

Environmental and Social Impact Assessment for 840 MW İç Anadolu Natural Gas Combined Cycle Power Plant



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ABBREVIATIONS

ACC	Air Cooled Condenser
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
ANSI	American National Standards Institute
APCRH	Air Pollution Control Regulation for Heating Sources
BOTAŞ	Petroleum Pipeline Corporation
BPIP	Building Profile Input Program
CCGT	Combined- Cycle Gas Turbine
CEC	Cation Exchange Capacity
CHC	Central Hunting Commission
CITES	Convention on the International Trade in Endangered Species of Wild Flora and Fauna
°C	Degree Centigrade
COD	Chemical Oxygen Demand
dB(A)	A-Weighted Decibel
DLN	Dry Low-NOx
EGECR	Exhaust Gases Emission Control Regulation
ESIA	Environmental and Social Impact Assessment
EMF	Electric and Magnetic Fields
EMRA	Energy Market Regulatory Authority
ENE	East-North-East
EP	Equator Principles
EPFIs	Equator Principles Financial Institutions
ERL	European Red List
ESIA	Environmental and Social Impact Assessment
ESP	Electrostatic Precipitators
FGD	Flue-Gas Desulphurization
GDP	Gross Domestic Product
GEAŞ	GAMA Energy Inc.
GEP	Good Engineering Practice
GTG	Gas Turbine Generator
hr	Hour
HP	High Pressure
HRSG	Heat Recovery Steam Generator
HWCR	Hazardous Wastes Control Regulation
ICSC	International Chemical Safety Cards
IP	Intermediate Pressure
IEC	International Electrotechnical Commission
IFC	International Finance Corporation
kV	Kilovolts
IAPCR	Industrial Air Pollution Control Regulation
IUCN	International Union for Conservation of Nature's
L	Liter
LCPR	Large Combustion Plants Regulation
LEL	Lower Explosive Limit
LP	Low Pressure
m	Meter

MCE	Maximum Credible Earthquake
MDE	Maximum Design Earthquake
MoEF	Ministry of Environment and Forestry
MSDS	Materials Safety Data Sheets
MTA	Mineral Research and Exploration Institute
MW	Megawatt
MWCR	Medical Waste Control Regulation
MWt	Megawatt Thermal
NAF	North Anatolian Fault
NE	North-East
NGCCPP	Natural Gas Combined Cycle Power Plant
NSR	Noise Sensitive Receptor
OBE	Operating Basis Earthquake
PCB	Polychlorinated Biphenyls
PM	Particulate Matter
PPE	Personal Protection Equipment
PWCR	Packaging Waste Control Regulation
RAMAQ	Regulation on Assessment and Management of Air Quality
RAMEN	Regulation on Assessment and Management of Environmental Noise
RDB	Red Data Book
RH	Reheat
RMS	Reduction and Measuring Station
RO	Reverse Osmosis
s	Second
SCBA	Self Contained Breathing Apparatus
SPT	Standard Penetration Tests
STG Steam	Turbine Generator
SWCR	Solid Waste Control Regulation
TDS	Total Dissolved Solids
TEİAŞ	Turkish Electricity Transmission Corporation
TPAO	Turkish Petroleum Corporation
TPH	Total petroleum hydrocarbon
TSS	Total Suspended Solids
TUBITAK	Scientific and Technological Research Council of Turkey
TÜBİVES	Turkish Plant Information Service
TÜPRAŞ	Turkish Petroleum Refineries Corporation
USEPA	Environmental Protection Agency
USCS	Unified Soil Classification System
USD	United States Dollar
USGS	United States Geological Survey
WB	World Bank
WBACR	Waste Batteries and Accumulators Control Regulation
km	Kilometer
kWh	Kilowatt Hour
WHO	World Health Organization
WOCR	Waste Oil Control Regulation
WPCR	Water Pollution Control Regulation

Executive Summary

İç Anadolu Doğalgaz Elektrik Üretim ve Ticaret A.Ş. (İç Anadolu Energy), which is established by GAMA Energy Inc. (GAMA), is planning to construct and operate a 840 mWe natural gas combined cycle power plant (CCPP). Initially proposed a project that was designed to be 420 MWe natural gas combined cycle power plant (CCPP). Then the project design was revised and the capacity of the Project was increased to 840 MWe. The proposed plant will be a typical 2 +1 single shaft (2 gas turbines and 1 steam turbine) configured natural gas-fired power plant.

The project will be located in Hacılar Town of Kırıkkale Province which is situated in the central part of Turkey. The project area is located in an industrial zone and the land is owned by GAMA. A fuel oil-fired 153 MW Barmek-GAMA Power Plant, which has been dismantled, was located to the southwest of the project site. The Tüpraş Orta Anadolu Refinery is located approximately 500 m to the southeast of the project site. The project site is approximately 3.2 km away from the center of Hacılar Town which is the closest settlement. It is planned that the construction will be completed in three years and the operation period of the project will be 49 years.

An “Electric Power Generation License” from the Energy Market Regulatory Authority (EMRA) has been secured for the proposed project for 49 years. Turkish Electricity Transmission Corporation (TEİAŞ) has also given its permission to connect to the national grid. In addition, an affirmative decision of Petroleum Pipeline Corporation (BOTAŞ) has been obtained for a 12.6 km pipeline connection to Samsun - Ankara Natural Gas Pipeline. The plant will be connected to the national grid through a single circuit 58 km 380 kV overhead power transmission line which will join to existing Keban OHL at the last 10 km to the Gölbaşı Substation. The Power Plant’s 420 MW Generation License has been granted by EMRA on March 16th, 2011 and has a term of 49 years which will expire in 2060. An application to double the capacity has been made on Apr 8th, 2011 and EMRA board approved the extension to 840MW on May 31st, 2012. An EIA report was prepared and submitted to the MoEU on June 15, 2012 for the 840 MWe CCPP. The EIA report has been accepted as the final report by the review committee and “EIA Affirmative” decision is being prepared by the MOEU.

This Environmental and Social Impact Assessment (ESIA) report has been prepared according to the Equator Principles (EP). The purpose of the ESIA is to identify potential environmental and social impacts of the Project on the local environment and community during construction, operation and decommissioning phases. The ESIA also aims at providing mitigation measures to eliminate potential adverse impacts and propose a management and monitoring plan. The report is also prepared in accordance with the host country Turkish Legislation and International Finance Corporation (IFC)-World Bank Group Guidelines as referred by the EP.

The project is regarded as Category A project which applies to projects that expected to have “adverse impacts that may be sensitive, irreversible, and diverse”, with attributes such as direct pollutant discharges large enough to cause degradation of air, water, or soil; large-scale physical disturbance of the site or surroundings; extraction, consumption, or conversion of substantial amounts of forest and other natural resources; measurable modification of hydrologic cycles; use

of hazardous materials in more than incidental quantities; and involuntary displacement of people and other significant social disturbances with potential limited adverse social or environmental impacts that are few in number, generally site specific, largely reversible, and readily addressed through mitigation measures.

AECOM has conducted a detailed environmental baseline study in the scope of the ESIA study. General climatology, air quality, land use, noise, geology, flora, fauna, naturally protected areas, archeologically protected areas specific to the Project site are assessed in the scope of this study.

Air Quality

The existing ambient air quality near the Project site is obtained from the ambient air quality monitoring studies. Ambient SO₂ and PM₁₀ concentrations were obtained from a passive sampling study conducted between August 2003 and January 2004. In addition, ambient NO₂ and NO concentrations around the Project area are measured at 13 points for 2 months (June – August 2010) by conducting a passive sampling study. The monitoring results showed that ambient levels of NO₂, NO, NO_x, SO₂ and PM₁₀ are all below the Turkish and IFC/WB limits.

The air quality impacts associated with the proposed Project are estimated using a state-of-the-art air dispersion model developed by the U.S. EPA and recommended by the World Bank for air quality assessment. The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) was used to calculate concentrations of particulates emitted during construction period and gases emitted from the heat recovery steam generator (HRSG) stack during operation.

It is concluded that the proposed Project will not affect adversely the local air quality during the construction and operation, taking into account the dispersion effect of the wind in the project area. Mitigation measures will be taken to reduce the amount of dust generated during construction and therefore it is not expected that dust generated during construction activities will create adverse impacts on the local air quality. The modeling analysis demonstrated that ambient pollutant concentrations in the Project area will be in compliance with the Turkish ambient air quality standards and the IFC/WB guideline concentrations. The predicted ambient concentrations were much lower than the limits. Therefore, emissions from the proposed plant will provide almost negligible contribution to the background air quality.

Noise

Existing background noise levels are measured continuously for a period of 24 hours a day for two days at the closest noise sensitive receptor (NSR-1) as part of the ESIA study. The results showed that the Project site and surrounding area have a stable and similar noise levels for daytime and nighttime since there is no noise emitting activity in the close vicinity of the Project area.

The noise impact assessment included calculation of noise levels at three residential homes (i.e., noise sensitive receptors). The noise levels are calculated both for the construction and operation

phases with adding the measured background levels. The proposed Project will comply with the relevant noise limits given by the Turkish regulatory limits at all sensitive receptors. However, the daytime and nighttime cumulative noise levels at the closest sensitive receptor will exceed the IFC/WB Guideline noise limits.

Geology and Seismicity

According to literature survey and observations, undifferentiated Mid-Miocene Pliocene continental sediments and Central Anatolia Granodiorites (granite, granodiorite and monzonite) and Quaternary Alluvium, constitute the lithological structures in the close vicinity of the project site. In addition, a preliminary geotechnical study is conducted in order to assess the local geological features of the site and geotechnical laboratory tests are conducted in order to determine the engineering properties of soil and rock within a project site.

The project site is located in the 1st degree earthquake zone according to the earthquake risk map prepared by General Directorate of Disaster Affairs.

Hydrogeology and Hydrology

The project site is located in Kırıkkale Province which includes the Central Anatolia Kızılırmak Basin. The formations which have aquifer properties are alluvium and sedimentary units like sand, gravel sandstone and conglomerates of Neocene.

The major surface water courses located in the vicinity of the project site are Kızılırmak River and Kapulukaya Dam. Kızılırmak River is about 2.5 km to the project site and it flows in north-south orientation in the east of the project site. This dam reservoir is about 7 km to the project site. Both of these water courses will not be used and will not be affected due to the proposed plant construction and operation.

Flora and Fauna

The project site has terrestrial characteristics. Depending on these characteristics, generally short lived, herbaceous plants are widely distributed at the area. The forest areas are either rare or totally removed from the area.

In the scope of the ESIA Study, floristic site surveys are conducted within the project site and its vicinity. According to these surveys, two endemic plant species have been found in the project site. However, while these two endemic species have broad distribution, it is determined that they are not local. The conservation status both of the species' is Least Concern (LC) according to IUCN. Thus, no conservation measure is suggested in ESIA. In addition, there is no record of species that have status of protected, extinct or under threat.

In the in order to define aquatic life and terrestrial fauna, field surveys and literature searches are conducted. As a result of this study, 2 amphibian, 6 reptile, 32 bird and 8 mammal species are identified as most likely to exist in the proposed project site and its vicinity. All amphibian species that are likely to exist in the Project site and its close vicinity are classified as LC (Least concern) according to IUCN Red List. Among the fauna species *Nannospalax nehringi* (blindmole) is

classified as Data Deficient category and *Testudo graeca iberica* (Common Tortoise) is classified as VU (vulnerable) category according to IUCN Red List. However, *Testudo graeca iberica* (Common Tortoise) are abundant and widely seen in Turkey. The Project site is not located on a major migration route. In addition, there are no endemic, vanished, threatened or under conservation fauna. These circumstances gathered and constitute the main reason of low biodiversity. Therefore, the negative effects of the proposed plant project are expected to be very limited.

Soil Quality and Acidification

Soil samples from the project site are taken and analyzed for petroleum based contamination and heavy metals. The analysis results revealed that there was no petroleum based contamination and potential soil contamination due to heavy metals in the project area. The project will comply with the Soil Pollution Control Regulation and all necessary precautions will be taken to prevent potential releases to reach environment, an adverse impact to soil or groundwater is not expected during the construction and operation phases.

In addition, annual dry and wet deposition values of NO_x emissions discharged from the facility are calculated by using AERMOD in order to assess the impacts of plant on soil. Total deposition value is obtained by summation of dry and wet deposition values. Acid buffering capacity of soil is determined by the analysis of soil samples taken from the project area.

It is concluded that, acidic deposition originated from the proposed plant will not affect pH of the soil significantly. For that reason, plants in the region will not be affected by the potential acid deposition originated from the project.

Naturally Protected and Archeological Areas

There are no national parks, nature reserves, natural monuments, wildlife protection areas, wildlife improvement areas and key biodiversity areas within the project site and its vicinity. In addition, there are no archaeological, historical and cultural assets in the close vicinity of the project site.

Biological Resources

There is no protection areas natural parks, wetlands, natural monuments, natural protection areas, wild life protection areas, biogenetic reserve areas, biosphere reserves, natural/cultural protection areas and monuments, special protection areas, touristic areas and centres, the areas conserved as pasture land by the law within the project area.

Water Supply and Wastewater

During the construction phase, potable water requirement of the workers/employees, concrete curing water and water sprays to prevent dust formation will be required. The estimated amount of water consumption during the construction phase is expected to be about 600 m³/day. The potable water requirement will be supplied from the existing pipeline supplying water to Hacilar Town. The water requirement of employees during construction will be 135 m³/day.

It is planned that domestic wastewater generated during construction will be discharged to the Hacilar Municipality sewerage network in case it is completed. In case the sewerage network is not completed, wastewater generated during construction will be collected in leakproof tanks and will be transferred by vacuum trucks of Municipality.

During the operation phase, the water use will be limited to: regeneration of HRSG blowdowns and demineralization system, turbine washing and the domestic water use by employees. The proposed plant will have an air cooled condenser (ACC) system thus water requirement due to process will be minimum. It is estimated that employees will consume 9.6 m³/day water. The water requirement of the plant will be approximately 35.5 m³/hour.

Wastewater generated during operation will be discharged to the Hacilar Municipality sewerage network after it is treated in case the sewerage network is completed. If it is not completed, wastewater generated during operation will be collected in leakproof septic tank and will be transferred by vacuum trucks of Municipality. The plant will have a wastewater treatment system which can treat chemically contaminated water, TSS, TDS and domestic wastewater.

The proposed project will comply with the Turkish Water Pollution Control Regulation and the IFC/WB Guidelines and will not have any negative impact on the local environment in terms of wastewater discharge and water supply.

Hazardous and Non-Hazardous Wastes

Hazardous wastes and waste oil will be generated during construction period of the Project. Hazardous waste will be collected in leak-proof containers and removed to a licensed disposal facility by licensed transporters. Waste oils generated at site will be collected by qualified personnel from the licensed processing and disposal facilities. These wastes will be removed from the Project site in accordance with the Waste Oil Control Regulation.

Waste battery and accumulators will be collected separately and will be delivered to the collection points to be established by enterprises engaged in the distribution and sales of battery products, or by municipalities in accordance with Waste Batteries and Accumulators Control Regulation.

During operation the plant will generate various types of hazardous wastes. These wastes will be stored at designated storage areas with fire prevention systems and with necessary precautions to prevent contamination of soil and groundwater. Hazardous wastes will be transported and disposed of by the MOEU certified disposal companies in accordance with the Hazardous Waste Control Regulation. Waste oil will be stored in leak-proof storage tanks and analyzed by an accredited laboratory according to the Waste Oil Control Regulation. If waste oil is determined as hazardous waste, it will be transported and disposed of by licensed companies according to the Hazardous Waste Management Regulation. Waste batteries and accumulators will be collected, temporarily stored, transported and disposed in accordance with the Waste Batteries and Accumulators Control Regulation. Three-year waste management plan and waste declaration transportation forms will be prepared and submitted for hazardous waste and waste oils. The proposed Project will not create any adverse impact in the local environment due to the handling,

storage, transport and disposal of the hazardous waste and waste oil generated during the construction and operation.

Non-hazardous wastes will also be generated during construction and operation periods. Recyclable wastes will be segregated from other wastes and stored temporarily on site for eventual recycling process. A sound, impermeable, rain-proofed, labeled storage area will be designated for recyclables keeping them segregated from other wastes. Excavated soil will be re-used for landscaping purposes primarily. Remaining soil, excavation waste will be transported to the sites approved by Hacilar Municipality. Necessary permits will be obtained during this process. Non-recyclable and non-hazardous solid wastes will be collected within closed bags and these wastes will be collected and properly disposed. It is estimated that negligible amount of medical waste will be generated annually since it is not planned to construct infirmary at the proposed project site. These wastes will be managed in accordance with the Medical Waste Control Regulation.

Socio-Economics

Socio-economic impacts of the proposed project are assessed in terms of probable income growth, employment, population movements and migration and health issues.

It is estimated that nearly 900 personnel will be required for construction and most personnel will be employed from local work force. It is planned that necessary material and service will be delivered using existing local opportunities. These expenses will contribute to local economy positively. Probable income growth arising from employees working for the plant during operation period will be negligible since 60 personnel will work during operation period. There will not be an important population movement or migration since unskilled workers during construction period will be tried to be employed from locals and 60 employees will work during operation period of the plant.

There is not a directly affected community from the project as the project area is located on project owner's land. There will be no physical resettlement associated with the proposed plant. The socio-economic impacts of the project are minor and indirect. Employment opportunity during construction and operation phases might provide positive socio-economic impact to the project area when a recruitment approach to hire construction workers from region and especially from project-affected communities is applied.

Public Consultation and Disclosure

A public participation meeting was held in order to inform people about the project and obtain their opinions and suggestions on April 24, 2010 and January 23, 2012 in Hacilar Town which is the nearest settlement to the project site as required by Environmental Impact Assessment Regulation. The meeting was announced in local and national newspapers and town. People from Hacilar Town and governmental institutions participated the meeting. A presentation including specifications, environmental and social impacts of the project and mitigation measures to be taken was made. Then opinions of people were received and their questions were

answered. Throughout the meeting participants asked questions generally about business opportunities and environmental impacts of the project.

Consultation will also be provided during construction and operation phases of the project and a grievance mechanism will be established for the proposed project.

Occupational Health and Safety

Occupational and community health and safety issues are also assessed in the scope of the ESIA study. Non-ionizing Radiation, heat, noise, confined spaces, electrical hazard, fire and explosion hazards, chemical hazards, fire, means of egress, public access, traffic safety, disease prevention issues are addressed in terms of occupational and community health and safety. All the precautions related with these issues will be taken throughout the construction and operational phases of the proposed project in accordance with the Turkish Health and Safety laws and regulations and the IFC/WB Guidelines. With the proper implementation of health and safety plans and taking the necessary precautions given in the regulations, potential accidents associated with these issues are expected to be eliminated.

Project Alternatives

The project alternatives are also evaluated in the scope of the ESIA study. Due to the project site is owned by the owner of the project, it is in the industrial site, it is far from the residential areas and it is close the connection point to natural gas transmission line of Samsun-Ankara Natural Gas Transmission Pipeline, the proposed site is selected.

The natural gas combined cycle power plant technology was selected after economic and technical specifications and fuel requirement of the fuel-oil and coal fired thermal power generation facility alternatives.

In addition, after it was determined that a water resource is not available for a water cooling system to be installed for the proposed plant, air cooling system was chosen.

Management Plan

An Environmental and Social Management Plan which addresses the impacts, significance of the impacts, mitigation measures, responsible parties, monitoring methods and frequencies and costs, is also prepared for the proposed project in the scope of the ESIA study.

Conclusion

The ESIA study has demonstrated that the overall significance of potential environmental and social impacts associated with the construction, operation and decommissioning of the proposed İç Anadolu Natural Gas Combined Cycle Power Plant will be negligible and the Project will comply fully with all relevant Turkish Legislation as well as the requirements of the Equator Principles and the IFC Guidelines with the exception of the noise exceedance at the closest sensitive receptor.

1.0 INTRODUCTION

1.1 Background of the Project

GAMA Energy Inc. ("GEAŞ") is an energy and water infrastructure development and investment company established in Turkey in 2002. GEAŞ activities incorporate an in-house project development, financing, construction and operation management capability. The shareholders of GEAŞ are GAMA Holding and General Electric Energy Financial Services, each holding 50% stake in the company. GEAŞ plans to make various energy investments in Turkey. GEAŞ has totally 1,620 MW installed power generation capacity and 142 million m³/year water supply capacity (see, www.gama.com.tr).

İçanadolu Doğalgaz Elektrik Üretim ve Ticaret A.Ş. (İçanadolu Energy) is an affiliated company of GEAŞ. İçanadolu Energy proposes to construct and operate a 840 MWe natural gas fired combined cycle power plant (CCPP) in the Central District of the Kırıkkale Province ("Project"). İçanadolu Energy had obtained a "power generation license" from the EMRA for the proposed 420 MWe CCPP project. A 49-year License (License No. EU/3118-1/1867, dated March 16, 2011, 420 MW) was granted for the proposed project by the EMRA under the provisions of Law No. 4628 governing the electricity market in the Republic of Turkey. Then, the project design was revised by GEAŞ and the capacity of the Project was increased to 840 MWe. İçanadolu Enerji applied to the EMRA for the revision of licence on April 8, 2011. Revision of Licence Application was found to be appropriate by the EMRA for the 840 MWe CCPP project on May 31, 2012.

It is foreseen that the proposed 840 MWe CCPP project will be completed in 34 months following the financial close and will generate electricity for 49 years. The generated electricity will be connected to the national interconnected network and will meet the growing demand for electrical energy of Turkey.

The required permission for connection to the national interconnected electric network was obtained from the Turkish Electricity Transmission Corporation (TEİAŞ).

Natural gas will be supplied from the Samsun - Ankara Natural Gas Pipeline via a 12.6 km pipeline. BOTAŞ has confirmed that it will be able to supply gas to the plant, although it is possible to seek gas from other wholesale companies in Turkey. A gas connection agreement with local gas distribution company KIRGAZ will be signed for the 13 km pipeline connection to the Samsun-Ankara Natural Gas Pipeline transportation system.

