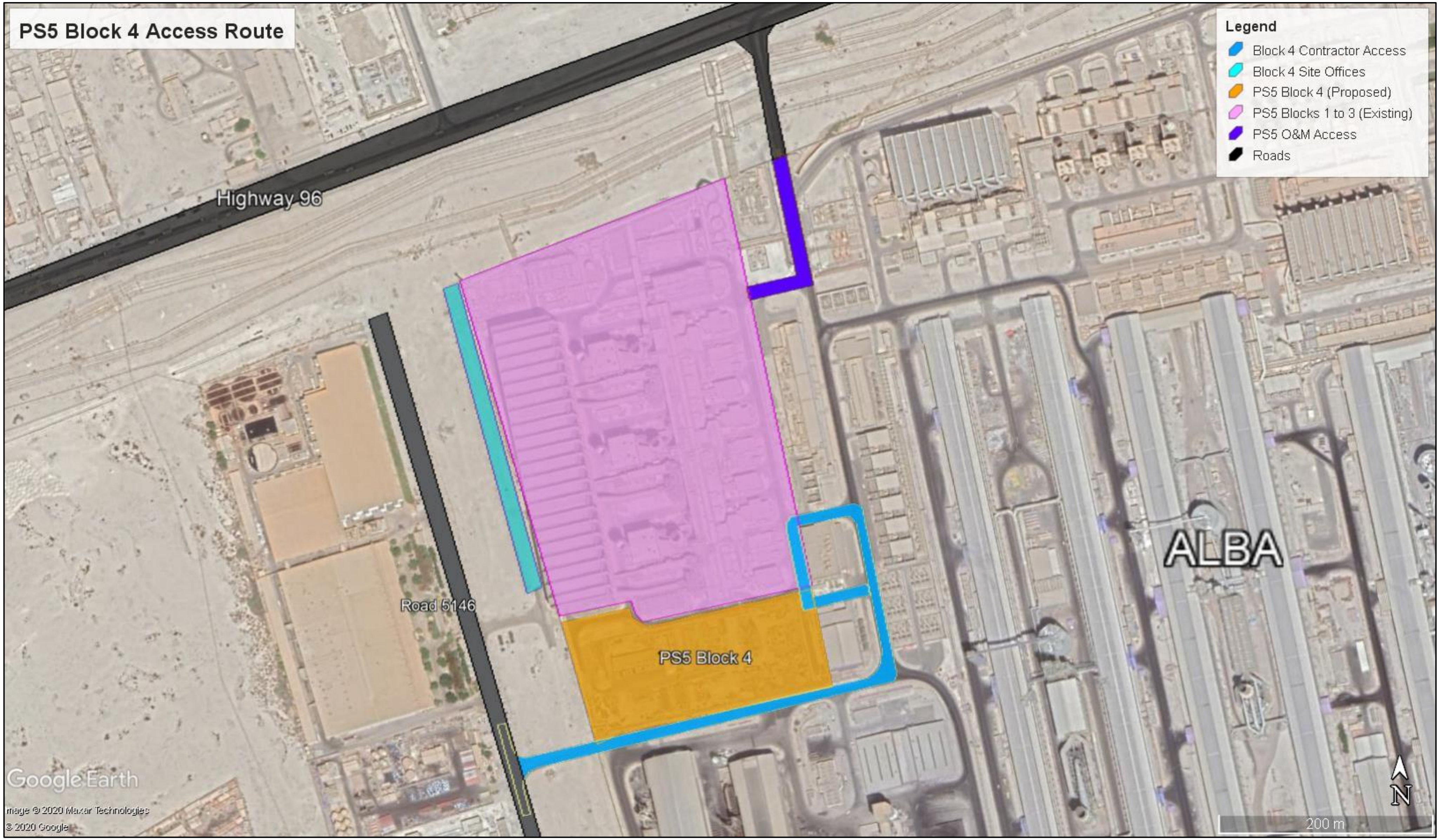
Checked by:

Rajith Chandran
Environmental Manager
Envirotech Consultancy S.P.C.

Approved by:

Ahmed Nasser
Engineering and Maintenance Manager
Kymera International


PS5 Block 4 Access Route
Legend
Block 4 Contractor Access
Block 4 Site Offices
PS5 Block 4 (Proposed)
PS5 Blocks 1 to 3 (Existing)
PS5 O&M Access
Roads
Highway 96
Road 5146
PS5 Block 4
ALBA
Google Earth
Image © 2020 Maxar Technologies
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VAT Account Number: 220003361100002 | TIN Number: 2200033611 | Effective From: 1st January 2020

28th December 2021

Ref No. ENV-RJC-PS5BLK4/EMPACK-SC-MOM/02/2021

MINUTES OF MEETING

Call to Order

In line with Environmental and Social Impact Assessment (ESIA) study for construction and operation of Powers Station 5 (PS5) - Block 4 of Aluminium Bahrain (Alba), a stakeholder meeting was held at Eminent Packaging Systems Co. W.L.L. (Empack) on 28th December 2021 at 11.05 AM.