According to the Turkish Environmental Impact Assessment (EIA) Regulation, which was published in Official Gazette No. 26939 dated 17.July.2008, the proposed project is placed in the list of facilities required to prepare an environmental impact assessment report. Therefore, an EIA report was prepared in accordance with the format given by the Ministry of Environment and Urbanization (MoEU) of Turkey and at the end of EIA process carried out by the MoEU and related institutions in Turkey, an "EIA Affirmative" decision was granted for the initially proposed project (420 MWe) on

December 31, 2010. İcanadolu Enerji applied to the MoEU for capacity increase on December 02, 2011. An EIA report was prepared and submitted to the MoEU on June 15, 2012 for the 840 MWe CCPP. The EIA report has been accepted as the final report by the review committee and “EIA Affirmative” decision is being prepared by the MOEU.

The local EIA report and this Environmental and Social Impact Assessment (ESIA) report are prepared by AECOM Turkey Consulting and Engineering Ltd. AECOM is a global leader in providing fully integrated engineering, design and program management services for a broad range of markets, including architecture, building engineering, design and planning, economics, energy, environment, government services, program management, transportation and water. With more than 50,000 employees around the world, AECOM serves clients in more than 100 countries (see, www.aecom.com).

1.2 Purpose and Scope of ESIA

The Project owner, GEAŞ, plans to apply international finance institutions (IFIs) for financing of the proposed Project. Therefore, GEAŞ has initiated this ESIA to be prepared according to the Equator Principles (EP). The “Equator Principles” is a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing. The Equator Principles are based on the International Finance Corporation’s (IFC) Environmental and Social Safeguard Policies. Thus, this report also complies with IFCs guidelines that are referred by the EP.

The purpose of the ESIA is to identify potential environmental and social impacts of the Project to the local ecosystem and community during construction, operation and decommissioning phases of the Project. The ESIA also aims at providing mitigation measures to eliminate potential adverse impacts and propose a management and monitoring plan. The ESIA evaluates potential impacts in terms of additionally caused by the Project. Thus, an environmental and social baseline data is also assessed within the scope of the ESIA. The ESIA was carried in the following stages:

- Review of applicable national and international regulations and standards, industry best practice.
- Compilation of a technical description of the project.
- Description of the existing (baseline) environmental and social conditions within the project area.
- Identification, characterization and quantification of all emissions to air, water and soil during construction, operation and decommissioning phases of the Project.
- Assessment of the environmental impacts of the Project.
- Identification of mitigation measures that minimize or eliminate potential impacts.
- Provision of plans for monitoring programs, auditing and feedback.

The ESIA report includes following sections:

- Executive summary;

- Policy, legal and administrative framework;
- Project description;
- Baseline data;
- Environmental and social assessment;
- Analysis of alternatives;
- Environmental management plan; and
- Public consultation.

Following issues are addressed in the ESIA:

- Assessment of the baseline social and environmental conditions;
- Consideration of feasible environmentally and socially preferable alternatives;
- Requirements under Turkish laws and regulations, applicable international treaties and agreements;
- Community health and safety;
- Protection of cultural property and heritage;
- Protection and conservation of biodiversity, including endangered species and sensitive, ecosystems in modified, natural and critical habitats, and identification of legally protected areas;
- Sustainable management and use of renewable natural resources;
- Use and management of dangerous substances;
- Occupational health and safety;
- Socio-economic impacts;
- Cumulative impacts of existing projects, the proposed Project, and anticipated future projects;
- Consultation and participation of affected parties in the design, review and implementation of the project; and
- Pollution prevention and waste minimization, pollution controls (liquid effluents and air emissions) and solid and chemical waste management.

1.3 Project Categorization

According to the Equator Principle 1, the project is categorized based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the International Finance Corporation (IFC) (Exhibit I). The project is regarded as Category A project since the project potentially expected to have “adverse impacts that may be sensitive, irreversible, and diverse”, with attributes such as direct pollutant discharges large enough to cause

degradation of air, water, or soil; large-scale physical disturbance of the site or surroundings; use of hazardous materials in more than incidental quantities; and other significant social disturbances with potential limited adverse social or environmental impacts that are few in number, generally site specific, largely reversible, and readily addressed through mitigation measures.

2.0 LEGAL FRAMEWORK

The Environmental Law (No. 2872), which was published in Turkish Official Gazette No. 18132 dated August 11, 1983 and revised in Turkish Official Gazette No. 26167 dated May 13, 2006 (Law No. 5491) provides the legislative framework for the regulation of industries and their potential impact on the environment. Industrial projects are subject to varying levels of review that begin while projects are in the development and pre-operation phases. Additional regulations apply to facilities once they are in operation.

The Environmental Law authorized the promulgation of a number of regulations. Those that pertain to development and operation of natural gas combined power plant projects are the following:

- Environmental Impact Assessment Regulation, Official Gazette No. 26939 dated July 17, 2008;
- Large Combustion Plants Regulation; Official Gazette No. 27605 dated June 08, 2010;
- Industrial Air Pollution Control Regulation, Official Gazette No. 27277 dated July 3, 2009 and revised in Official Gazette No. 27537 dated March 30, 2010;
- Regulation on Assessment and Management of Air Quality, Official Gazette No. 26898 dated June 6, 2008 and revised in Official Gazette No. 27219 and dated May 5, 2009;
- Regulation on Tracking of Greenhouse Gas Emissions, Official Gazette No. 28274 dated April 25, 2012;
- Regulation on Assessment and Management of Environmental Noise, Official Gazette No. 27601 dated June 04, 2010 and revised in Official Gazette No. 27917 dated April 27, 2011;
- Water Pollution Control Regulation, Official Gazette No. 25687 dated December 31, 2004 and revised in Official Gazette No. 27537 dated March 30, 2010;
- Regulation on General Principles of Waste Management, Official Gazette No. 26927 dated July 5, 2008;
- Hazardous Wastes Control Regulation, Official Gazette No. 25755 dated March 14, 2005 and revised in Official Gazette No. 27744 dated October 30, 2010 ;
- Waste Oil Control Regulation, Official Gazette No. 26952 dated July 30, 2008 and revised in Official Gazette No. 27537 dated March 30, 2010;
- Vegetable Waste Oil Control Regulation, Official Gazette No. 25791 dated April 19, 2005 and revised in Official Gazette No. 27537 dated March 30, 2010;
- Solid Waste Control Regulation, Official Gazette No. 20814 dated March 14, 1991 and revised in Official Gazette No. 27533 dated March 26, 2010;

- Medical Waste Control Regulation, Official Gazette No. 25883 dated July 22, 2005 and revised in Official Gazette No. 28131 dated December 03, 2011;
- Communiqué on Recovery of Some Non-Hazardous Wastes, Official Gazette No: 27967, dated June 17, 2011
- Environmental Audit Regulation, Official Gazette No. 27061 dated November 21, 2008 revised in Official Gazette No: 28027, dated August 16, 2011;
- Regulation on Environmental Permits and Licenses, Official Gazette No. 27214 dated April 29, 2009 and revised in Official Gazette No. 28027 dated, August 16, 2011;
- Packaging Waste Control Regulation, Official Gazette No. 28035 dated August 24, 2011;
- Waste Batteries and Accumulators Control Regulation, Official Gazette No. 25569 dated August 31, 2004 and revised in Official Gazette No. 27537 dated March 30, 2010;
- Regulation on Control of Excavation, Construction and Demolition Wastes, Official Gazette No. 25406 dated March 18, 2004 and revised in Official Gazette No. 27533 dated March 26, 2010;
- Regulation on Soil Pollution Control and Contaminated Sites by Point Source, Official Gazette No: 27605 dated June 8, 2010 and revised in Official Gazette No. 28323 dated June 14, 2012;
- Regulation Related to Workplace Opening and Operation Permits, Official Gazette No. 25902 dated August 10, 2005 and revised in Official Gazette No. 27983 dated July 03, 2011;
- Air Pollution Control Regulation For Heating Sources, Official Gazette No. 25699 dated January 13, 2005 and revised in Official Gazette No. 27134 dated February 07, 2009;
- Regulation on Reduction in Ozone Depleting Substances, Official Gazette No. 27052 dated November 12, 2008;
- Regulation on Landfill of Waste Official Gazette No. 27533 dated March 26, 2010;
- Regulation on Control of Major Industrial Accidents, Official Gazette No: 27676 dated August 18, 2010;
- Regulation on Tracking of Greenhouse Gas Emissions, Official Gazette No. 28274 dated April 25, 2012;
- Regulation on Inventory and Control of Chemicals, Official Gazette No. 27092 dated December 26, 2008;
- Guideline Concerning the Measures to be Taken at Work Sites and Works Utilizing Explosive, Flammable, Hazardous and Detrimental Materials” Official Gazette No. 14752 dated December 24, 1973;
- Exhaust Gases Emission Control Regulation, Official Gazette No. 27190 dated April 04, 2009; and

In addition, there are several other laws and regulations that directly or indirectly include environmental review, and thus, are applicable to the proposed project. These laws and regulations are mostly related to the construction phase of the project and stated below:

- Labor Law No. 4857;
- Organized Industrial Zones Law No. 4562
- Occupational Health and Safety Statute, Official Gazette No. 14765 dated January 11, 1974;
- Health and Safety Regulation for Construction Works, Official Gazette No. 25325 dated December 23, 2003;
- Regulation on Health and Safety Regarding Temporary Works, Official Gazette No. 25463 dated May 15, 2004.

2.1 Environmental Impact Assessment Procedure in Turkey

The first Environmental Impact Assessment (EIA) Regulation was published in Official Gazette No. 21489 dated February 7, 1993. The EIA regulation was subsequently revised three times and reissued in Official Gazette on June 23, 1997, June 6, 2002 and December 16, 2003. The final version of EIA Regulation was published on July 17, 2008 in Official Gazette No. 26939. The purpose of the EIA regulation is to define the administrative and technical aspects that must be followed during an environmental impact assessment process.

The scope of the EIA regulation includes the following:

- Determination of the type of projects required to prepare an environmental impact assessment report or a project description report and the issues to be covered in these applications or reports;
- The technical, administrative and legal aspects related to the environmental impact assessment process;
- The work related to the establishment of the Scope Definition, Review and Evaluation Committee; and
- Monitoring and auditing of the projects subject to this regulation, prior to the commissioning phase, during the operational phase and the decommissioning phase.

According to Article 6 of the EIA regulation, projects should either submit an Environmental Impact Assessment (EIA) Report or Project Description Report (PDR) based on the classification of the projects listed in Annex I and Annex II of the EIA regulation. Annex I and Annex II define the type and projects that are subject to preparing and submitting an EIA Report and PDR, respectively.

The projects that are listed in Annex I are directly subject to preparing an EIA Report. As the first requirement, they will need to prepare an Environmental Impact Assessment Application File and apply to the Ministry of Environment and Urbanization by submitting a report that includes a project description and information according to the format given in the Annex III of the EIA Regulation. The power plants, which have total thermal power higher than 300 MWt, must prepare an Environmental Impact Assessment Application File and then prepare and submit an EIA report prior to construction.

The MoEU reviews the EIA Application File and establishes a review and evaluation committee to review and evaluate the EIA report. Before the first meeting of the committee, the project owner should conduct a public participation meeting at the proposed project location to inform the public about the project.

As a result of the evaluation meetings by the MoEU and the evaluation committee, the evaluation process will be finalized and the project owner will be requested to submit the final report by incorporating the necessary additional information. Then, the final report will be made available for public review for 10 days by MoEU. The final report will be reproduced for committee members and submitted to the MoEU after incorporating public opinions. Finally, the MoEU issues the final opinion as “Affirmative Opinion on Environmental Impact Assessment” or “Negative Opinion on Environmental Impact Assessment”. The EIA Affirmative opinion is valid for seven years. The project should be initiated within seven years after the affirmative opinion is issued otherwise the opinion will be invalid.

The project owner should submit monitoring reports for the project to the MoEU at the time intervals determined by the MoEU throughout the construction and operation periods. These reports should include whether the commitments given in the final EIA report are made or not. The monitoring reports should be prepared and submitted to the MoEU at the time intervals determined by the MoEU throughout the pre-construction, construction periods.

An “EIA Affirmative” decision has been granted for the initially proposed project (420 MWe) on December 31, 2010. İÇ Anadolu Enerji applied to the MoEU for capacity increase on December 02, 2011. An EIA report was prepared and submitted to the MoEU on June 15, 2012. The EIA report has accepted as final by the review committee and the “EIA Affirmative” is expected to be issued in September 2012.

Moreover, according to the Turkish EIA Regulation, if the transmission line is longer than 15 km, then an EIA Report should be prepared for the transmission line and a development consent should be secured. If the line is between 5 km and 15 km and over 154 kV or higher capacity, then a project description report should be submitted to Provincial Environment and Urbanization Directorate and this will be sufficient for development consent of the transmission line.

The power will be connected to the 380 kV Gölbaşı Substation and 380 kV switchyard of the proposed 1200 MW Kırıkkale Natural Gas Power Plant that will be constructed in Yahşihan District of Kırıkkale Province. This connection will be accomplished through a 58 km transmission line. An

EIA report will be prepared for the transmission line. GAMA Energy will have an EIA report prepared for the transmission line once the route of the line is determined and finalized.

2.2 Turkish Legal Framework for Environmental Protection

2.2.1 Air Quality

The main regulations regarding the air quality are:

- Large Combustion Plants Regulation, (LCPR) (Official Gazette No. 27605 dated June 08, 2010);

The purpose of the LCPR is to control emissions emitted to the atmosphere resulting from the activities of energy production facilities, to protect and prevent the environment and human beings from atmospheric pollution hazards, to eliminate adverse impacts due to air pollution which cause harm to the general public and to ensure that such impacts do not emerge.

- Industrial Air Pollution Control Regulation (IAPCR) (Official Gazette No. 27277 dated July 3, 2009 and amended in 2010)

The purpose of the IAPCR is to control soot, fume, dust, gas, vapor, and aerosols emitted to the atmosphere resulting from the activities of industrial and energy production facilities, to protect and prevent the environment and human beings from atmospheric pollution hazards, to eliminate adverse impacts due to air pollution which cause harm to the general public and to ensure that such impacts do not emerge.

- Regulation on Assessment and Management of Air Quality (RAMAQ) (Official Gazette No. 26898 on June 6, 2008 and amended in 2009)

The purpose of the RAMAQ is to define and establish objectives for ambient air quality designed to prevent or reduce harmful effects on human health and the environment, to assess the ambient air quality on the basis of common methods and criteria, to maintain air quality where it is good and improve it in other cases and to obtain adequate information on ambient air quality and ensure that the such information on ambient air quality is available to the public.

- Air Pollution Control Regulation for Heating Sources (APCRH) (Official Gazette No. 25699 dated January 13, 2005 and amended in 2007 and 2009)

The purpose of the APCRH is to reduce and control harmful effects of soot, fume, dust, gas, vapor, and aerosols emitted to the atmosphere resulting from the heating sources used in places such as residences, schools, universities, hospitals, offices, social facilities and industrial facilities.

- Exhaust Gases Emission Control Regulation (EGECR) (Official Gazette No. 27190 dated April 04, 2009)

The purpose of the EGECR is to determine the necessary methods and principles regarding reduction of the exhaust gas pollutants and control of the pollutants via measurements to protect the living organisms and environment from the air pollution and its effects of exhaust emission caused by the motorized vehicles in traffic. This regulation does not cover the construction vehicles.

- Regulation on Tracking of Greenhouse Gas Emissions, (Official Gazette No. 28274 dated April 25, 2012)

The purpose of the Regulation on Tracking of Greenhouse Gas Emission is to arrange the necessary methods and principles regarding, tracking, approving, and reporting of greenhouse gas emissions due to the activities listed in Annex I of the regulation. Combustion installations with a rated thermal input exceeding 20 MW (except hazardous or municipal waste installations) are listed in Annex I, therefore, the Project is subject to responsibilities of the regulation.

Ambient Air Quality

Regulation on Assessment and Management of Air Quality (RAMAQ) defines ambient air quality limits for two regulatory periods. The first period is transitional period which is until January 1 2014. The transitional period ambient air quality standards are given in Annex-IA of RAMAQ. Limit values for ambient air quality standards after transitional period are given in Annex I of RAMAQ. The Turkish ambient air quality standards are presented in Table 2-1.

Table 2-1 Turkish RAMAQ and Air Quality Standards

Pollutant	Averaging Period	Turkish RAMAQ	
		Limit Value ¹ ($\mu\text{g}/\text{m}^3$)	Annual Decrease of Limit Value
SO ₂	1 Hour	900	Starting from 1.1.2014, the limit value will be 500 $\mu\text{g}/\text{m}^3$ and it will decrease 30 $\mu\text{g}/\text{m}^3$ each year down to 350 $\mu\text{g}/\text{m}^3$ till 1.1.2019.
	24 Hour (95 th percentile) -to protect human-health	400	The limit value will decrease 30 $\mu\text{g}/\text{m}^3$ each year down to 250 $\mu\text{g}/\text{m}^3$ till 1.1.2014. Starting from 1.1.2014, the limit value will decrease 25 $\mu\text{g}/\text{m}^3$ each year down to 125 $\mu\text{g}/\text{m}^3$ till 1.1.2019.
	Winter Season Average (1 October – 31 March) -to protect human-health	250	The limit value will decrease 25 $\mu\text{g}/\text{m}^3$ each year down to 125 $\mu\text{g}/\text{m}^3$ till 1.1.2014.
	Target Limit Value Winter Season Average (1 October – 31 March)	120	-
	Annual -to protect human-health	150	-
	Annual -to protect vulnerable animals, plants and entities	60	The limit value will decrease 8 $\mu\text{g}/\text{m}^3$ each year down to 20 $\mu\text{g}/\text{m}^3$ till 1.1.2014.
	Target Limit Value Annual	60	-
NO ₂	24 Hour (95 th percentile)	300	The limit value will decrease 10 $\mu\text{g}/\text{m}^3$ each year down to 200 $\mu\text{g}/\text{m}^3$ starting from

	-to protect human-health		1.1.2014 till 1.1.2024.
	Annual -to protect human-health	100	The limit value will decrease 8 $\mu\text{g}/\text{m}^3$ each year down to 60 $\mu\text{g}/\text{m}^3$ till 1.1.2014. Starting from 1.1.2014, the limit value will decrease 2 $\mu\text{g}/\text{m}^3$ each year down to 40 $\mu\text{g}/\text{m}^3$ till 1.1.2024.
NO _x	Annual -to protect vegetation	30	The limit value will be valid after 1.1.2014.
PM ₁₀	24 Hour (95 th percentile) -to protect human-health	300	The limit value will decrease 40 $\mu\text{g}/\text{m}^3$ each year down to 100 $\mu\text{g}/\text{m}^3$ till 1.1.2014. Starting from 1.1.2014, the limit value will decrease 10 $\mu\text{g}/\text{m}^3$ each year down to 50 $\mu\text{g}/\text{m}^3$ till 1.1.2019.
	Winter Season Average (1 October – 31 March) -to protect human-health	200	The limit value will decrease 22 $\mu\text{g}/\text{m}^3$ each year down to 90 $\mu\text{g}/\text{m}^3$ till 1.1.2014.
	Annual -to protect human-health	150	The limit value will decrease 18 $\mu\text{g}/\text{m}^3$ each year down to 60 $\mu\text{g}/\text{m}^3$ till 1.1.2014. Starting from 1.1.2014, the limit value will decrease 4 $\mu\text{g}/\text{m}^3$ each year down to 40 $\mu\text{g}/\text{m}^3$ till 1.1.2019.
CO	24 Hour (95 th percentile) -to protect human-health	30	The limit value will decrease 4 $\mu\text{g}/\text{m}^3$ each year down to 10 $\mu\text{g}/\text{m}^3$ till 1.1.2014.
	Annual -to protect human-health	10	-
Note: ¹ Regulation on Assessment and Management of Air Quality (RAMAQ) (Official Gazette No. 26898 on June 6, 2008 and amended in 2009)			

Emission Limits

The Turkish Large Combustion Plants Regulation (LPCR) provides emission limits for stationary sources. Proposed power plant emissions will comply with the Turkish Large Combustion Plants Regulation emission limits. Table 2-2 presents the emission limits stated in the Regulation.

Table 2-2 Turkish LCPR Emission Limits

Parameter	Units	Emission Limits
		Turkish
NO _x	mg/Nm ³ @15% O ₂ , dry	50
CO	mg/Nm ³ @15% O ₂ , dry	100
SO ₂	mg/Nm ³ @15% O ₂ , dry	11.7

2.2.2 Wastewater

Water Pollution Control Regulation (WPCR) was published in Official Gazette No. 25687, dated December 31, 2004 and revised and re-issued in Official Gazette No. 26786 dated February 13, 2008 and in Official Gazette No. 27537 dated March 30, 2010. The aim of the WPCR is to determine the necessary legal and technical principles in order to protect surface and groundwater resources, provide sustainable water use and prevent water pollution in harmony with sustainable development objectives.

The WPCR covers water quality classes and utilization principles, planning principles and prohibitions concerning water quality, wastewater discharge principles and discharge permits, applications in wastewater infrastructure facilities and monitoring and auditing principles in order to prevent water pollution. Industries are categorized according to their sectors in the WPCR. The WPCR presents “sector-specific” discharge limits for numerous types of wastewater discharges. The WPCR also sets the discharge limits for domestic wastewaters.

The proposed project should comply with the below mentioned limits given in the WPCR. Discharge limits in case the wastewater is discharged to a receiving environment are given in Table 2-3 below.