Attendees:

- Mr. Sayed Salah Aqeel Alhassan, Acting ESG Manager, Aluminium Bahrain B.S.C.
- Mr. Sayed Amer, Acting Power Station Expansion Project Manager, Aluminium Bahrain B.S.C.
- Mr. Mugren Ohaly, Vice President, Eminent Packaging Systems Co. W.L.L.
- Mr. Faisal Kamran, Manager Accounts & Admin, Eminent Packaging Systems Co. W.L.L.
- Mr. Aynudeen, Operations Manager, Eminent Packaging Systems Co. W.L.L.
- Mr. Rajith Chandran, Environmental Manager, Envirotech Consultancy W.L.L.

Proceedings:

1. Mr. Sayed Salah and Mr. Sayed Amer explained about the existing Power Station 5 of Alba which was developed as part of Potline 6 and the present need for expansion of PS5. He described that the proposed Block 4 will be developed towards south of the existing PS5 within the Alba premises and the plant will have less greenhouse gases in comparison to the older plants.
2. Mr. Sayed Amer gave a detailed description of the power station expansion projects conducted in Alba in 1993, 2004 and 2018 with an aim to reduce greenhouse gas emissions. Mr. Sayed Amer informed that the implementation of the new block in Power Station 5 will significantly reduce emissions of pollutants such as Oxides of Nitrogen (<15 ppm) and Sulphur Dioxide.
3. Mr. Faisal Kamran then explained that Empack has been facing following issues:
    a. Occasionally smoke releasing during the night-time which makes their operation area unworkable, affecting badly their employees resulting eyes burning, breathing difficulty and cough because of the smoke. Mr. Sayed Salah explained that smoke is releasing from carbon plant by-pass stacks in every four (4) to six (6) months. Alba keeps Supreme Council

for Environment about the bypass stack releases. Mr. Sayed Salah ensured that Alba would contact Empack to inform about future bypass stack releases as and when it happens.

b. Small dots of sulfur on vehicles, parking area and on the building are damaging the property. Mr. Sayed Salah explained that Alba was also a victim of the brown spot deposition and as per the instructions from the Supreme Council for Environment Alba appointed an Environmental Consultant to study the phenomenon. The scope of the study was given by the SCE to the appointed consultant. The consultant did an extensive study in the area and collected samples from different locations and analyzed. A formal report was then submitted to the SCE as well as Alba. The report concludes that the depositions observed in the area are not generates from the operation of Aluminium Smelters. Mr. Sayed Salah shared a summary of the report to Empack.

c. During the construction times of potline 6 expansion heavy vehicles parking outside the company's premises disturbing their vehicles movement. Mr. Sayed Amer ensured that the Project is small scale in comparison to potline 6 expansion Project. Thus, the traffic generation from the project will be very less.

4. Mr. Ohaly had no other specific observations and concluded that Empack do not have any objection to establishment of Alba Power Station 5 Block 4.
5. Mr. Sayed Salah concluded the meeting and ensured Alba's full cooperation in addressing the environmental issues and requested Empack to contact him in case of any future issues. Also, he informed that the grievance cell's contact information will be shared with Empack to formally lodge their concerns.

Prepared by:

For

Minhajuddin Ahmed Faruqi
Senior Environmental Specialist
Envirotech Consultancy W.L.L.

Checked by:

Rajith Chandran
Environmental Manager
Envirotech Consultancy W.L.L.

Approved by:

5/1/2022

For **Mugren Ohaly**
Vice President
Eminent Packaging Systems Co. W.L.L.

التقنية البيئية للاستشارات ذ.م.م.
P.O. Box 54005-Kingdom of Bahrain
Tel: 17716112 - Fax: 17714481 - C.R. 43645
ENVIROTECH CONSULTANCY W.L.L.

04th January 2022

Ref No. ENV-RJC-PS5BLK4/TPI/02-2022

MINUTES OF MEETING

Call to Order

In line with Environmental and Social Impact Assessment (ESIA) study for construction and operation of Powers Station 5 (PS5) - Block 4 of Aluminium Bahrain (Alba), a stakeholder meeting was held at Tylos Plastic Industries Company WLL (TPI) on 04th January 2022.