Table 2-3 Discharge Limits for Industrial Discharge

Parameter	Unit	WPCR Table 20.7 Water Softening Demineralization and Regeneration, Active Carbon Washing and Regeneration Plants	
		2 hr Composite Sample	24hr Composite Sample
pH	-	6 to 9	6 to 9
Chloride	mg/l	2,000	1,500
Sulfate	mg/l	3,000	2,500
Iron	mg/l	10	-
Fish Bioassay (ZSF)	TL50	10	-

Discharge limits in case the wastewater is discharged to sewer system connected to a treatment plant are given in Table 2-4.

Table 2-4 Sewerage System Discharge Limits

Parameter	Sewerage system connected to a treatment plant	Sewerage system not connected to a treatment plant
Temperature (°C)	40	
pH	6.5-10.0	
Suspended Solids (mg/l)	500	
Oil and Grease (mg/l)	250	
Tar and Petroleum-based Oils (mg/l)	50	
Chemical Oxygen Demand (COD) (mg/l)	4000	
Sulphate (SO ₄) (mg/l)	1700	
Total Sulphur (S) (mg/l)	2	
Phenols (mg/l)	20	
Free Chlorine (mg/l)	5	
Total Nitrogen (N) (mg/l)	-(a)	
Total Phosphorus (P) (mg/l)	-(a)	
Arsenic (As) (mg/l)	3	
Total Cyanide (Total CN ⁻) (mg/l)	10	

Total Lead (Pb) (mg/l)	3	
Total Cadmium (Cd) (mg/l)	2	
Total Chromium (Cr) (mg/l)	5	
Total Mercury (Hg) (mg/l)	0.2	
Total Copper (Cu) (mg/l)	2	
Total Nickel (Ni) (mg/l)	5	
Total Zinc (Zn) (mg/l)	10	
Total Tin (Sn) (mg/l)	5	
Total Silver (Ag) (mg/l)	5	
Cl- (Chlorine) (mg/l)	10000	
Surface Active Substances with methylene blue (mg/L)	Prohibited	

Discharge limits in case the domestic wastewater is discharged to a receiving environment are given in Table 2-5 below.

Table 2-5 Domestic Wastewater Discharge Limits to Receiving Environment

WPCR Table 21.1 Domestic Wastewater (BOD load 5-120 kg/day; Population 84-2000)			
Parameter	Unit	Composite Sample (2 hr)	Composite Sample (24 hr)
BOD	mg/l	50	45
COD	mg/l	180	120
TSS	mg/l	70	45
pH	-	6-9	6-9

2.2.3 Soil Pollution

The Soil Pollution Control Regulation and Contaminated Sites by Point Source was newly published in Official Gazette No. 27605, dated June 08, 2010. This Regulation superseded the previous Soil Pollution Control Regulation. The purpose of the Regulation is to prevent soil pollution and to undertake required measures to clean up soil contamination.

In accordance with the Regulation, it is obligatory to prevent pollution, stop pollution in the polluted areas and determine the extent of pollution and carry out. The facility is liable to assure that any type of waste and residue are not discharged, stored directly or indirectly to the receiving environment in compliance with the standards and procedures stated in the Environmental Law and the relevant Regulations in a way that they do not harm soil and cause soil pollution. According to this regulation, it is the responsibility of the facility owner to remediate (i.e., clean-up) contaminated soil. In addition, after remediation parameters listed in the regulation should be analyzed and the samples should comply with the limit values for these parameters.

The proposed project must comply with the Regulation during the construction and operation phases.

2.2.4 Noise

Regulation on Assessment and Management of Environmental Noise (RAMEN) published in Official Gazette No. 27601 dated June 4, 2010 and amended in 2011. The purpose of the RAMEN is to take necessary precautions in order to prevent the disturbance of the comfort and tranquility of public and ensure physical and mental health of human beings due to exposure to environmental noise.

RAMEN sets the noise level limits for construction sites. The limits are given in Table 2-6. The proposed project should comply with these limits during construction phase.

Table 2-6 Noise Limits for Construction Sites

Type of Activity (construction, demolition, restoration)	L _{day} (dBA)
Building	70
Road	75
Other Resources	70

Various equipment and machinery will be used during the construction phase of the project. Thus, the project should also comply with the limits stated in the Regulation on Noise Emission by Outdoor Equipment which was published in the Official Gazette No. 26392 dated December 30, 2006.

For the operation phase of the facilities, RAMEN also sets the noise level criteria (for night, day and evening periods) for the industrial facilities categorized into four groups according to sensitivity of the area. The project is subject to limits given in the category which is referred to as "For each facilities that are in organized industrial zone or industrial region". The corresponding limits are given in Table 2-7. Thus, the proposed project should not exceed these limits during operation phase.

Table 2-7 Turkish Noise Level Limits

Areas	L _{day} (dBA)	L _{evening} (dBA)	L _{night} (dBA)
Noise sensitive areas where education, cultural activities, health centers, summer resorts and camping sites predominate.	60	55	50
Areas with both noise sensitive areas and industrial activities (predominantly residential)	65	60	55
Areas with both noise sensitive areas and industrial activities (predominantly industrial)	68	63	58
For each facilities that are in organized industrial zone or industrial region	70	65	60

In accordance with RAMEN, information related to starting and finishing dates and working durations of the construction and the permits obtained from municipalities should be displayed on a signboard that can easily be seen by everyone.

2.2.5 Waste

Regulation on General Principles of Waste Management was published in Official Gazette No 26927 dated on June 5, 2008. The purpose of the regulation is to provide waste management without causing harm to the environment and human health.

It is indicated in Article 5 of the Regulation that waste generators are obliged to decrease the amount of waste and its hazardous properties, utilize methods for separation, collection, transportation, recycling and disposal operations that will not cause a risk for water, air, soil, flora and fauna. In addition, according to Article 11 of the Regulation, the waste generating facilities should record the waste quantity, source, type and the corresponding waste code given in the annex part of this regulation, disposal facility the waste was sent and applied processes and keep the records for at least five years; submit them to the MoEU on periods determined by MoEU; and make them accessible for the inspection of MoEU.

The regulation also includes the list of hazardous and non-hazardous wastes and their waste codes, their way of recycling and disposal methods and properties of hazardous wastes. The proposed project must comply with the Regulation on General Principles of Waste Management.

Solid Waste

Solid Waste Control Regulation (SWCR) was published in Official Gazette No. 20814 dated March 14, 1991 and amended in Official Gazette No. 27533 dated March 26, 2010.

In accordance with Article 4 of the SWCR, facilities generating solid wastes are liable to choose the technology generating the least quantity of solid waste, to reduce the amount of solid waste quantity of the existing production, to eliminate harmful materials from the solid wastes and participate in and contribute to the efforts of recycling of materials.

According to Article 8 of SWCR, domestic solid wastes and the used batteries, used accumulators, medical wastes, used vehicle tires, packaging wastes and recyclables wastes should be disposed of separately. In addition, it is also indicated that disposal of solid wastes by waste generating or transporting parties to seas, lakes and similar receiving environments, streets, forests and other places where environment would be adversely affected is prohibited.

According to the SWCR, facilities generating waste and industrial sources with domestic wastes are required to collect their solid wastes in the facilities where they are produced, as required by the municipalities. Within the municipality boundaries, the municipality is responsible for providing collection services and the disposal of domestic waste from industrial sources. However, industrial facilities out of municipal borders are responsible for transportation of their wastes. The generators are obliged to keep the garbage containers closed in such manner not to cause any harm to the environment and to make them ready on the street at the time of collection of garbage.

Excavation, Construction and Demolition Wastes

Regulation on Control of Excavation, Construction and Demolition Wastes was published in Official Gazette No. 25406 dated March 18, 2004 and revised Official Gazette No. 27533 dated March 26, 2010.

In accordance with Article 9 of the regulation, excavation, construction and demolition generating facilities are obliged to provide the waste management in a way that will minimize the adverse effects of wastes on the environment and human health. The facilities must acquire the necessary permissions that concern the generation, transportation and storage operations of the wastes. The facilities are not allowed to dump construction wastes to the sites/locations and facilities other than the permitted ones by the municipal or other authorities.

Packaging Wastes

Packaging Waste Control Regulation (PWCR) was published in the Official Gazette No. 28035 dated August 24, 2011.

Article 23 of PWCR states that the package wastes should be collected and stored separately from the other wastes at source in order to ensure their disposal without causing any environmental damage; to reduce environmental pollution; to benefit from the landfills at maximum levels; and to contribute to the economy. Organized industrial zone (OIZ) gives the stored packaging wastes to the collection, separation facility with licensed/temporary operation document or the responsible municipalities' packing waste collection system. However, the OIZ, which established collection, separation facility with licensed/temporary operation document, is able to collect packaging wastes from the participants.

The project must comply with the Solid Waste Control Regulation, Regulation on Control of Excavation, Construction and Demolition Wastes and Packaging Waste Control Regulation during the construction and operation phases.

Hazardous Waste

Hazardous Wastes Control Regulation (HWCR) was published in Official Gazette No. 25755 dated March 14, 2005 and revised in 2010.

According to Article 9 of HWCR, the hazardous waste producers are obliged to take the required precautions in order to minimize hazardous waste generation; to provide waste management in a way that minimizes the adverse affects of wastes on human health and environment; to prepare 3-year waste management plan within six months from the issue date of this Regulation and obtain approval from the Governorate; to record the hazardous wastes generated; to provide proper packaging and labeling; and to dispose and transfer the hazardous wastes in conformity with the principles stated in the regulation.

According to HWCR, facilities are required to secure a permit from local Governorate in case of temporary onsite storage of their wastes. However, facilities producing less than 1,000 kg/month of hazardous wastes may store these waste temporarily onsite for up to 180 days without

obtaining a permit from the local Governorate. In this situation, the total amount of the collected waste must not exceed 6,000 kg at any time.

In case of temporary onsite storage of hazardous wastes, the hazardous wastes should be stored in containers that are non-damaged, leak-proof, safe and appropriate for the international standards, on concrete place within the land of the facility, away from the plants and buildings. "Hazardous waste" label should be placed on the containers and this label should also indicate the amount of stored waste as well as the storage time of the hazardous waste. In case the containers are damaged, wastes should be transferred to the other containers with the same properties. Containers should be kept closed and wastes should be stored in a way that they will not go in chemical reactions.

Transportation of the wastes should be done by the licensed persons and entities with appropriate vehicles for the properties of the transported waste. The vehicles that are used to transport hazardous wastes should carry a waste transport form as specified in the regulation. The HWCR also contains a list of hazardous materials, their properties and their way of disposal.

Battery and Accumulator Wastes

Waste Batteries and Accumulators Control Regulation (WBACR) was published in Official Gazette No. 25569 dated August 31, 2004 and amended in Official Gazette No. 27537 dated March 30, 2010.

According to Article 13 of the WBACR the battery and accumulator consumers are obliged to collect used batteries separately from household wastes, and deliver used batteries to the collection points to be established by enterprises engaged in the distribution and sales of battery products, or by municipalities.

The project must comply with the requirements of the Hazardous Wastes Control Regulation and Waste Batteries and Accumulators Control Regulation during construction and operation phases.

Waste Oil

Waste Oil Control Regulation (WOCR) was published in the Official Gazette No. 26952 dated June 30, 2008 and revised in Official Gazette No. 27537 dated March 30, 2010.

According to Article 9 of WOCR, waste oil producers are obliged to take required measures to minimize the generation of waste oils including waste motor oils and residues resulting from processing of waste oils. Waste oil producers must conduct waste oils analyses once at licensed laboratories in case there is no change in the oil type used, and declare to the MoEU of Environment. The waste oils of different category should not be mixed with each other, PCB and other hazardous wastes. The waste producers must obey the conditions of Hazardous Waste Control Regulation for disposal and for transporting waste oils by licensed transporters to the licensed processing and disposal facilities.

The proposed project must comply with the requirements stated in the Waste Oil Control Regulation.

Medical Waste

Medical Waste Control Regulation (MWCR) was published in Official Gazette No. 25883 dated July 22, 2005 and revised in Official Gazette No. 28131 dated December 03, 2011. The Regulation requires that medical waste must be collected separately at source and be transported, temporarily stored and disposed of without causing harm to environment or human health.

The project must comply with the MWCR during the construction and operation phase of the project.

2.3 International Requirements

Turkey signed many international conventions and agreements to protect its environment and biodiversity. Potential related international conventions with thermal power energy plants are the following:

- Convention on Biological Diversity, approved by 4177 numbered Law dated August 29, 1996 and published in the Official gazette No. 22860 and dated December 27, 1996, Ratified 1997;
- Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES), published in the Official Gazette No.22672 and dated June 20, 1996, Ratified 1996;
- Convention On The Conservation Of European Wildlife And Natural Habitats (Bern), published in the Official Gazette No. 18318 and dated February 20, 1984, Ratified 1984;
- Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar), published in the Official Gazette No. 21937 and dated May 17, 1994, Ratified 1994;
- International Convention For the Protection of Birds, published in the Official Gazette No. 12480 and dated December 17, 1966, Ratified 1967; and
- Convention Concerning the Protection of the World Cultural and Natural Heritage, published in the Official Gazette No. 17959 and dated February 14, 1983.

The Project will comply with the relevant provisions of conventions mentioned above.

2.4 Equator Principles

The Project is assessed in accordance with the Equator Principles. The “Equator Principles” is a financial industry benchmark for determining, assessing and managing social and environmental risk in project financing. The Principles apply to all new project financings globally with total project capital costs of US\$10 million or more, and across all industry sectors.

The Equator Principles (2006) that are adopted by the Equator Principles Financial Institutions (EPFIs) are listed below:

○ **Principle 1: Review and Categorization**

The project is categorized based on the magnitude of its potential impacts and risks in accordance with the environmental and social screening criteria of the International Finance Corporation (IFC).

○ **Principle 2: Social and Environmental Assessment**

A Social and Environmental Assessment is prepared to address the relevant social and environmental impacts and risks of the proposed. The Assessment should also propose mitigation and management measures relevant and appropriate to the nature and scale of the proposed project.

○ **Principle 3: Applicable Social and Environmental Standards**

The Social and Environmental Assessment refers to the applicable IFC Performance Standards and the applicable IFC Industry Specific EHS Guidelines.

○ **Principle 4: Action Plan and Management System**

The Action Plan describes and prioritizes the actions needed to implement mitigation measures, corrective actions and monitoring measures necessary to manage the impacts and risks identified in the Social and Environmental Assessment. Borrowers establish a Social and Environmental Management System that addresses the management of these impacts, risks, and corrective actions required to comply with applicable host country social and environmental laws and regulations, and requirements of the applicable IFC Performance Standards and EHS Guidelines, as defined in the Action Plan.

○ **Principle 5: Consultation and Disclosure**

Project affected communities are consulted with in a structured and culturally appropriate manner. For projects with significant adverse impacts on affected communities, the process ensures their free, prior and informed consultation.

○ **Principle 6: Grievance Mechanism**

Grievance mechanism allows the borrower to receive and facilitate resolution of concerns and grievances about the project's social and environmental performance raised by individuals or groups from among project-affected communities.

○ **Principle 7: Independent Review**

For all Category A projects and, as appropriate, for Category B projects, an independent social or environmental expert not directly associated with the borrower reviews the Assessment, Action Plan and consultation process documentation in order to assist EPFI's due diligence, and assess Equator Principles compliance.

○ **Principle 8: Covenants**

For Category A and B projects, the borrower covenants in financing documentation; a) to comply with all relevant host country social and environmental laws, regulations and permits in all material respects, b) to comply with the Action Plan during the construction and operation of the project in all material respects, c) to provide periodic reports in a format

agreed with EPFIs, d) to decommission the facilities, where applicable and appropriate, in accordance with an agreed decommissioning plan.

○ **Principle 9: Independent Monitoring and Reporting**

For all Category A projects, and as appropriate, for Category B projects, in order to ensure ongoing monitoring and reporting over the life of the loan, EPFIs require appointment of an independent environmental and/or social expert, or require that the borrower retain qualified and experienced external experts to verify its monitoring information which would be shared with EPFIs.

○ **Principle 10: EPFI Reporting**

Each EPFI adopting the Equator Principles commits to report publicly at least annually about its Equator Principles implementation processes and experience, taking into account appropriate confidentiality considerations

The Equator Principles are based on the IFCs Environmental and Social Safeguard Policies. Thus, the IFC/World Bank environmental, health and safety guidelines are described in the following section.

2.5 World Bank/IFC Environmental, Health, and Safety Guidelines

The proposed Project is also assessed in accordance with the IFC guidelines, performance standards and their guidance notes, and manuals related to environmental, social, health and safety issues. The documents guided the ESIA study is listed in the following sections.

Guidelines:

- IFC Environmental, Health, and Safety General Guidelines (2007); and
- IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants (2008);

The IFC EHS Guidelines for thermal power plants defines the environmental issues specific to the operation of thermal power plant projects and facilities as air emissions, noise, wastewater and water quality. Air emissions, wastewater discharges, and solid wastes related to construction and decommissioning activities are evaluated in accordance with the EHS General Guidelines.

The Guidelines also addresses the occupational and community health and safety hazards during the construction, operation, and decommissioning of thermal power plant projects which are generally similar to those of most large industrial facilities and infrastructure projects.

Performance Standards:

- IFC Performance Standards on Environmental and Social Sustainability (2012),
 - Performance Standard 1 – Assessment and Management of Environmental and Social Risks and Impacts
 - Performance Standard 2 - Labor and Working Conditions
 - Performance Standard 3 – Resource Efficiency and Pollution Prevention

- Performance Standard 4 - Community Health, Safety and Security
- Performance Standard 5 - Land Acquisition and Involuntary Resettlement
- Performance Standard 6 - Biodiversity Conservation and Sustainable Management of Living Natural Resources
- Performance Standard 7 - Indigenous People
- Performance Standard 8 - Cultural Heritage
- IFC Guidance Notes: Performance Standards on Environmental and Social Sustainability (2012).

IFC's Performance Standards and related guidance notes were followed in the EIA. The overall content of the ESIA is formulated in accordance with the Guidance Note on Performance Standard 1. Guidance notes for Performance Standard 2 to 8 were addressed when applicable. Performance Standard 7 is not applicable to the Project.

Good Practice Manuals:

- A Good Practice Manual: Doing Better Business through Effective Public Consultation and Disclosure,
- A Good Practice Note: Addressing the Social Dimensions of Private Sector Projects (2003),
- Stakeholder Engagement: A Good Practice Handbook for Companies Doing Business in Emerging Markets (2007).

These manuals are used to prepare public consultation and social assessment sections of the ESIA.

Operational Manuals:

- Operational Manual OP 4.01 – Environmental Assessment (1999).

The Operational Manual and Annex A, Annex B and Annex C of the Manual are followed in the ESIA.

In general, content of the ESIA was in accordance with the "IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants" (IFC, 2008). However, "IFC Environmental, Health, and Safety General Guidelines" (IFC, 2007) are also followed in the ESIA. Following sections provide a brief explanation of the IFC's General EHS Guidelines.

2.5.1 Noise

The Noise Guidelines addresses the impacts of noise beyond the property boundary of the facilities. According to the Guidelines, noise impacts should not exceed the levels presented in Table 2-8 below, or result in a maximum increase in background levels of 3 dBA at the nearest receptor location off-site.

Table 2-8 Noise Limits

Receptor	One Hour L_{Aeq} (dBA)	
	Day Time (07:00-22:00)	Night Time (22:00-07:00)
Residential; Institutional; Educational	55	45
Industrial, Commercial	70	70

2.5.2 Air Emissions and Ambient Air Quality

The proposed facility should avoid, minimize, and control adverse impacts to human health, safety and the environment from emissions to air. If this is not possible the generation and release of emissions should be managed through a combination of energy use efficiency, process modification, selection of fuels or other materials that may result in less polluting emissions, application of emission control techniques.

According to the General EHS Guidelines, projects with significant sources of air emissions and potential for significant impacts to ambient air quality should prevent or minimize these impacts. In this respect, the emissions of the projects should not result in pollution concentrations that reach or exceed relevant ambient air quality guidelines and standards by applying national legislated standards or in their absence, the current WHO Air Quality Guidelines or other internationally recognized sources. In addition, the emissions should not contribute a significant portion to the attainment of relevant ambient air quality guidelines and standards. The air pollutant limit levels presented in WHO Ambient Air Quality Guidelines are given in Table 2-9 below.

Table 2-9 WHO Ambient Air Quality Guidelines Air Pollutant Limit Levels

	Averaging Period	Guideline Value ($\mu\text{g}/\text{m}^3$)
Sulfur dioxide (SO_2)	24-hour	125 (Interim target-1) 50 (Interim target-2) 20 (guideline)
	10 minute	500 (guideline)
Nitrogen dioxide (NO_2)	1 year	40 (guideline)
	1 hour	200 (guideline)
Particulate Matter PM_{10}	1 year	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline)
	24 hour	150 (Interim target-1) 100 (Interim target-2)

		75 (Interim target-3) 50 (guideline)
Particulate Matter PM _{2.5}	1-year	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10(guideline)
	24 hour	75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

The IFC/WB “Environmental, Health and Safety Guidelines on Thermal Power Plants” provide emission limits. Proposed natural gas fired power plant will comply with the IFC/WB limit provided in Table 2-10 below during operation.

Table 2-10 IFC/WB Emission Limits for Natural Gas Fired Power Plants

Parameter	Units	Emission Limits
		IFC/WB
NO _x	mg/Nm ³ @15% O ₂ , dry	51

2.5.3 Wastewater and Water Quality

The IFC General EHS Guidelines Wastewater and Ambient Water Quality Section is applicable to projects that have either direct or indirect discharge of process wastewater or wastewater from utility operations to the environment and industrial discharges to sanitary sewers that discharge to the environment without any treatment. The guideline provides information on common techniques for wastewater management, water conservation, and reuse that can be applied to a wide range of industry sectors. According to the guidelines the projects with the potential to generate process wastewater, sanitary (domestic) sewage, or storm water should incorporate the necessary precautions to avoid, minimize, and control adverse impacts to human health, safety, or the environment.

In accordance with the guidelines, the wastewater discharges to sanitary sewer systems should meet the pretreatment and monitoring requirements of the sewer system.

The guidelines set limits for treated sanitary sewage discharges. The applicable limits for sanitary wastewater discharge are provided in Table 2-11.

Table 2-11 IFC Limits for Sanitary Wastewater Discharge

Indicative Values for Treated Sanitary Sewage Discharges^a		
Pollutants	Units	Guideline Value
pH	pH	6-9
BOD	mg/l	30
COD	mg/l	125
Total Nitrogen	mg/l	10
Total Phosphorus	mg/l	2
Oil and Grease	mg/l	10
Total Suspended Solids	mg/l	50
Total Coliform Bacteria	MPN ^b / 100 ml	400*
a Not applicable to centralized, municipal, wastewater treatment systems which are included in EHS Guidelines for Water and Sanitation		
b MPN = Most Probable Number		

IFC Environmental Health and Safety Guidelines for Thermal Power Plants set limits for effluent discharges. These limits are presented in Table 2-12.

Table 2-12 IFC Limits for Effluent Discharge

Table 5 – Effluent Guidelines	
(To be applicable at relevant wastewater stream: eg. 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)	
Parameter	mg/L, except pH and temperature
PH	6-9
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
Note: 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.	

2.5.4 Hazardous Materials

The Hazardous Material Management guidelines apply to projects that use, store, or handle any quantity of hazardous materials, defined as materials that represent a risk to human health, property, or the environment due to their physical or chemical characteristics. Hazardous materials can be classified according to the hazard as explosives; compressed gases, including toxic or flammable gases; flammable liquids; flammable solids; oxidizing substances; toxic materials; radioactive material; and corrosive substances.

According to the guidelines the overall objective of hazardous materials management is to avoid or, when avoidance is not feasible, minimize uncontrolled releases of hazardous materials or accidents (including explosion and fire) during their production, handling, storage and use. Projects which manufacture, handle, use, or store hazardous materials should establish management programs that are commensurate with the potential risks present. The main objectives of projects involving hazardous materials should be the protection of the workforce and the prevention and control of releases and accidents. These objectives should be addressed by integrating prevention and control measures, management actions, and procedures into day-to-day business activities.

The guidelines also address preventive measures for hazardous materials transfer. It states that uncontrolled releases of hazardous materials may result from small cumulative events, or from more significant equipment failure associated with events such as manual or mechanical transfer between storage systems or process equipment. It is recommended to use dedicated fittings, pipes, and hoses specific to materials in tanks and maintaining procedures to prevent addition of hazardous materials to incorrect tanks, to use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer, to regular inspect, maintain and repair of fittings, pipes and hoses, to use secondary containment, drip trays or other overflow and drip containment measures for hazardous materials containers at connection points or other possible overflow points.

The project will comply with the requirements of the Hazardous Materials Management Guidelines.

2.5.5 Waste Management

Waste Management Guidelines apply to projects that generate, store, or handle any quantity of waste across a range of industry sectors. It emphasizes that the facilities should establish a waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes, avoid or minimize the generation waste materials as far as practicable, recover or reuse waste where waste generation cannot be avoided, treat, destroy and dispose wastes in an environmentally sound manner where waste can not be recovered or reused.

The guidelines stipulate that the facilities that generate waste should characterize their waste according to composition, source, types of wastes produced, generation rates, or according to local regulatory requirements. It also requires that the processes of the facilities should be

designed and operated to prevent, or minimize, the quantities of wastes generated and hazards associated with the wastes generated. It is also essential to implement recycling plans in order to reduce the total amount of waste. If waste materials are still generated after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, waste materials should be treated and disposed of and all measures should be taken to avoid potential impacts to human health and the environment.

Solid (non-hazardous) Wastes

According to the guidelines solid wastes generally include any garbage, refuse. Examples of such waste include domestic trash and garbage; inert construction/demolition materials; refuse, such as metal scrap and empty containers (except those previously used to contain hazardous materials which should, in principle, be managed as a hazardous waste).

Solid waste that will be generated throughout the construction and operational phases of the project will be managed with the provisions stated in the guidelines.

Hazardous Wastes

According to the guidelines hazardous wastes share the properties of a hazardous material (e.g. ignitability, corrosivity, reactivity, or toxicity), or other physical, chemical, or biological characteristics that may pose a potential risk to human health or the environment if improperly managed. Wastes may also be defined as "hazardous" by local regulations or international conventions, based on the origin of the waste and its inclusion on hazardous waste lists, or based on its characteristics.

The guidelines state that the hazardous wastes should always be segregated from nonhazardous wastes and its management should focus on the prevention of harm to health, safety, and the environment. It is crucial that the potential impacts and risks associated with hazardous wastes should be completely understood, the hazardous wastes are handled, treated and disposed by reputable and legitimate enterprises licensed by the relevant regulatory agencies and they should be stored so as to prevent or control accidental releases to air, soil and water resources. On-site and off-site transportation of wastes should be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public.

3.0 PROJECT DESCRIPTION

3.1 Proposed Project

İç Anadolu Doğalgaz Elektrik Üretim ve Ticaret A.Ş. (İç Anadolu Enerji) proposes to install a natural gas power plant (Project) with 840 MWe installed capacity in Kırıkkale Province of Turkey ("Project"). The project will be referred to as "İç Anadolu Natural Gas Combined Cycle Power Plant" (İç Anadolu CCPP).

The power will be connected to the 380 kV Gölbaşı Substation and 380 kV switchyard of the proposed 1200 MW Kırıkkale Natural Gas Power Plant that will be constructed in Yahşihan District of Kırıkkale Province. This connection to Gölbaşı Substation will be accomplished via a single circuit 58 km 380 kV overhead power transmission line which will join to existing Keban OHL at the last 10 km to the Substation. The connection scheme of the power plant was advised by the Turkish Electricity Transmission Inc. (TEİAŞ). İç Anadolu Enerji signed an agreement with TEİAŞ for connection.

Natural gas will be supplied from the Samsun-Ankara Natural Gas Pipeline with a 13 km long, new pipeline. BOTAŞ has confirmed that it will be able to supply gas to the plant, although it is possible to seek gas from other wholesale companies in Turkey. A gas connection agreement with local gas distribution company KIRGAZ will be signed for the 13 km pipeline connection to the Samsun-Ankara Natural Gas Pipeline transportation system.

İç Anadolu Enerji has obtained a 49-year Electric Power Generation License from the Energy Market Regulatory Authority (EMRA) for the 420 MWe project on March 16, 2011 in accordance with the provisions of Law No. 4628. Then, the project design was revised by GEAS and the capacity of the project was increased to 840 MWe. İç Anadolu Enerji applied to the EMRA for licence revision on April 8, 2011. Revision of Licence Application was approved by the EMRA on May 31, 2012.

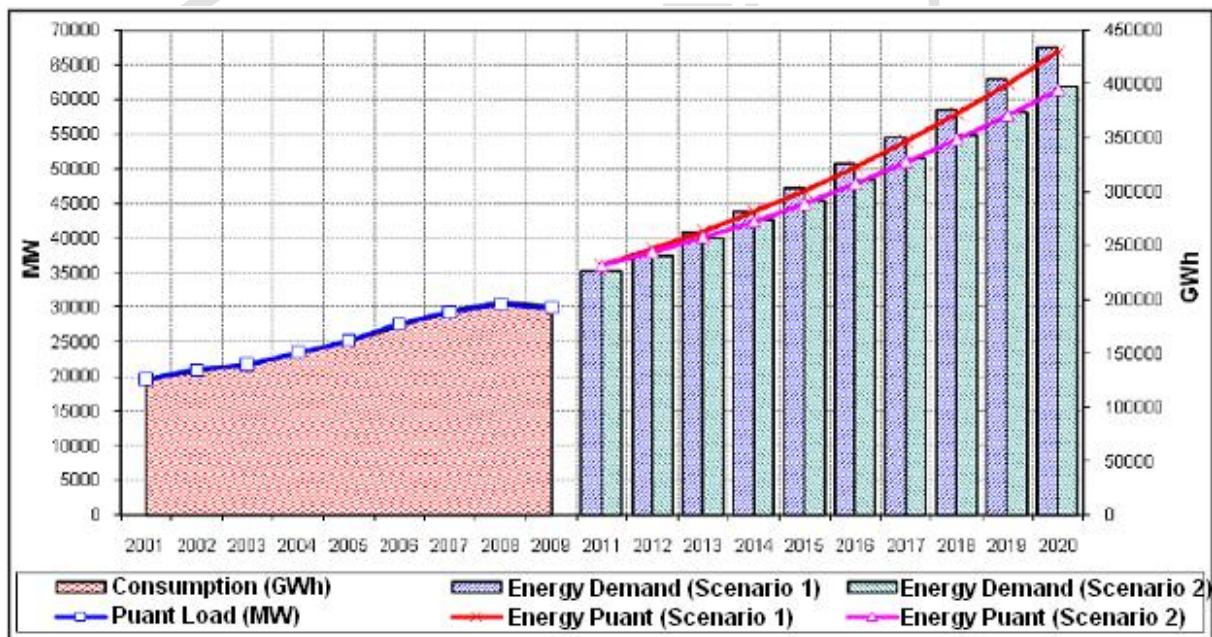
3.2 Project Objective

The electricity industry is a large, high-growth sector in the Turkish economy. According to Turkish Electricity Transmission Company's (TEİAŞ) 2011 – 2020 Capacity Projection Report, gross electricity consumption of Turkey (Gross electricity generation of Turkey + import/export) has reached 194.1 billion kWh in 2009 with a decrease of 2% compared to 2008. The net electrical energy consumption in Turkey was recorded 210.4 billion kWh in 2010 with an increase of 8.4% compared to 2009. Instantaneous peak demand and energy demand of Turkey interconnected electricity system is presented in Table 3-1.

Table 3-1 Interconnected Electricity Power System Peak Power and Energy Demand

Years	Peak Demand (MW)	Increase (%)	Energy Demand (GWh)	Increase (%)
2001	19,612	1.1	126,871	-1.1
2002	21,006	7.1	132,553	4.5
2003	21,729	3.4	141,151	6.5
2004	23,485	8.1	150,018	6.3
2005	25,714	7.2	160,794	7.2
2006	27,594	9.6	174,230	8.3
2007	29,249	6.0	190,000	8.8
2008	30,517	4.3	198,085	4.2
2009	29,870	-2.1	194,079	-2.0
2010	33,392	11.8	210,434	8.4

In addition, according to Turkish Electricity Transmission Company's (TEİAŞ) 2011 – 2020 Capacity Projection Report, in June 2011, two alternatives scenarios, one of them is Main Demand (1st Scenario) and the other one is Low Demand (2nd Scenario), are calculated by the Ministry of Energy and Natural Resources (Figure 3-1).

**Figure 3-1 Interconnected Electricity Power System Peak Power and Energy Demand**

(Source: 10 years capacity projection report of the energy production in Turkey (2011 – 2020), June 2011)

As stated at the energy projection above, the basic aim of the energy policy of Turkey is the supplying cheap, safe and qualified electrical energy continuously to the consumers to provide the economic and social development of the country in healthy manner. For this reason, to meet the primary and secondary energy demands in economic and safety ways, all domestic and foreign, private and public investment/financial resources should be mobilized.

To meet the Turkey's electric energy demand expected to continue to increase rapidly, various technologies have been encouraged. Proposed İç Anadolu CCPP Project will contribute to the national economy and also will help to meet the energy demand of Turkey by using natural gas which is an environmental friendly fuel when compared to other fossil fuels.

3.3 Project Background

The draft feasibility studies for the İç Anadolu CCPP Project (420 MWe) were completed in February 2010. In the feasibility report, the project units, installed capacity and the amount of energy generation were assessed in accordance with the economic, geological, hydrogeological, physical and environmental characteristics of the project location. The application for generation license to the Energy Market Regulation Authority (EMRA) was submitted on October 31, 2007 and the letter of conformity on the application was received from EMRA on October 23, 2009. The electricity generation license was secured on March 16, 2011. Then the project design was revised and the capacity of the project was increased to 840 MWe. İç Anadolu Enerji applied to EMRA for revision of licence on April 8, 2011. Revision of Licence Application was found to be appropriate by EMRA on May 31, 2012.

3.4 Project Location

İç Anadolu CCPP will be located in the District of Hacılar Town situated at the Central District of the Kırıkkale Province. Kırıkkale Province is located in the Central Anatolia region. Hacılar Town is located approximately 18 km to the northwest of Kırıkkale Province Center. The project site is approximately 3.2 km away from the center of Hacılar Town which is the closest town to the project site. The coordinates of the project site is given in Table 3-2 and the site location map of the project site is presented in Figure 3-2 below.

Table 3-2 Project Site Coordinates (UTM ED50 Zone 36)

No	X (m)	Y (m)
1	538457.376	4401408.935
2	538529.534	4401346.909
3	538605.849	4401281.290
4	538614.835	4401277.392
5	538739.601	4401223.245
6	538802.195	4401198.558
7	538614.991	4400895.739
8	538609.549	4400898.041
9	538334.097	4401014.628
10	538285.527	4401035.185



Figure 3-2 Location Map of the Project Site

Panoramic view of the project site can be seen in Figure 3-3 and satellite images of the project site can be seen in Figure 3-4, Figure 3-5 and Figure 3-6 below.



Figure 3-3 Panoramic View of the Project Site

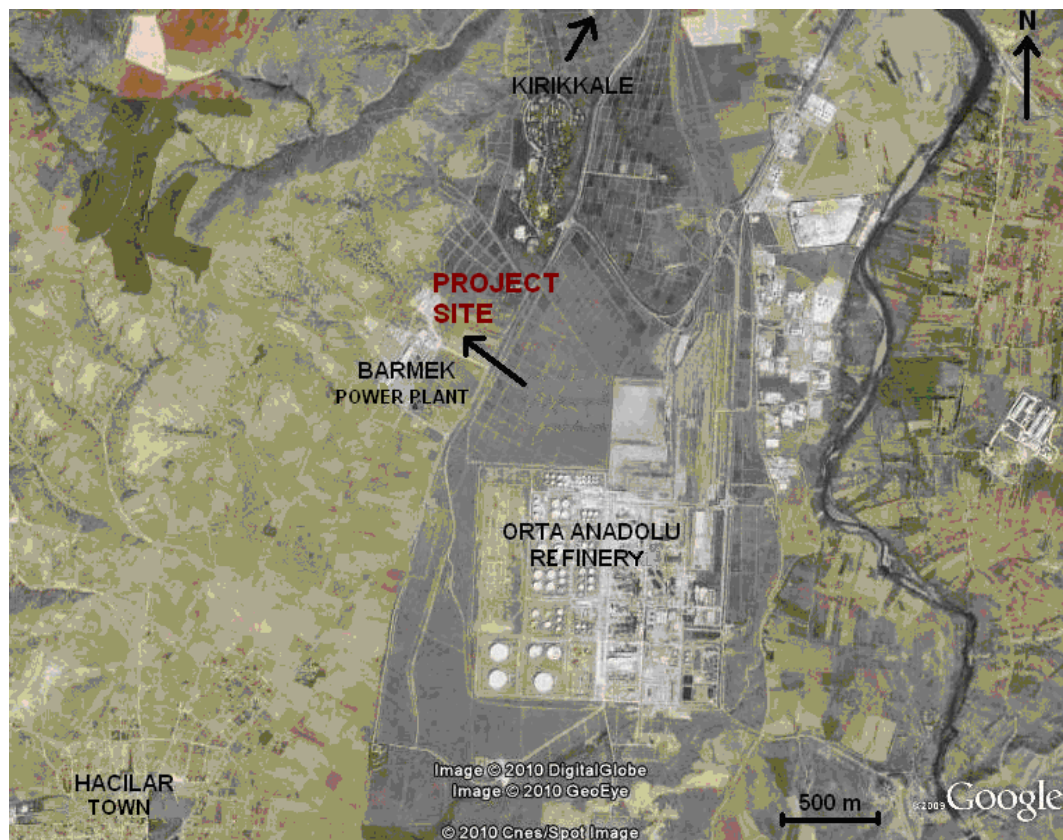


Figure 3-4 Satellite Image of the Project Site

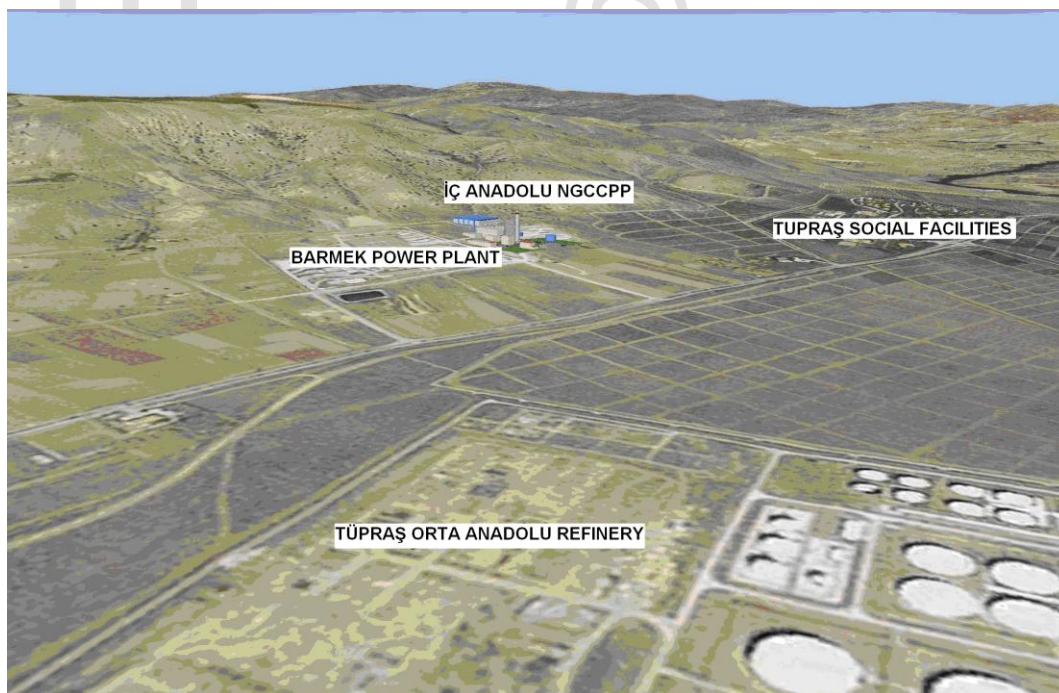


Figure 3-5 Satellite Image of the Project Site



Figure 3-6 Satellite Image of the Project Site

The fuel oil-fired 153 MW BARMEK GAMA Power Plant was located to the southwest of the project site. This power plant was not operated since 2007. Decommissioning of the plant was started in 2010 and at present the plant has been fully disassembled and removed from its original location. The view of the BARMEK GAMA Power Plant from the project site is presented in Figure 3-7 prior to its decommissioning. Figure 3-8 shows the same area after the plant was disassembled and removed.



Figure 3-7 BARMEK GAMA Power Plant



Figure 3-8 BARMEK GAMA Power Plant Area After Disassemble

The Tüpraş Orta Anadolu Refinery located approximately 500 m to the southeast of the project site was established to meet the petroleum products demand of the Central Anatolian region. The refinery has been in operation since 1986 and it has a crude oil processing capacity of 5.0 million tons/year (Kırıkkale Province Environmental Condition Report, 2008). The housing complex of the Refinery is located at approximately 500 m northeast of the Project site. The view of the Tüpraş Orta Anadolu Refinery from the Project site is presented in Figure 3-9.



Figure 3-9 View of Tüpraş Orta Anadolu Refinery

3.5 Project Land Ownership

The project site (Parcel no: 565, Block No: 3) is located in an industrial zone according to the Development (Master) Plan prepared by Hacılar Municipality. The project site is owned by the project company İçanadolu Doğalgaz Elektrik Üretim ve Tic A.Ş. The total area of the project site is 139,038 m². The utilization of this area for the proposed project has been approved by Hacılar Municipality.

3.6 Project Technical Characteristics

3.6.1 General Characteristics

Proposed İç Anadolu CCPP is a 2+1 (2 gas turbine and 1 steam turbine) configured natural gas-fired power plant with a net capacity of 840 MWe (1452,8 MWt). The primary fuel of the plant will be natural gas. The facility will not use any secondary fuel other than natural gas to generate electricity. The net efficiency of the plant will be approximately 57.82% (at 15°C, 0.9231 bar, 60% relative humidity).

The Plant will consist of the following main and auxiliary equipments listed below:

1. Two (2), GE Frame 9FB type gas turbine (GT) unit with dry low NO_x type burner,
2. Two (2), horizontal flow type HRSG unit with 3 (three) pressure levels,
3. One (1), reheat, condensing, horizontal exhaust, three (3) pressure, steam turbine (ST) Unit,
4. Three (3), hydrogen cooled generator unit common for gas and steam turbine units,
5. One (1), dry type air cooled condenser (ACC) unit,
6. Evaporative Cooler,
7. Purge Credit
8. Auxiliary transformer,
9. 17/380 kV main step-up transformer,
10. Isolated Phase Bus,
11. 380 kV switchyard,
12. Water treatment plant,
13. Wastewater treatment plant,
14. Boiler feed water pumps,
15. Auxiliary electrical systems,
16. Auxiliary mechanical systems, and
17. Gas fuel supply and heating system.

The proposed power plant will generate power by combined-cycle generation which is a configuration using both gas turbines and steam generator. In the combined-cycle gas turbine (CCGT), the hot exhaust gases of the gas turbines will be used to provide all, or a portion of, the

heat source for the boiler, which will produce steam for the steam turbine. This combination increases the thermal efficiency.

Due to the difficulty of providing water from the Kızılırmak River, which is approximately 2.5 km away from the project site, the main cooling system of the power plant has been selected as dry type air cooled condenser (ACC). The proposed process is illustrated in Figure 3-10.