Attendees:

- Mr. Sayed Salah Aqeel Alhassan, Acting ESG Manager, Aluminium Bahrain B.S.C.
- Mr. Sayed Amer, Acting Power Station Expansion Project Manager, Aluminium Bahrain B.S.C
- Mr. Vijay, Purchase Officer, Tylos Plastic Industries
- Dr. Ahmed Abdul Majeed, Plant Manager, Tylos Plastic Industries
- Mr. Rajith Chandran, Environmental Manager, Envirotech Consultancy S.P.C

Proceedings:

1. Mr. Sayed Salah and Mr. Sayed Amer explained about the existing Power Station 5 of Alba which was developed as part of Potline 6 and the present need for expansion of PS5. He described that the proposed Block 4 will be developed towards south of the existing PS5 within the Alba premises and the plant will have less greenhouse gases in comparison to the older plants.
2. Mr. Sayed Amer explained that the new power station 5 block 4 will help Alba in reducing air emissions especially Oxides of Nitrogen (<15 ppm) and Sulphur Dioxide. He emphasized on Alba's commitment to reduce emissions.
3. Mr. Abdul Majeed analyzed that wind direction in the area is from North to South thus all the emissions from North which is in the upwind direction will be reaching TPI.
4. Mr. Vijay and Mr. Ahmed Majeed informed that TPI observed brown spots in their premises and vehicles. Further he said that in the last two months, the phenomenon is not observed.
5. Mr. Sayed Salah explained that Alba was also a victim of the brown spot deposition and as per the instructions from the Supreme Council for Environment Alba appointed an Environmental Consultant to study the phenomenon. The scope of the study was given by the SCE to the appointed consultant. The consultant did an extensive study in the area and collected samples from different locations and analyzed. A formal report was then submitted to the SCE as well as Alba. The report concludes that the depositions observed in the area are not generates from the operation of Aluminium Smelters.

6. Mr. Ahmed Majeed and Mr. Vijay had no other specific observations and concluded that Tylos Plastics do not have any objection to establishment of Power Station 5 - Block 4 of Alba.

Prepared by:

For **Minhajuddin Ahmed Faruqi**
Senior Environmental Specialist
Envirotech Consultancy S.P.C.

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Checked by:

Rajith Chandran
Environmental Manager
Envirotech Consultancy S.P.C.

Approved by:

5 / 1 / 2022

Ahmed Abdul Majeed
Plant Manager
Tylos Plastic Industries Co. W.L.L.

Minhajuddin Ahmed Faruqi

From:	Dana Salah Al-Sabbagh <Dana.Alsabbagh@mtt.gov.bh>
Sent:	Thursday, December 03, 2020 2:45 PM
To:	Minhajuddin Ahmed Faruqi
Cc:	Hussain Ali Hasan Yaqoob
Subject:	RE: ESIA for ALBA Power Station 5 Block 4 - Appointment for Stakeholder Consultation

Dear Minhajuddin ,

Following up to your email regarding EIA study for construction and operation of Powers Station 5 (PS5) - Block 4 for Aluminium Bahrain , MTT has no objection on the proposal as it does not impact or interfere with any of the current or future proposed projects.
If a meeting is required kindly let me know.

Kindest Regards
Dana

وزارة المواصلات والاتصالات
Ministry of Transportation and Telecommunications

Dana AlSabbagh
General Engineer
Land Transportation Studies
Land Transportation Planning and Studies Directorate
P.O. Box 10325, Kingdom of Bahrain, T: +973 17337811.

From: Minhajuddin Ahmed Faruqi <minhaj@newtechgcc.com>
Sent: Monday, November 23, 2020 1:54 PM
To: Hussain Ali Hasan Yaqoob <hussain.yaqoob@mtt.gov.bh>
Cc: Dana Salah Al-Sabbagh <Dana.Alsabbagh@mtt.gov.bh>
Subject: ESIA for ALBA Power Station 5 Block 4 - Appointment for Stakeholder Consultation

Dear Sir,

Greetings from Envirotech Consultancy!

The purpose of this email is to inform that Envirotech Consultancy S.P.C is conducting an Environmental and Social Impact Assessment (EIA) study for construction and operation of **Powers Station 5 (PS5) - Block 4** for Aluminium Bahrain.

Block 4 Combined Cycle Power Plant will be an expansion of the existing Power Station 5 located within Alba premises which was commissioned in 2019 – 2020 with three (3) Combined Cycle Gas Turbine (CCGT) blocks. Block 4 will run on H-class gas turbine technology and add 610 MW to the grid thus increasing PS5 capacity from 1,800 MW to 2,410 MW.

Please find enclosed following project related documents for your kind perusal.

1. Purchase Order from Alba
2. Brief project description of PS5 Block 4
3. Map showing the PS5 Block 4 and adjacent properties.
4. Access route map during construction and operation phase

As part of the EIA, it is mandatory to conduct **Stakeholder Consultations** meetings with government agencies, non-government agencies, private establishments and community members with respect to the proposed expansion project. Since Ministry of Transportation and Telecommunications is an important Stakeholder for this Project, therefore we would like to have your **concerns** and **recommendations** on the environmental management practices to be implemented during construction and operation phases of the upcoming project and its associated activities.

Kindly let us know what date and time would be convenient for you to have further discussions on the proposed project. In view of the current restrictions due to covid-19, we can discuss through online meeting portals or email.

Best Regards,

Minhajuddin Ahmed Faruqi
Senior Environmental Specialist
Mobile: +973 35613324
Whatsapp: +91 9849438388
minhaj@newtechgcc.com

ENVIROTECH CONSULTANCY S.P.C

UQAS ISO/IEC 17025:2017 Certificate No. EL/200 2006

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