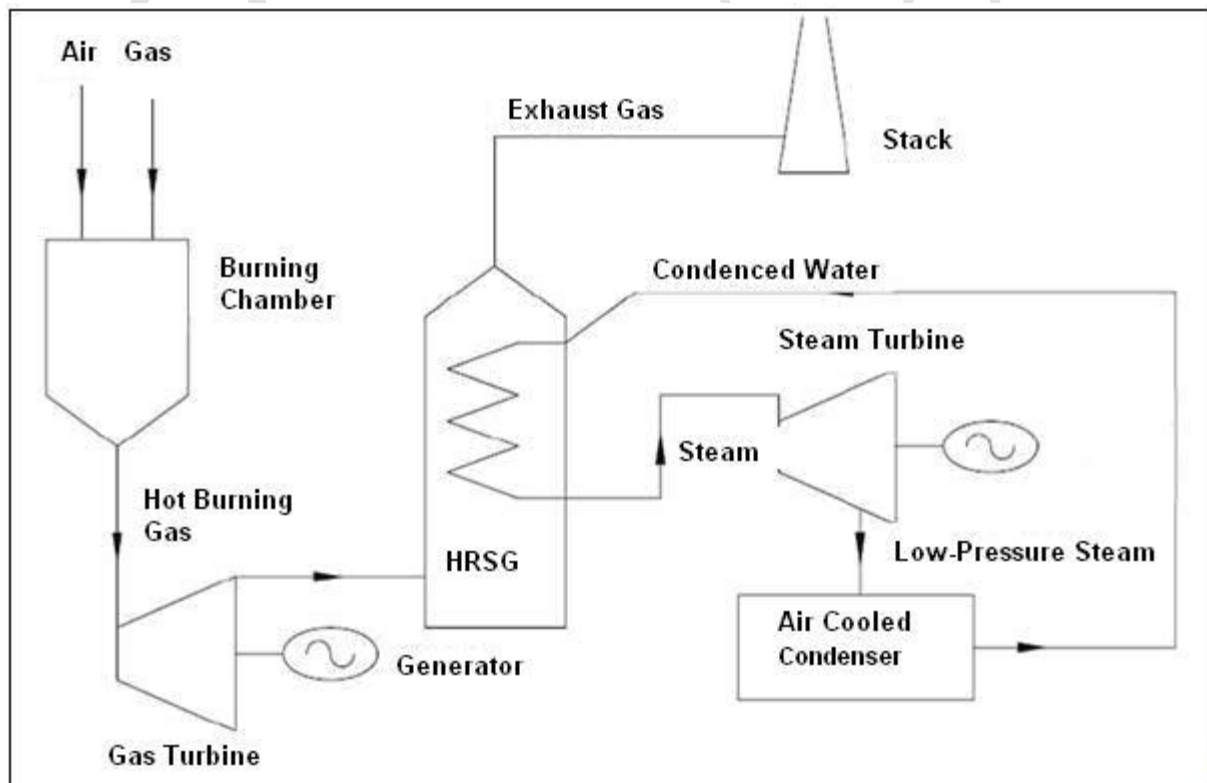


Figure 3-10 Process Flow Chart

The prime movers of the power plant is the heavy duty type, natural gas fired, gas turbine unit (GE Frame 9FB). The heat recovery steam generator (HRSG) units will generate steam by utilizing gas turbine exhaust gases without any additional fuel (no supplementary firing system). The HRSGs unit will be horizontal gas flow, three pressure, reheat and natural circulation type. There will be no by-pass stack and dampers. The steam generated by the HRSG unit will be utilized by a 3 pressure, reheat type steam turbine unit to generate electricity. Two GT and one ST units will drive separate generators. The generators will be of 3 phase and hydrogen cooled type.

In addition to the above mentioned major components, the air cooled condenser unit, demineralized and wastewater treatment systems, 380 kV switchyard, instrumentation and control systems, fire fighting system, compressed air system, ancillary systems, social and administrative buildings will be the major parts of the combined cycle power plant. Perimeter of the plant area will be fenced and will have an entry-exit gate. The general layout of the plant is presented in Appendix A.

The combustion system of the power plant will be the DLN - Dry Low NOx system which controls NOx emissions.

The power will be connected to the 380 kV Gölbaşı Substation and 380 kV switchyard of the proposed 1200 MW Kırıkkale Natural Gas Power Plant that will be constructed in Yahşıhan District of Kırıkkale Province. This connection to the Gölbaşı Station will be through a single circuit 58 km 380 kV overhead power transmission line which will join to existing Keban OHL at the last 10 km to the Substation. The connection scheme of the power plant was advised by the Turkish Electricity Transmission Inc. (TEİAŞ). İç Anadolu Enerji signed an agreement with TEİAŞ for connection.

The natural gas will be supplied from the Samsun – Ankara Natural Gas Transmission Line by connecting the pipeline from the point where Tüpraş natural gas pipeline is already connected. The total length of the pipeline will be 12+600 km. 9+150 km of this line will be parallel to the Tüpraş pipeline.

3.6.2 General Descriptions of the Major Equipments

GT Units

GT units will be heavy duty, indoor type, burning single fuel (natural gas), FB class (GE Frame 9FB) and will be equipped with a dry low NOx burner in order to keep NOx emissions below the limits foreseen by the regulations. There will be no need for steam or water injection systems.

The noise and vibration impacts will not exceed the acceptable levels stated in “Environmental Noise Management and Control Regulation”, published in the Official Gazette No: 27601, dated June 04, 2010. The equipment and material of the gas turbine will be furnished for indoor type. 9FB type gas turbine is presented in Figure 3-11.



Figure 3-11 9FB Type Gas Turbine

(Source: <http://images.vertmarkets.com>)

The expected performance data of the GE Frame 9FB type gas turbine unit at ISO conditions and the site conditions are given in Table 3-3 and Table 3-4, respectively.

Table 3-3 Performance Values of the GT Unit at ISO Conditions

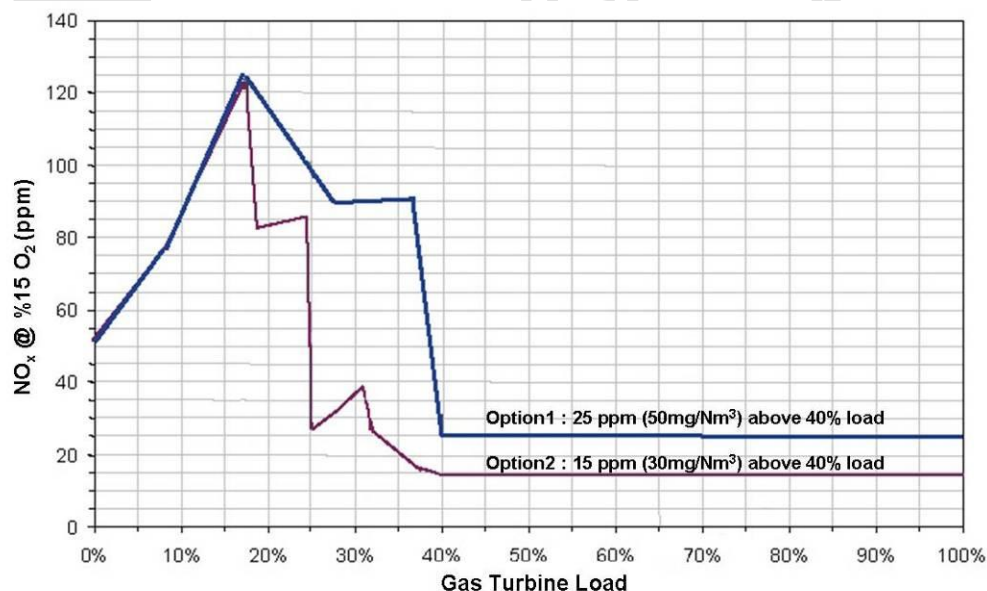
Technical Specification	Value
GT manufacturer	GE
Gas turbine model	9371FB
Combustion system	Dry Low NO _x
Gross output at generator terminals	291,486 kW
No of shafts	1
Shaft speed of GT unit	3000 rpm
GT compressor pressure ratio	18.2:1
GT unit inlet temperature	1,426.7 °C
GT unit exhaust temperature	636.7 °C
Air flow at compressor inlet	2,334.6 ton/h
Exhaust gas flow at turbine outlet	2,181.3 ton/h
GT gross (LHV) heat rate at generator terminals	9,390 kJ/kWh
GT gross efficiency at generator terminals	38.44%
Generator efficiency	98.6%

Table 3-4 Performance Values of the GT Unit at Site Conditions

Technical Specification	Value
Shaft Output	267,300 kWe
Shaft LHV Heat Rate of GT Unit	9,364 J/kWh
Shaft Speed of GT Unit	3000 rpm
Ambient Air Pressure at the GT Comp. Air Filter Inlet	0.9231 bar
GT Unit Exhaust Temperature	645 °C
Air Flow at Compressor Inlet	2,098 ton/h
Exhaust Gas Flow at Turbine Outlet	2,173 ton/h
GT Inlet air Filter Losses	93 mbar

Dry Low-NOx Burner (DLN 2.6)

Dry Low-NOx burner 2.6 (GE DLN 2.6), which controls nitrogen oxide emissions, will be used with the 9371FB model gas turbine. The main feature of this burner is the igniter located at the center in addition to the five igniters placed at similar burners. The change of NOx emissions to the load of gas turbine when DLN 2.6 burner used is illustrated at Figure 3-12 below. As can be seen from the figure, there are two options provided with DLN 2.6 burner. The first configuration has NO_x emission of 25 ppm (50 mg/Nm³) above 40% GT load where as it decreases to 15 ppm (30 mg/Nm³) in option 2.

**Figure 3-12 DLN 2.6 Dry Low NOx Burner Emissions**

İç Anadolu CCPP will work at 57.82% efficiency. As can be seen from the figure above, DLN 2.6 Dry Low-NOx provides 25 ppm and 15 ppm NO_x concentration in options 1 and 2, respectively.

Option 1 will be used for this project. The limit values for NO_x emissions given in Turkish Regulations and IFC/WB Guideline will not be exceeded.

HRSG Units

HRSG units will be connected to the exhaust duct of the GT units to utilize the waste heat contained in the exhaust gases. There will be no by-pass stack between the GT units and the HRSG units. The HRSG units will be horizontal gas flow type. Since the minimum ambient temperature at site is well below 0°C (recorded minimum temperature is -22.4°C), the HRSG units will be of outdoor type with enclosures.

The HRSG units shall be a natural circulation, water tube, three pressure levels with (reheat) cycle design which supplies high pressure (HP), reheat (RH), intermediate pressure (IP), and low pressure (LP) superheated steam to the steam turbine. It will have superheater, evaporator, and economizer sections for each pressure level.

The source of heat for generating steam will be the exhaust gases from the gas turbine units. The HRSG units will be designed and constructed according to the exhaust gas conditions of the GT units.

The HRSG units will receive hot exhaust gases from the gas turbine through horizontal ductwork connected to the turbines exhaust transition piece. The gas is distributed in a horizontal transition duct before entering the heat transfer sections of the HRSG units through vertically oriented heat transfer modules until it reaches the stack transition. There, the flow will be turned and directed upward out of the exhaust stacks. The main properties of the HRSG Units are given in Table 3-5.

Table 3-5 Main Properties of the HRSG

Technical Specifications	Value
Number of HRSG Unit	2
Type of HRSG Unit	Unfired, horizontal gas flow
Number of Pressure Stages	3
HRSG Exhaust Losses	33 mbar
Exhaust Gas Quantity @ HRSG Inlet	2,370.8 tons/h
Exhaust Gas Temperature @ HRSG Inlet	643.2 °C
Exhaust Gas Pressure @ HRSG Inlet	1046 mbar
Exhaust Gas Quantity @ HRSG Outlet	2,370.8 tons/h
Exhaust Gas Temp. @ HRSG Outlet	78.9 °C
Exhaust Gas Pressure @ HRSG Outlet	1013 mbar
HP Feedwater Pressure	103.3 bar
HP Feedwater Temperature	159 °C
HP Feedwater Quantity	329.4 tons/h
HP Steam Pressure	139.4 bar
HP Steam Temperature	567 °C
HP Steam Quantity	329.4 tons/h
Cold RH Steam Inlet Pressure	31.4 bar

Cold RH Steam Inlet Temperature	358.6 °C
Cold RH Steam Quantity	353.7 tons/ h
Hot RH Steam Inlet Pressure	29.5 bar
Hot RH Steam Inlet Temperature	566.3 °C
Hot RH Steam Quantity	354.8 tons/ h
IP Feedwater Pressure	45 bar
IP Feedwater Temperature	157.2 °C
IP Feedwater Quantity	33.3 tons/h
IP Steam Pressure	32.3 bar
IP Steam Temperature	309.9 °C
IP Steam Quantity	33.3 tons/h
LP Steam Pressure	5.9 bar
LP Steam Temperature	306.2 °C
LP Steam Quantity	35 tons/h

ST UNIT

The steam turbine unit will be a multi valve, multistage, multi cylinder, horizontal split casing type. The turbine exhaust will be vertical.

Based on the change in output of the GT units, the steam generation from the HRSG units will vary because of the exhaust gas flow variations. The steam generation will be higher at minimum ambient temperature due to higher mass flow rate of the exhaust gas from the GT units. The STG and all its accessories will be designed by taking into consideration the maximum generation capacity corresponding to the minimum ambient temperature conditions at site.

The steam turbine will be equipped with a dry type, air cooled condenser unit. The steam turbine unit will be able to operate safely and continuously throughout the whole range of operation of the gas turbine units, against the specified high back pressure, experienced at high ambient temperature during summer.

All ST equipment will be designed for continuous power plant duty for an intended life of 30 years, except for normally replaceable parts such as gaskets and oil under the following conditions of operations:

- Two shifting operation of approximately 16 hours per day within the operating envelope, with night-time shutdown;
- Weekend shutdown;
- Continuous base load operation; and
- A combination of the above.

The performance values of the ST unit are summarized at Table 3-6 below.

Table 3-6 Performance Values of the ST Unit at Site Conditions

Technical Specifications	Value
Nameplate capacity of ST unit	440 MVA
Capacity at site conditions	287.41 MW
Power factor	0.85
Steam turbine type	Condensing, 3 pressure level, Reheat
Nameplate throttle pressure	132 bar
Number of stages	23
Nameplate throttle temperature	565.5 °C
Nameplate throttle mass flow	670 tons/h
Exhaust end type	Axial
Exhaust temperature	38.4 °C
HP steam temperature @ ST inlet	565 °C
HP steam pressure @ ST inlet	117 bar
HP steam quantity @ ST inlet	603.8 tons/h
RH steam temperature @ ST inlet	565 °C
RH steam pressure @ ST inlet	24.52 bar
RH steam quantity @ ST inlet	653 tons/h
LP steam temperature @ ST inlet	312 °C
LP steam pressure @ ST inlet	4.79 bar
LP steam quantity @ ST inlet	724 tons/h
Last stage bucket length	1066.9 mm
ST exhaust temperature	38 °C
ST exhaust pressure	0.0677 bar
ST exhaust mass flow	724 tons/h

Air Cooled Condenser (ACC) Unit

Conventional cooling methods are extremely water intensive processes. Once-through cooling needs large bodies of natural water (sea or river) and disposing the waste heat into them causes thermal pollution. Evaporative (wet) cooling towers require make-up water, emit vapor plumes with the related drawbacks, meanwhile discharge concentrated cooling water blow-down, which may pollute the surroundings. The use of dry cooling systems completely eliminates the need for cooling make-up water. Dry cooling systems are emitting only warm and clean air, without adverse environmental effects. The choice between evaporative and dry cooling systems is very much depending on availability and cost of cooling make-up water.

Due to the above mentioned drawbacks of the once-through and wet cooling towers, the cooling system is selected as dry type with air cooled condenser for this project. The basic features of the ACC unit are herein below given in Table 3-7.

Table 3-7 Main Properties of the ACC Unit

Technical Specifications	Value
Number of Rows	9
Number of Cells	45
Cooling Capacity	~456,220 kW
Surface Area	~1,824,152 m ²
Estimated Plot Area	~11,000 m ²
Air Velocity	3 m/s
Steam Quantity @ ACC Inlet	724 tons/h
Steam Pressure @ ACC Inlet	0.06773 Bar
Steam Temperature @ ACC Inlet	38.41 °C
Condensate Quantity @ ACC Inlet	728.64 tons/h
Condensate Pressure @ Condensate Pump Inlet	0.5080 bar
Condensate Temperature @ ACC Inlet	33.2 °C
Cooling Air Relative Humidity @ ACC Inlet	60 %
Total Fan Capacity	3,345 kW

Generator

The generator will be sized to convert the mechanical energy of both prime movers to electrical energy.

Evaporative Cooler

The evaporative cooling process involves the adiabatic exchange of heat. Evaporative Cooler system is for decreasing the temperature of air inlet in gas turbine in order to increase the capacity when the ambient air temperature is 15 °C or higher.

Purge Credit

The Purge Credit product offers a suite of features designed to assist customers in achieving faster and more efficient startups.

Other Equipment

In addition to the above mentioned main equipment, the Power Plant will also include the following auxiliary and ancillary systems:

HP, IP and LP boiler feed water pumps.

- Generator circuit breaker;
- Step-up transformer;

- Natural gas supply system;
- Distributed control system;
- Central control room with administrative facilities;
- Warehouse and maintenance building;
- Water treatment and dematerialization water system;
- Roads, side walks, storm water drain and sanitary drain systems; and
- Plant fire protection system.

Wastewater Treatment Plant

Effluent Treatment (For the neutralization chemical contaminated waste water):

The effluent treatment plant will receive the effluents generated in the plant and will treat them so that the characteristics of the discharged water is within acceptable limits.

The HRSG blowdown, process drain water and chemically contaminated drains will be collected in an equalization sump. Wastewater will be transferred to neutralization pits with the help of submersible transfer pumps. pH adjustment and aeration will be provided in the neutralization pits. Treated wastewater will be discharged by the help of discharge pumps. If treated water quality is not accordance with desirable discharge limits, then wastewater will be recirculated to the equalization sump by discharge pumps.

Chemical Treatment Plant (For the treatment of TSS and TDS)

The chemical packaged treatment unit is designed. The following wastes will be transferred to the chemical treatment plant to decrease TSS and TDS content of the wastes;

- RO concentrate reject;
- UF/CEB wash and backflash wastes;
- MB backwash and regeneration wastes; and
- Filters backwashes.

The first step is coagulation, wastewater flows into the coagulation tank. Coagulant solution will be dosed to form the flocs for homogenous mixing of water and coagulation chemical; there will be installed a flash mixer in the tank.

After coagulation process the water overflows into the clarification tank where formed chemical sludge is settled under hydro-static conditions. Sludge will be transferred to a filter press. Before the filter unit will be dosed polyelectrolyte on line. Offered clarification method is parallel plate separators. Parallel plate technology is a great solution for treatment facilities needing separation and clarification of its suspended solids, but does not have ample space for a conventional clarifier.

Sewage Treatment Plant

Sewage Treatment Plant will consist of following units:

Basket Screen: Before collecting of the domestic wastewater in an equalization basin, water will be passed through a basket screen for removing of solid particles.

Equalization Basin (Concrete): Effluent collected in a holding tank where it equalized.

Domestic Wastewater Treatment Package Unit: The main packaged unit consists of below sections where corresponding process steps are realized:

- Aeration
- Clarification
- Sludge digestion
- Blower compartment: Blower groups for one package unit are proposed.

Aeration Unit: Feeding to the aeration section is from the equalization basin via a transfer pump. During aeration an intimate contact between wastewater and air is secured by means of employing a blower and fine air bubble diffusers. Thus sufficient oxygen is provided for metabolic activities of living organism and ultimately oxidation and conversion of organic and bio-degradable pollutants present in domestic wastewater.

Clarification Unit: Aeration is followed by Clarification. Aerated effluent will be passed to clarification section where formed activated sludge is settled under hydro – static conditions. Settled sludge is partially recycled back to aeration basin by means of an air-lift system. Remaining sludge is called “excess sludge” and it is subject to further treatment (digestion).

Sludge Digestion Unit: Excess sludge from clarification section will be passed to sludge digestion section (again via air-lift system) where it is aerated and stabilized. Frequent removal of stabilized sludge from this section is collected in sludge drying beds. Supernatant due to digestion process is recycled to aeration section.

Sodium Hypochlorite Storage Tank and DP -101 Dosing Pump: Due supernatant will be disinfected by means of Sodium Hypochlorite dosage into the line. Dosing pumps will be controlled by a level switch in the storage tank.

Dual-Media Filters: In order to achieve the requested treated water quality, a further polishing step consisting of dual media (sand +anthracite) filtration units follows the biological treatment effected in the packaged unit. Via sand filtration, any remaining fine particles of suspended solids are adsorbed.

3.7 Integration of the Power Plant with the National Grid

The power will be connected to the 380 kV Gölbaşı Substation and 380 kV switchyard of the proposed 1200 MW Kırıkkale Natural Gas Power Plant that will be constructed in Yahşihan District of Kırıkkale Province. This connection will be accomplished through a 58 km transmission line. The connection scheme of the power plant was advised by the Turkish Electricity Transmission Inc. (TEİAŞ). İç Anadolu Enerji signed an agreement with TEİAŞ for connection.

3.8 Shipment and Access

The turbines will be purchased from GE. An international logistics company will transport the turbine from France and the USA to Turkey.

3.9 Project Construction

Proposed İç Anadolu CCPP will mainly consist of two gas turbines, steam turbine, two HRSG units, generators, ACC unit, transformer, coolers, step-up transformer, switchyard, water and wastewater treatment plant, boiler, electrical and mechanical systems, fire fighting system, compressed air system, ancillary systems, social and administrative buildings.

The construction period will be approximately 3 years. The following works will be performed during the construction of the proposed project:

- Preparation of site, site compound/letdown area;
- Excavation activities for building foundations and auxiliary units;
- Site access roads preparation;
- Construction of auxiliary units and administrative building;
- Transportation and construction of the turbines and equipments;
- Design, Manufacturing & Shipment of GTGs;
- Erection of GTGs;
- Design, Manufacturing & Shipment of STG;
- Design, Manufacturing & Shipment of HRSGs;
- Erection of HRSG and STG;
- Design, Manufacturing & Shipment of Transformer and Switchyard Equipment to Site;
- Erection of Transformer Units Switchyard Equipment;
- Erection of Mechanical & Electrical Auxiliaries;
- Connection to the system;
- Commissioning and energizing the plant; and
- Site re-instatement and restoration.

3.10 Project Operation and Maintenance

The operation period of the proposed project is minimum 30 years. The operation of the natural gas combined cycle power plant will be undertaken in accordance with an Environmental Management Plan.

The natural gas-fired power plant will have a net capacity of 840 MWe (1452.8 MWt). The net efficiency of the plant will be approximately 57.82% (at 15°C, 0.9231 bar, 60% relative humidity).

3.11 Project Decommissioning

The project life will be 49 years. In case there will be no extension on license, then there are some aspects of the decommissioning phase of the project that may have environmental impacts. The main decommissioning activities will comprise of removal of natural gas combined cycle power plant and ancillary structures.

Decommissioning will take account of the environmental legislation and the technology available at the time. Necessary notices will be given to the authorities in advance of the commencement of the decommissioning work. Any necessary licenses or permits will be acquired prior to the decommissioning activities.

It is probable that most of the plant and equipment will be at the end of its useful operating life and will be obsolete and unsuitable for further use. It will therefore need to be dismantled for recycling. Decisions on reuse of plant items, recycling of materials or the disposal to waste will be made at the time of decommissioning in the light of the technology then available, environmental and economic considerations and legislation. Unsalvageable material will be disposed of at a licensed landfill. Soil surface will be restored. Disturbed areas will be re-vegetated or made available for any future intended use.

3.12 Work Force

The construction period of the Project will be 3 years and the operation period of the project will be minimum 30 years. A construction work-force of up to 900 workers is expected, however, not all workers will be on-site at any one time. The peak workforce will be onsite during the busiest construction period when multiple disciplines of contractors complete work simultaneously. Furthermore, there will be 60 workers that will be employed during the operation of İç Anadolu CCPP Project.

4.0 ENVIRONMENTAL BASELINE

4.1 General Climatology of the Region

Kırıkkale Province is located 747 m above sea level and in mild temperature zone. Since the province is located far away from the sea (approximately 300 km), temperature difference between day and night time period is significant and thus the climate becomes continental climate. Because of this semi-arid climate, summers are hot and arid and winters are cold. Precipitation is usually in the form of rain and snow (Kırıkkale Province Environmental Condition Report, 2008).

The closest meteorological station to the project site is Kırıkkale Meteorology Station which is located in the Kırıkkale City Center on the coordinates of 33° E and 39° N and at an altitude of 747 m. The distance between the Kırıkkale Meteorology Station and the project site is about 11.5 km.

Temperature

According to the long-term meteorological data (1970-2011) recorded by the Kırıkkale Meteorological Station, the annual average temperature is 12.6°C. As seen in Figure 4-1, annual average temperature ranges from 0.4°C in January to 24.6°C in July. The warmest months are July and August whereas the coldest month is January. The maximum and minimum temperatures during the observation period (1970-2011) were recorded as 41.6°C on July 30, 2000 and -22.4°C on January 16, 1980, respectively.

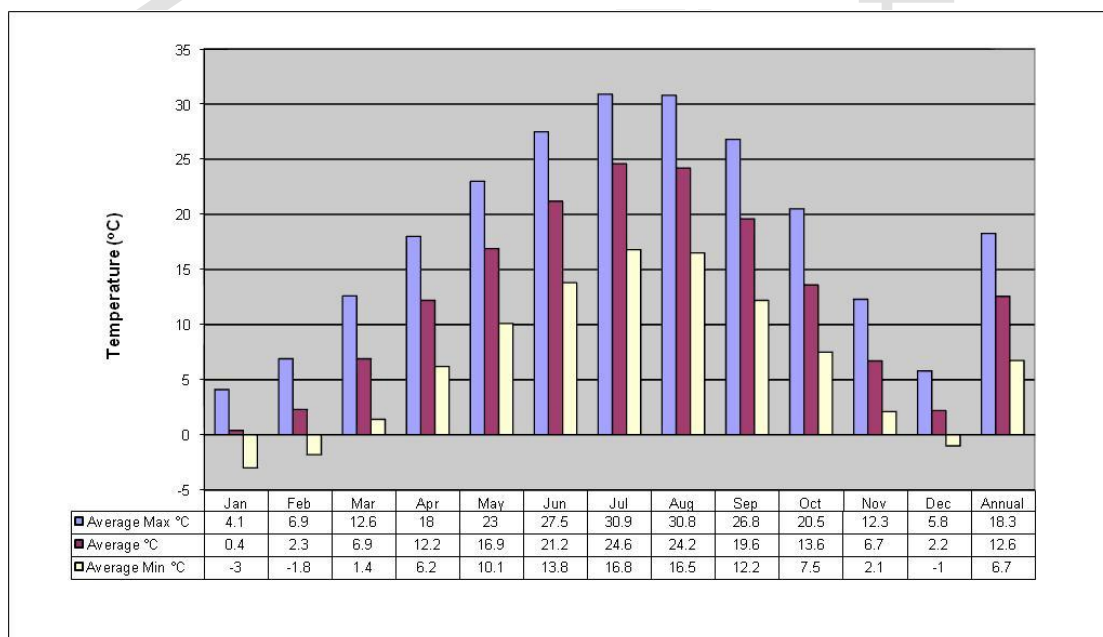


Figure 4-1 Long Term Temperature Data
(Source: Kırıkkale Meteorological Station 1975-2011)

Precipitation

According to the long-term meteorological data, annual average precipitation is 375.6 mm. Monthly average and daily maximum precipitation data is provided in Figure 4-2. As can be seen in Figure 4-2, precipitation is generally observed in April and May. Most rainy seasons are spring and winter. While the maximum average total precipitation (49.9 mm) is observed in May, the minimum average total precipitation (8.4 mm) is observed in August. The maximum daily precipitation is recorded as 100.6 mm in June.

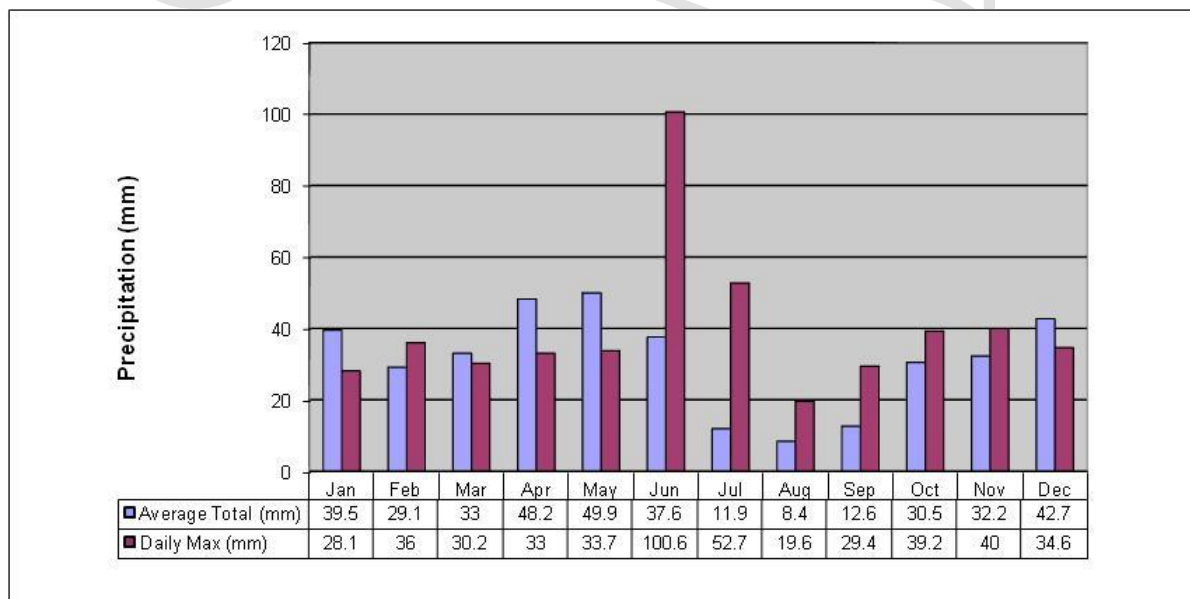


Figure 4-2 Monthly Average and Daily Maximum Precipitation Amount
(Source: Kırıkkale Meteorological Station 1975-2011)

Humidity

Monthly and annual average humidity data recorded during the last 42 years at the Kırıkkale Meteorological Station are provided in Figure 4-3. As can be seen in this figure, the annual average relative humidity in Kırıkkale Province is 63 percent. In addition, the highest average relative humidity value is observed in winter with 77.6 percent average humidity whereas the least humid season is summer when average relative humidity is 48.4 percent.

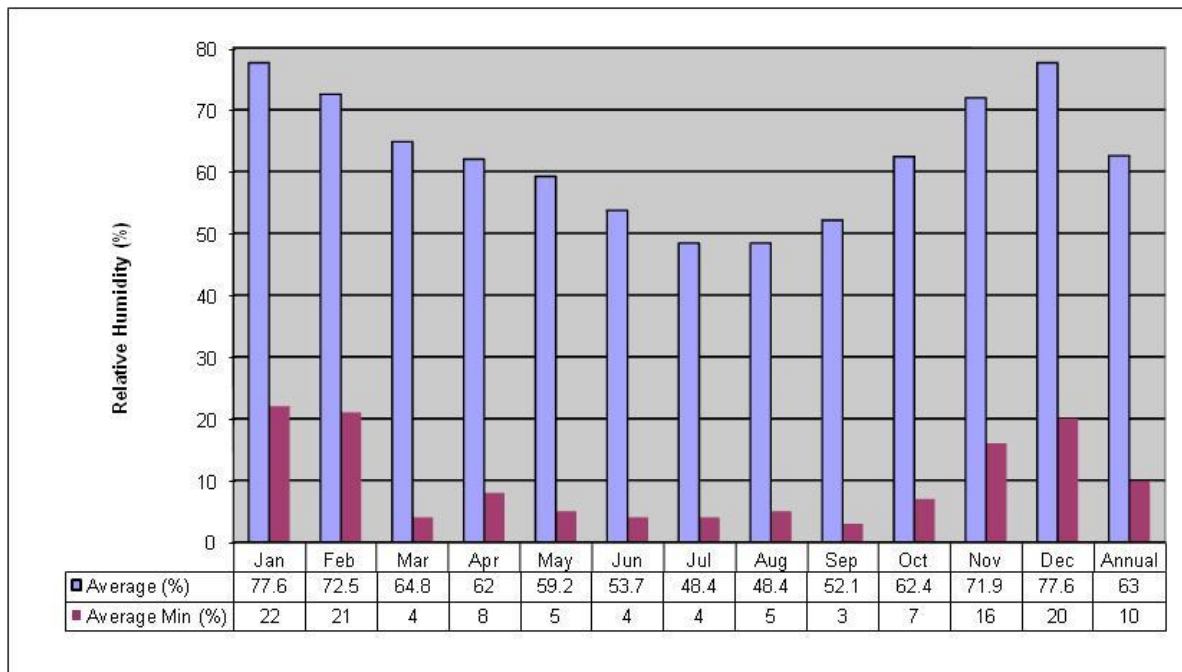


Figure 4-3 Monthly and Annual Average Humidity Data
 (Source: Kırıkkale Meteorological Station 1975-2011)

Evaporation

Monthly average evaporation and daily maximum evaporation data recorded at the Kırıkkale Meteorological Station are provided in Figure 4-4. The maximum monthly average evaporation occurs in July with 295 mm and evaporation is maximum in summer season. The maximum daily evaporation occurs in July with 17.0 mm. Evaporation is not observed in the months of January, February, March and December.

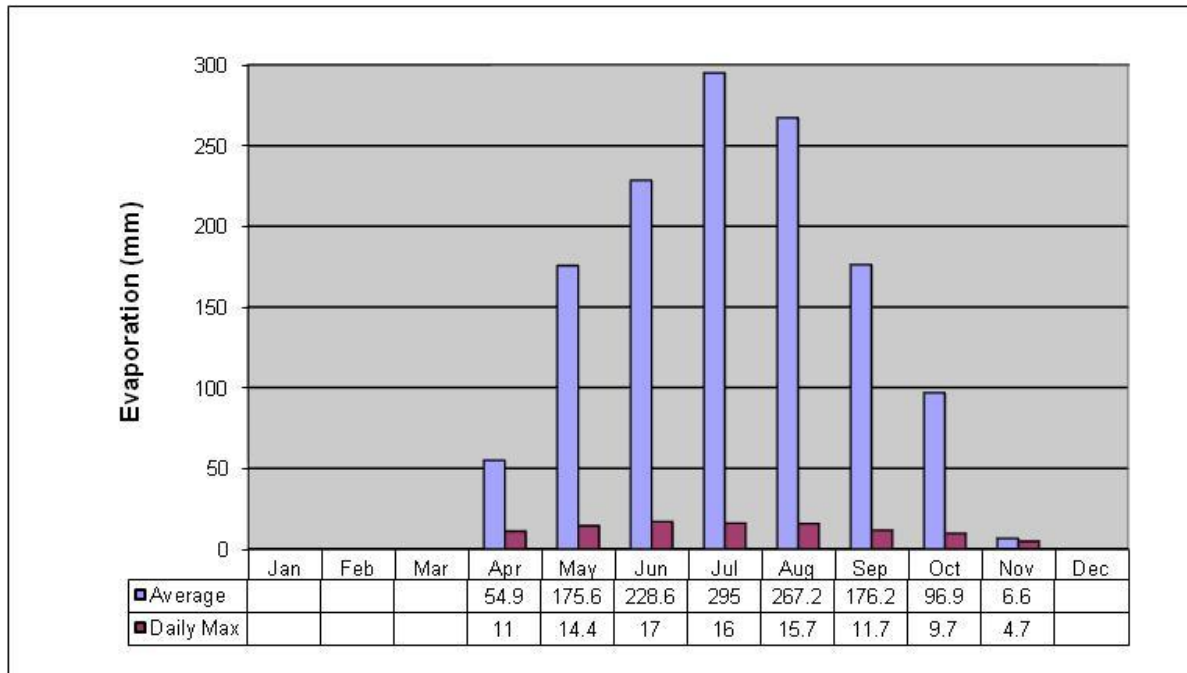


Figure 4-4 Monthly and Monthly Average Evaporation and Daily Maximum Evaporation Data
(Source: Kirikkale Meteorological Station 1975-2011)

Distribution of the Snowy and Foggy Days

According to the observation records of Kirikkale Meteorological Station between 1970–2011, annual number of days with snow, snow cover and fog, and the maximum snow cover thickness are provided in Figure 4-5, Figure 4-6, Figure 4-7 and Figure 4-8, respectively. According to the station data, annual number of snowy days is 18.8 and annual number of days with snow cover is 17.5. In addition, the maximum thickness of snow cover is 48.0 cm in January and annual number of foggy days is 12.5.

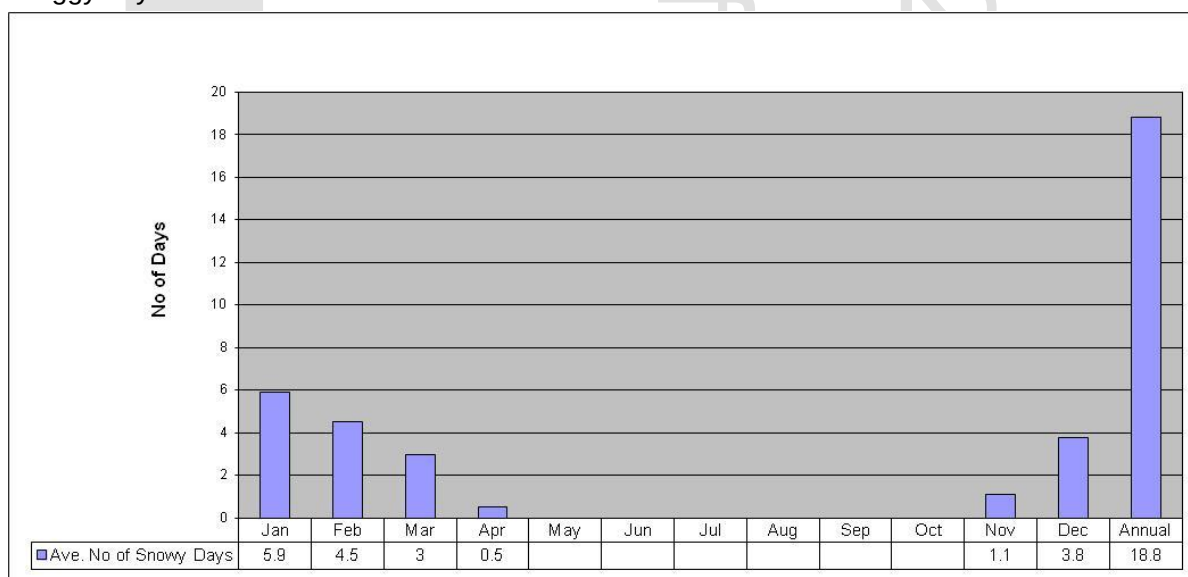


Figure 4-5 Monthly and Annual Average Snowy Days
(Source: Kirikkale Meteorological Station 1975-2011)

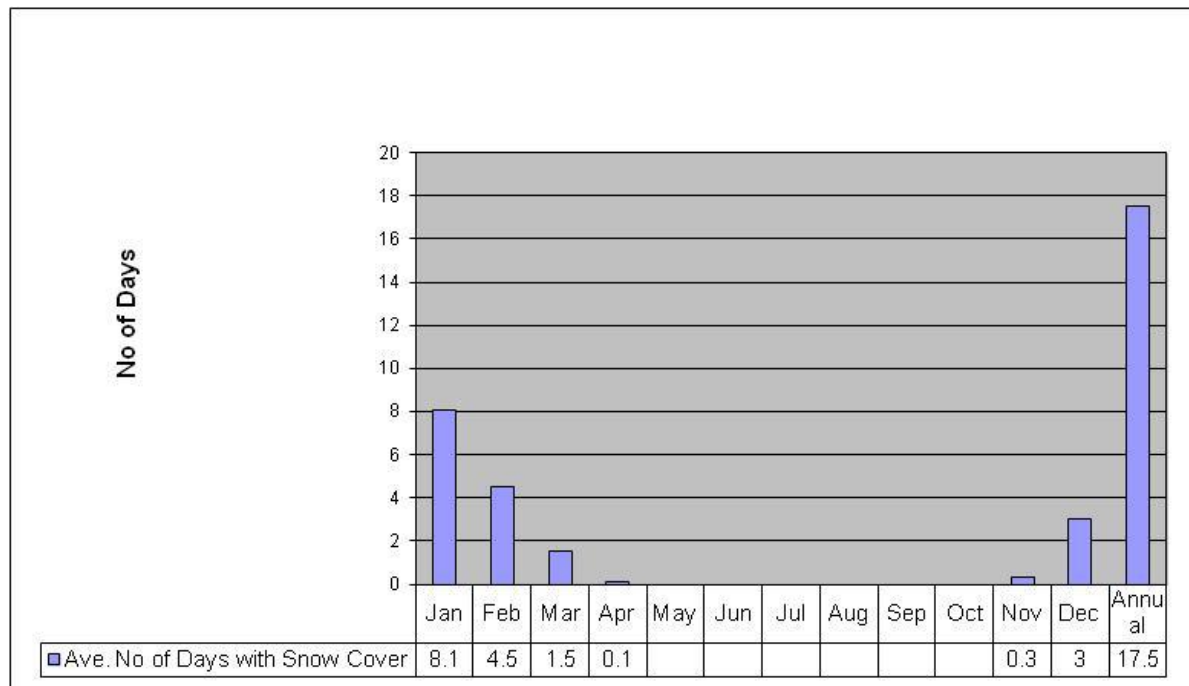


Figure 4-6 Monthly and Annual Average Days with Snow Cover
 (Source: Kirikkale Meteorological Station 1975-2011)

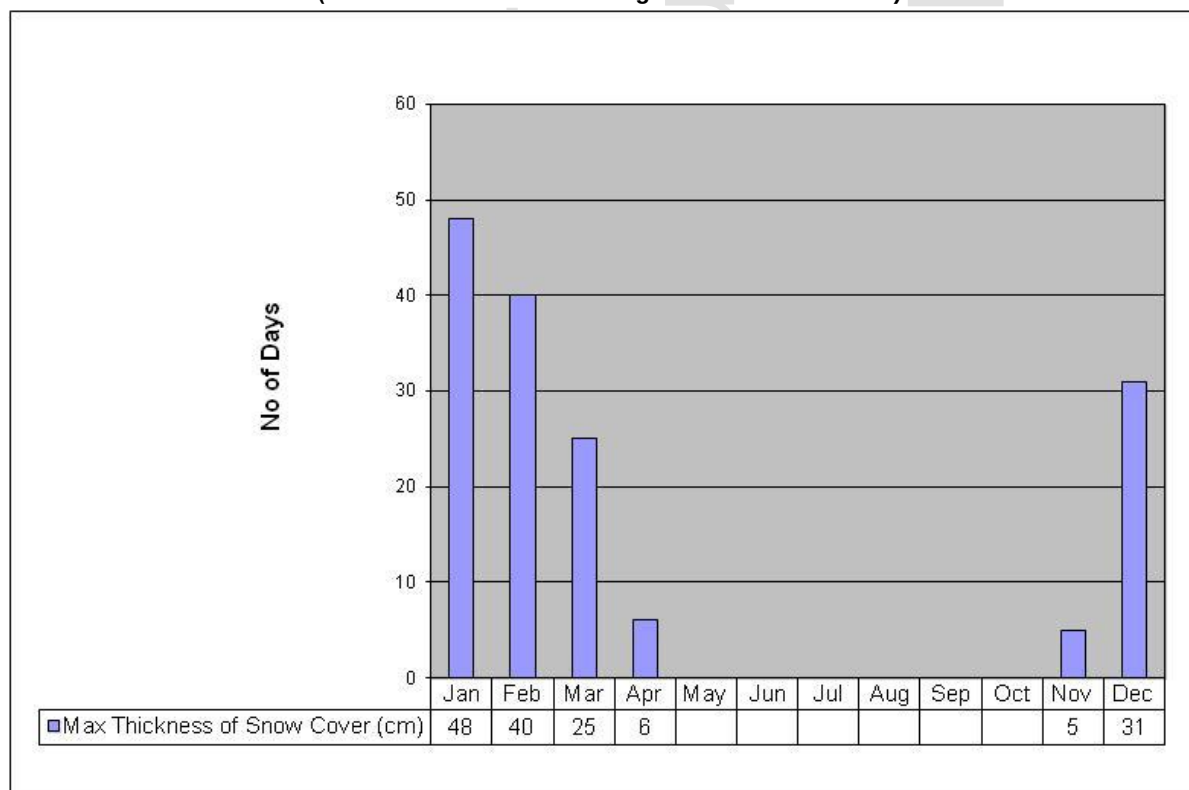


Figure 4-7 Maximum Thickness of Snow Cover (Source: Kirikkale Meteorological Station 1975-2011)

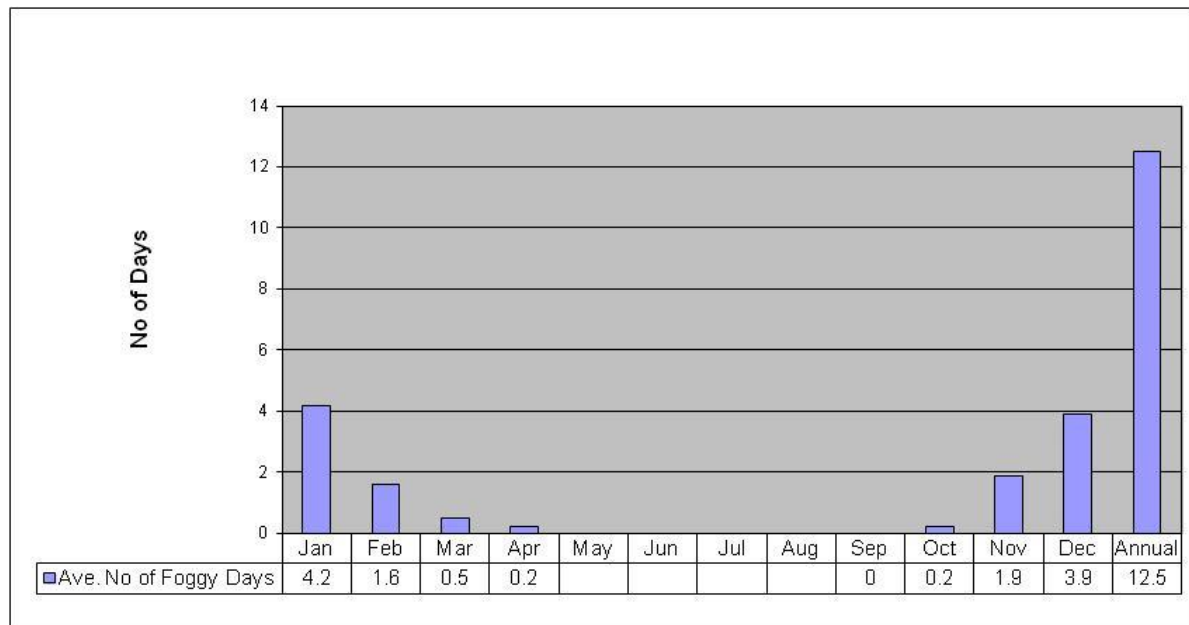


Figure 4-8 Monthly and Annual Average Foggy Days (Source: Kırıkkale Meteorological Station 1975-2011)

4.2 Air Quality

In the assessment of existing background, air pollution levels in the region and the pollutants SO_2 , CO, PM and NO_x are taken into consideration. The proposed plant will use natural gas as the primary fuel and there will be no auxiliary (secondary) fuel. Thus, because of the nature of the fuel (natural gas) and the high-technology turbine that will be used in the proposed plant, there will be negligible amount of SO_2 , CO and PM emissions from the proposed plant in the operation phase. As a result of the discussions with the Turkish Ministry of Environment and Urbanization (MoEU), it was agreed that passive sampling would be sufficient to monitor existing ambient NO and NO_2 background concentrations.

The background concentrations of the other pollutants were assessed using the results of ambient monitoring studies conducted around the proposed project location between August 2003 and January 2004. These monitoring studies were conducted by the Barmek Power Plant which used heavy fuel oil for fuel. The monitoring study performed in 2003 and 2004 consists of determining background SO_2 concentrations at twenty locations by passive sampling method and PM_{10} concentrations at one location.

The assessment of the results of background SO_2 and PM_{10} concentration monitoring studies in 2003 and 2004 and the assessment of the passive sampling studies performed to determine background NO and NO_2 concentrations are given in the following sections. In addition to the detailed assessment of the monitored pollutant concentrations, the comparison with the values given in relevant Turkish regulation and IFC/WB Guidelines are also included. The limit values given in Turkish "Regulation on Assessment and Management of Air Quality" (RAMAQ) and IFC/WB "General EHS Guidelines: Environmental – Air Emissions and Ambient Air Quality" that are used in the comparison are given in Table 4-1 below.

Table 4-1 Turkish RAMAQ and IFC/WB Guidelines Air Quality Standards

Pollutant	Averaging Period	Turkish RAMAQ		IFC/WB Guideline
		Limit Value ¹ ($\mu\text{g}/\text{m}^3$)	Annual Decrease of Limit Value	Limit Value ² ($\mu\text{g}/\text{m}^3$)
SO ₂	10 minutes	-	-	500
	1 Hour	900	-	-
	24 Hour (95 th percentile) -to protect human-health	400	The limit value will decrease 30 $\mu\text{g}/\text{m}^3$ each year down to 250 $\mu\text{g}/\text{m}^3$ until 01.01.2014.	20
	Winter Season Average (1 October – 31 March) -to protect human-health	250	The limit value will decrease 25 $\mu\text{g}/\text{m}^3$ each year down to 125 $\mu\text{g}/\text{m}^3$ until 01.01.2014.	-
	Target Limit Value Winter Season Average (1 October – 31 March)	120	-	-
	Annual -to protect human-health	150	-	-
	Annual -to protect vulnerable animals, plants and entities	60	The limit value will decrease 8 $\mu\text{g}/\text{m}^3$ each year down to 20 $\mu\text{g}/\text{m}^3$ until 01.01.2014.	-
NO ₂	Target Limit Value Annual	60	-	-
	1 Hour	-	-	200
	24 Hour (95 th percentile) -to protect human-health	300	-	-
PM ₁₀	Annual -to protect human-health	100	The limit value will decrease 8 $\mu\text{g}/\text{m}^3$ each year down to 60 $\mu\text{g}/\text{m}^3$ until 01.01.2014.	40
	24 Hour (95 th percentile) -to protect human-health	300	The limit value will decrease 40 $\mu\text{g}/\text{m}^3$ each year down to 100 $\mu\text{g}/\text{m}^3$ until 01.01.2014.	50
	Winter Season Average (1 October – 31 March) -to protect human-health	200	The limit value will decrease 22 $\mu\text{g}/\text{m}^3$ each year down to 90 $\mu\text{g}/\text{m}^3$ until 1.1.2014.	-
	Annual -to protect human-health	150	The limit value will decrease 18 $\mu\text{g}/\text{m}^3$ each year down to 60 $\mu\text{g}/\text{m}^3$ until 01.01.2014.	20
Not: ¹ Regulation on Assessment and Management of Air Quality (RAMAQ) (Official Gazette No. 26898 on June 6, 2008 and amended in 2009) ² IFC/WB General EHS Guidelines: Environmental – Air Emissions and Ambient Air Quality				

Sulphur dioxide

Sulphur dioxide (SO₂) and sulphur trioxide (SO₃) are the types of sulphur oxides that are commonly present in the atmosphere. SO₂ is mainly discharged to atmosphere via exhaust gases of reciprocating engines and flue gases formed from combustion of fossil fuels like oil and coal. SO₂ in the atmosphere goes into photochemical or catalytic reaction and is partially converted to SO₃ or H₂SO₄.

Monthly average background SO₂ concentration levels determined by the passive sampling study between August 2003 and January 2004 are given in Figure 4-9. As it can be seen in the figure, SO₂ concentrations show variations between months and reaches to higher values in months of winter season (November, December and January).

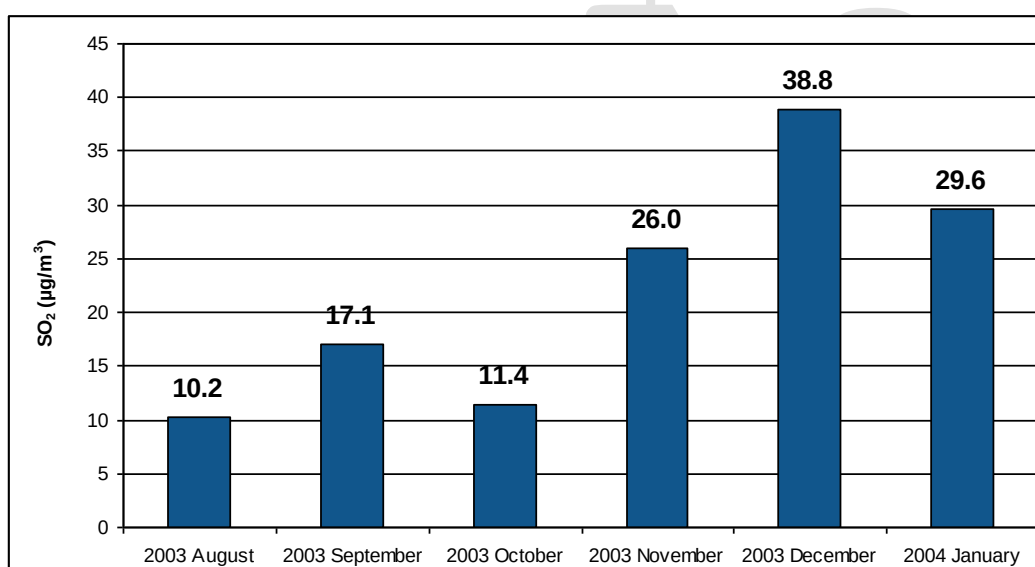


Figure 4-9 Monthly Average Background SO₂ Concentrations between August 2003 and January 2004

The average background SO₂ and PM₁₀ concentration levels determined by the passive sampling study between August 2003 and January 2004 are given in Table 4-2 in order to compare with the limit values given in Turkish RAMAQ. In addition to values given in Table 4-2, average concentrations of SO₂ and PM₁₀ measured in winter months are given in Table 4-3 in order to compare with the winter season limit values given in Turkish RAMAQ.

Table 4-2 Average Background SO₂ and PM₁₀ Concentrations Measured between August 2003 and January 2004

Pollutant	Concentration (µg/m³)	
	24 hour (95 th percentile)	Annual (Average)
SO ₂	33.98	21.27
PM ₁₀	26.29	16.96

The average SO₂ concentrations for 24 hour averaging period which is the 95th percentile value of the average concentrations is 33.98 µg/m³ and it is 8.49% of the Turkish RAMAQ limit value, 400 µg/m³, for this averaging period.

The average SO₂ concentration for winter months is 26.4 µg/m³. It is 10.56% of the Turkish RAMAQ limit value, 250 µg/m³, for 2009 and 22.0% of the Turkish RAMAQ target limit value of 120 µg/m³, respectively.

The average background SO₂ and PM₁₀ concentrations for winter season were calculated and given in Table 4-3.

Table 4-3 The Average Background SO₂ and PM₁₀ Concentrations in Winter Season

	SO ₂	PM ₁₀
Winter Season	26.4	16.53

There are two SO₂ concentration limits defined for annual averaging period in Turkish RAMAQ. The annual average SO₂ concentration measured between August 2003 and January 2004 was 21.27 µg/m³ and it is 14.18% and 35.45% of the annual limit value (to protect human health) and target limit value given in Turkish RAMAQ, respectively.

In Turkish RAMAQ, there is also a limit value for annual averaging period which is to protect vulnerable animals, plants and entities. The annual average SO₂ concentration measured between August 2003 and January 2004 was 35.45% of the annual limit value, 60 µg/m³, to protect vulnerable animals, plants and entities.

In summary, monitoring results showing existing background SO₂ concentration in the region are in compliance with the Turkish RAMAQ limit values. In addition, background SO₂ concentrations are well below the limit values and the target limit values given in Turkish RAMAQ. It should be also noted that these measurements were conducted when the Barmek Power Plant was in operation. However, currently the Barmek Power Plant has been dismantled and thus not in operation. Thus, the monitored SO₂ levels in 2003 and 2004 can be viewed as the worst case ambient SO₂ concentrations since the SO₂ source has been taken out of operation in the region.

Particulate Matter (PM₁₀)

The solid or liquid objects that can suspend in the air and having average gaseous molecule size with diameter between 0.0002 µm and 10 µm are classified as particulate matter. Particulate matter emissions are named as aerosol, smoke, and dust according to their diameter, density and chemical formation. It is a known fact that particulate matters have negative impacts directly on lung and respiratory tract.

Monthly average background PM₁₀ concentration levels determined by the passive sampling study between August 2003 and January 2004 are given in Figure 4-10. As in the case of SO₂, PM₁₀ concentrations show variations between months.

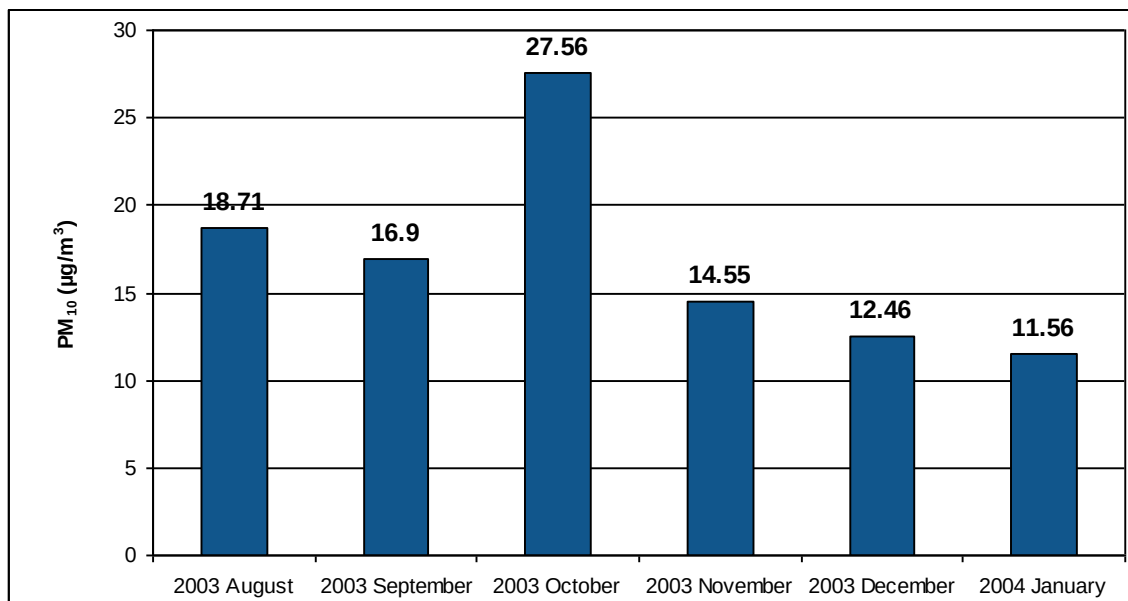


Figure 4-10 Monthly Average Background PM₁₀ Concentrations between August 2003 and January 2004

The average background PM₁₀ concentration levels determined by the passive sampling study between August 2003 and January 2004 are given in Table 4-2 in order to compare with the limit values given in Turkish RAMAQ. The average PM₁₀ concentrations for 24 hour averaging period which is the 95th percentile value of the average concentrations is 26.29 µg/m³ and it is 2.83% of the Turkish RAMAQ limit value, 300 µg/m³, for this averaging period. In addition, average PM₁₀ concentration for 24 hour averaging period is 8.49% of the target limit value, 100 µg/m³ given in the Turkish RAMAQ. In conclusion, background monitoring results show that PM₁₀ concentration in the region is below the limit values and in compliance with the Turkish RAMAQ.

It should be also noted that the Barmek Power Plant was operational during these monitoring studies and thus these PM10 results can be considered as the worse case ambient conditions since the Barmek Power Plant is no longer operational in the region.

Nitrogen Oxides

In order to determine background NO_x and NO₂ concentrations around the project site, passive sampling studies were conducted at 13 locations for two months between June 11, 2010 and August 11, 2010. The following parameters were considered in determining the passive sampling locations:

- Prevailing wind direction (East-Northeast),
- Populated places (settlements), and
- Air quality modeling results.

In the light of above parameters, thirteen passive sampling locations were determined. Prior to the monitoring, AECOM shared this information with the Ministry of Environment and Forestry (MoEF) and the MoEF has approved the ambient monitoring locations. The coordinates (UTM ED50, Zone: 36) of the passive sampling locations are given in Table 4-4. At these locations, NO_x and NO₂

monitoring was performed by passive sampling method with diffusion tubes. The passive sampling locations are shown on the 1/25,000 scale topographic map in Figure 4-11. Sample-1 is at the location where the highest annual and 24-Hour NO_x concentrations were estimated in air quality modeling. Sample-2, 3 and 4 are at the locations where high NO_x concentrations were calculated. Sample-5 and 6 are located in Hacilar Town situated in the south of the project site. Sample-7 and 8 locations in the northwest of the project site were selected because the highest 1-Hour NO_x concentrations occurred at these locations. Sample-9 is located at the south of Tüpraş social facilities which is the closest populated place to the project site in northeast. Sample-10 was located in a region where cultivated areas are present in the northeast of the project site. Sample-11 and 12 were situated on the hills located in southwest of the project site. These two locations were selected in order to assess the impact of Tüpraş Orta Anadolu Refinery on existing air quality. Sample-13 is located at south of the project site at the west border of Tüpraş Orta Anadolu Refinery.

Table 4-4 NO_x and NO₂ Passive Sampling Locations

Number	Sample Name	Easting (m)	Northing (m)	Elevation (m)
1	SAMPLE-1	537,559.56	4,400,963.89	909
2	SAMPLE-2	537,312.88	4,400,957.14	958
3	SAMPLE-3	536,790.48	4,400,386.35	890
4	SAMPLE-4	536,962.50	4,400,780.08	944
5	SAMPLE-5	536,909.88	4,398,359.15	784
6	SAMPLE-6	537,439.82	4,398,815.66	765
7	SAMPLE-7	538,226.83	4,401,493.27	848
8	SAMPLE-8	538,048.52	4,401,174.95	855
9	SAMPLE-9	539,050.48	4,401,235.48	743
10	SAMPLE-10	536,883.01	4,402,705.36	1034
11	SAMPLE-11	536,327.07	4,399,644.96	884
12	SAMPLE-12	536,004.41	4,399,203.92	964
13	SAMPLE-13	538,385.40	4,399,416.34	735

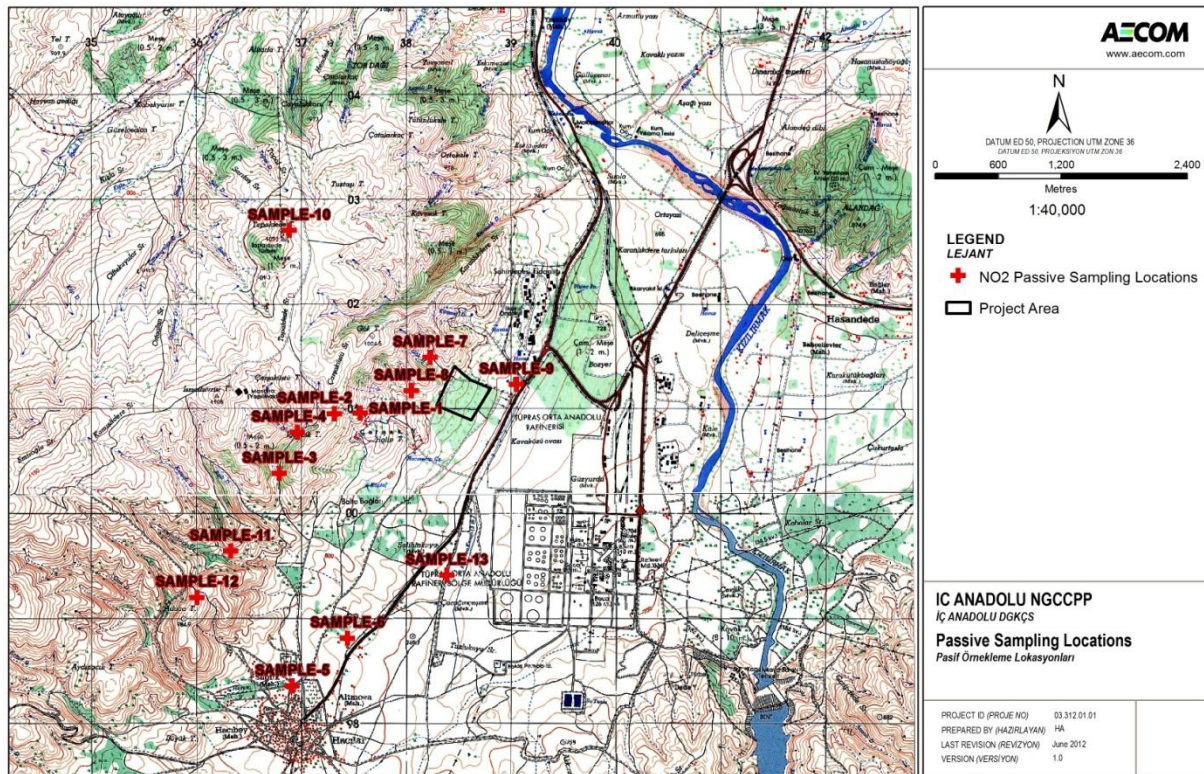


Figure 4-11 NO_x and NO₂ Passive Sampling Locations

In background NO_x and NO₂ passive sampling studies, diffusion tubes obtained from Gradko International Ltd. were used. The tubes were placed to appropriate locations at where there is no barrier preventing air flow into the tubes from the open ends. The tubes were 1-5 m above the ground hanged on wooden piles, trees or electricity/phone posts as shown in Figure 4-12. Diffusion tubes have measuring range of 1-200 µg/m³. The analysis of the diffusion tubes were performed in the environmental analysis laboratory of Gradko International Ltd in the U.K. The results of NO_x and NO₂ passive sampling studies are given in Table 4-5 below.



Figure 4-12 Diffusion Tubes Used in Passive Sampling Studies

Table 4-5 Passive Sampling Results - Average NO_x Concentration

No	Name	11.06.2010 – 11.08.2010 (Average of two months)		
		NO ₂ (µg/m ³)	NO _x (µg/m ³)	NO(µg/m ³)
1	SAMPLE-1	2.88	6.63	3.75
2	SAMPLE-2	2.60	16.70	30.26 ²
3	SAMPLE-3	2.95	6.51	3.56
4	SAMPLE-4	2.34	8.83	6.49
5	SAMPLE-5	3.00	4.31	1.31
6	SAMPLE-6	3.22	6.85	3.62
7	SAMPLE-7	3.46	16.30	12.84
8	SAMPLE-8	2.23	5.69	3.46
9	SAMPLE-9	3.66	10.15 ¹	6.72 ¹
10	SAMPLE-10	2.91	7.32	4.41
11	SAMPLE-11	2.91	10.77	7.86
12	SAMPLE-12	1.74	7.93	6.19
13	SAMPLE-13	3.21	20.76	17.55
¹ 2 nd month sampling result is given since there was soil and water in the 1 st month tube				
² 2 nd month sampling result is given since 1 st month result was below the detection limit.				

The highest NO₂ concentration was measured as 3.66 µg/m³ at Sample-9 which was located in south of Tüpraş Social Facilities. The second and third highest NO₂ concentrations were measured as 3.46 µg/m³ and 3.22 µg/m³ at Sample-7 and 6, respectively. Sample-5 and 6 were located in Hacilar Town and background NO₂ concentrations measured at these locations were 3.00 µg/m³ and 3.22 µg/m³, respectively.

There are NO₂ limit values for 24-Hour and annual averaging periods in the Turkish IAPCR. The 24-Hour average concentration values are generally greater than monthly average values and annual average concentrations values are commonly lower than monthly average values. The background NO₂ concentrations determined with the performed passive sampling studies are below the limit values given in Turkish IAPCR for both 24-Hour and annual averaging period.

4.3 Landuse

The proposed area, where the project will be located, is designated as an industrial area according to the Development (Master) Plan prepared by Hacilar Municipality. The size of the project site is 139,038 m². Hacilar Municipality approved the use of the area for this project.

The natural gas pipeline that will be constructed in the scope of the project will be constructed parallel to the pipeline that supplies natural gas to Tüpraş Orta Anadolu Refinery. Thus, limited expropriation will be performed for the area that will be used in the scope of pipeline construction.

The route of the transmission line that will be constructed in the scope of the project is not determined yet. Thus, the landuse characteristics could not be determined.

4.4 Background Noise Levels

The Project site is located near Tüpraş social facility that is located in the northeast. In addition, there are several dwellings closer than Tüpraş social facility near the Project area. According to information obtained from the local people, these dwellings are used seasonally in spring and summer for agricultural purposes. In addition to the dwellings located in east of the project area, there are also two houses in south and southwest of the project area.

4.4.1 Noise Sensitive Receptors

The noise sensitive receptors (NSRs), selected as the houses that are used permanently as well as seasonally and was determined according to their distances to the project site. The coordinates (UTM Projection, ED-50 Datum, Zone 36) of the NSRs are given in Table 4-6. The NSR locations are shown in Figure 4-13.

Table 4-6 UTM Coordinates of Noise Sensitive Receptors

Noise Sensitive Receptor	Easting (m)	Northing (m)
NSR-1	538,894	4,401,086
NSR-2	537,572	4,400,803
NSR-3	538,290	4,400,414

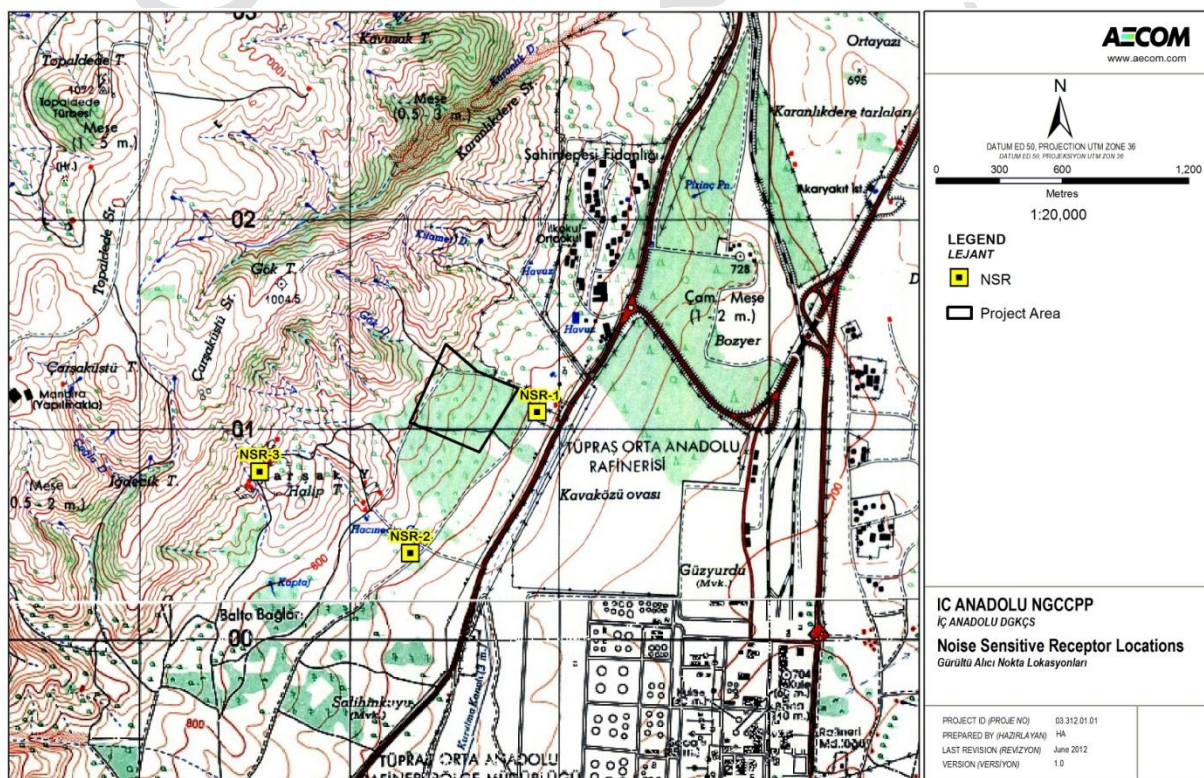


Figure 4-13 Location of Noise Sensitive Receptors

NSR-1 is situated in the east of the project site. It is a house used in certain seasons within 150 m of the D753 Kırıkkale – Konya State Road. The distance between this house and the border of the

project site is approximately 135 m. The closest building to NSR-1 is another dwelling located in 30 m in northeast. The view of NSR-1 is given in Figure 4-14 below.

NSR-2 and NSR-3 are situated in south and southwest of the project site at a distance of about 570 m and 750 m, respectively. According to information obtained from the local people, the dwelling chosen as NSR-2 is occupied seasonally whereas the house at NSR-3 is used permanently. In order to determine existing ambient noise levels (background noise) in the region, background noise monitoring studies were undertaken at NSR-1 which is the closest receptor to the project site. Since there is no permanent noise source near the project site, it is expected to have similar background noise levels at each receptor.



Figure 4-14 View of NSR-1

4.4.2 Measurement Procedure

Background noise level measurement studies were performed for two days, between November 3, 2010 and November 5, 2010. The noise measurements were undertaken on one hour sampling periods with *Type 2 Quest 2900 Integrating/Logging Sound Level Meter*. The equipment is in compliance with the standards of ANSI S1.4, IEC 651 and IEC 804. The equipment calibration was checked before and after each measurement with an acoustic calibrator which is *Quest QC/10 Calibrator*. The calibrator used complies with the standards of ANSI S1.4 and IEC 942.

The equipment used for the measurements set to a-weighted, fast response, continuously monitoring over one hour sampling period. All noise measurements were performed with the following precautions;

- Field calibration checked before and after measurements.
- Windshield positioned over the microphone.

- Microphone was positioned approximately 1.5 m above local ground level (on a tripod).
- Microphone placed away from any significant vertical reflective surfaces.
- Monitoring equipment was secured so as to avoid extraneous wind noise generated in close proximity to the microphone.

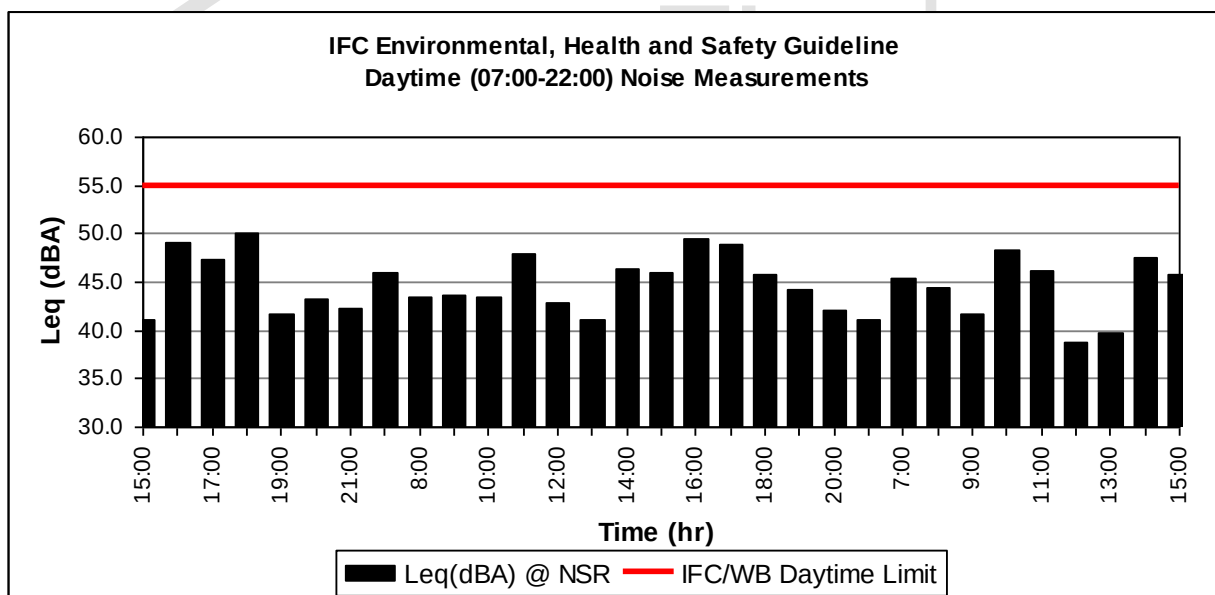
4.4.3 Background Noise Measurement Results

At the end of a series of one hour sound level measurements performed for two days, L_{min} , L_{max} and L_{eq} sound levels are quantified at NSR-1. The results of the background noise level measurements (L_{eq}) are evaluated with respect to both IFC Environmental Noise Management Guideline and Turkish Regulation on Assessment and Management of Environmental Noise (RAMEN). Since Equator Principles refer to the IFC guidelines for noise assessment, background noise levels are compared with the IFC Guidelines below.

IFC Environmental Noise Management Guideline

Related IFC Guideline divides the day into two parts: Daytime (07:00-22:00) and Nighttime (22:00-07:00). Since the noise sensitive receptor is classified as residential building, noise level limits of 55 dBA and 45 dBA are considered for daytime and nighttime limits, respectively.

The results of the daytime and nighttime background noise levels are compared with the IFC guideline values. In this regard, the daytime noise measurement results (L_{eq}), IFC guideline value of 55 dBA and the nighttime measurement results (L_{eq}), IFC guideline value of 45 dBA are plotted in the graphs and given in Figure 4-15 below.



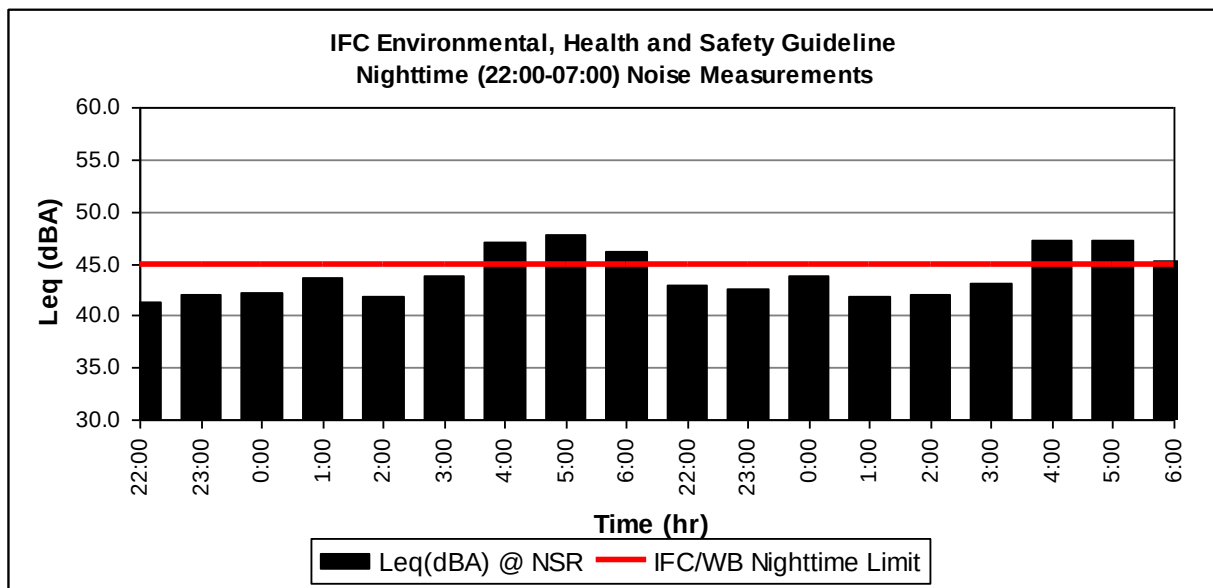


Figure 4-15 Daytime and Nighttime Background Noise Measurement Results compared to IFC Guideline

As can be seen from the graphs above, background noise levels at NSR-1 are well below the IFC daytime noise level limit of 55 dBA. This result is expected since there is no noise emitting activity in the close vicinity of the NSR.

The nighttime background noise levels measured at NSR-1 are mostly below the IFC nighttime noise level limit of 45 dBA. There are only 6 exceedences out of 18 values. All exceedences were observed between 4:00 a.m. and 6:00 a.m.

Turkish Regulation on Assessment and Management of Environmental Noise (RAMEN)

RAMEN divides the day into three parts: Daytime (07:00-19:00), evening time (19:00-23:00) and nighttime (23:00-07:00). Since the project site is located in an area having both residential area and industrial facilities, it is classified as “areas with both noise sensitive areas and industrial activities (predominantly industrial)” according to RAMEN, and thus, noise level limits of 68 dBA, 63 dBA and 58 dBA are considered for daytime, evening time and nighttime periods, respectively.

The results of the daytime background noise measurements are compared with the Turkish RAMEN. The daytime noise measurement results (Leq) and RAMEN limit of 68 dBA are plotted in the graph given in Figure 4-16 below.

As can be seen from Figure 4-16, the daytime background noise levels at NSR-1 are well below the RAMEN limit of 68 dBA. The highest noise level was measured as 50.1 dBA in one hour period of 18:00-19:00 during daytime of RAMEN.

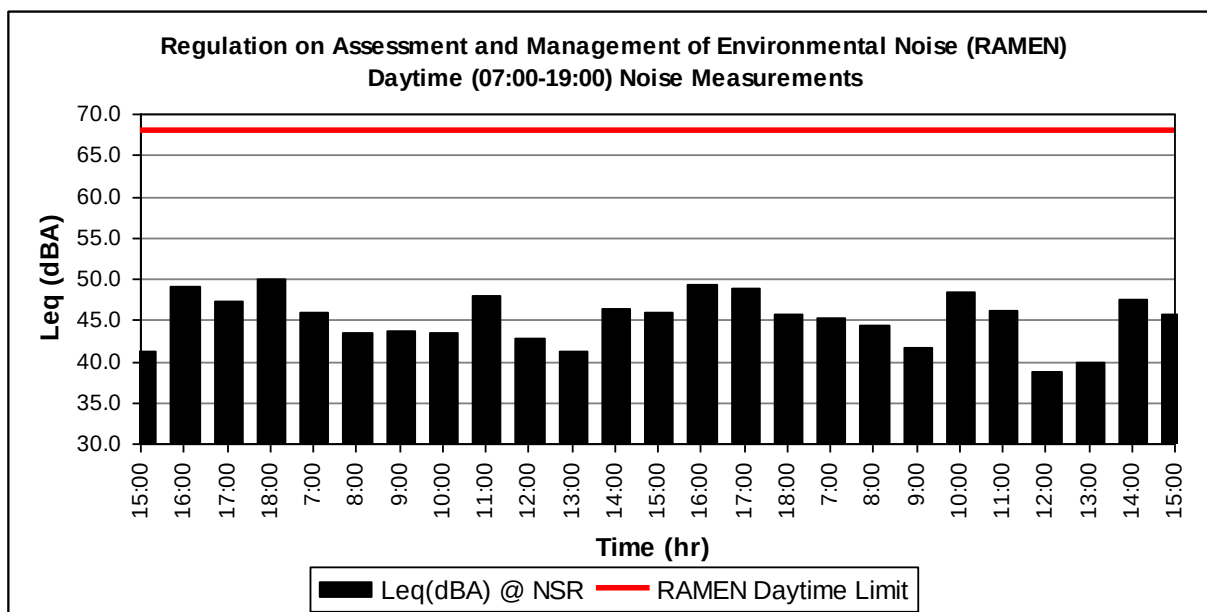


Figure 4-16 Daytime Background Noise Measurement Results compared to Turkish RAMEN

The results of the evening time background noise measurements are compared with the Turkish RAMEN. The evening noise measurement results (Leq) and RAMEN limit of 63 dBA are plotted and given in Figure 4-17 below.

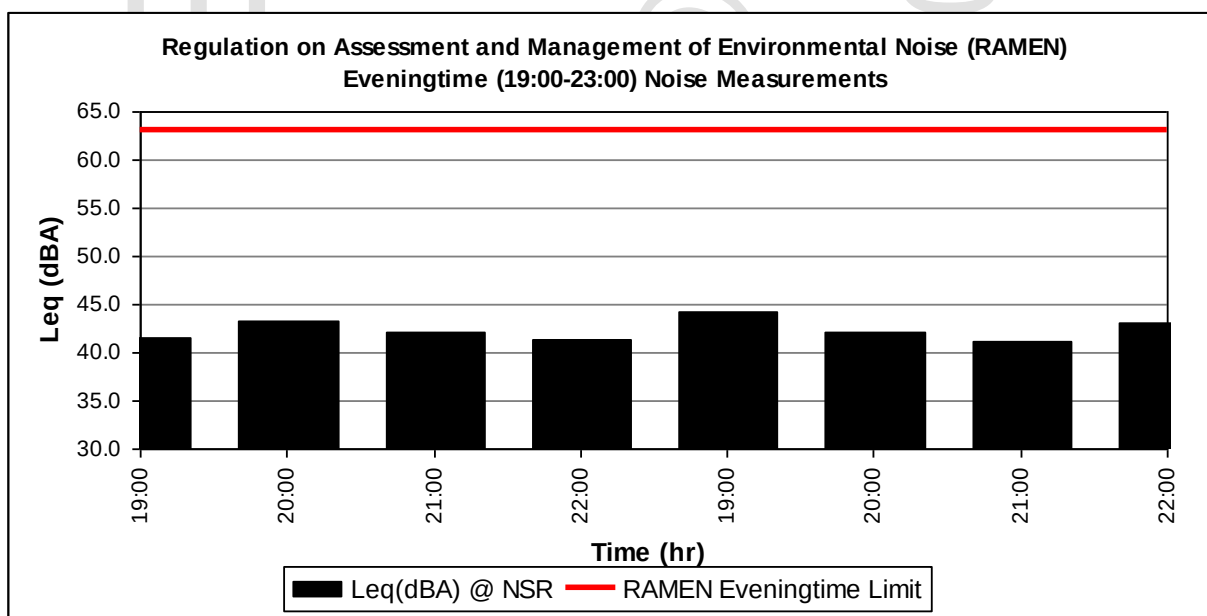


Figure 4-17 Evening time Background Noise Measurement Results compared to Turkish RAMEN

Background noise level measurements performed between 19:00 and 23:00 at NSR-1 show that evening time background noise levels at the receptor are well below the RAMEN evening time limit of 63 dBA.

The results of the nighttime background noise measurements are compared with the Turkish RAMEN. The nighttime noise measurement results (Leq) and RAMEN limit of 58 dBA are plotted in the graph given in Figure 4-18 below.

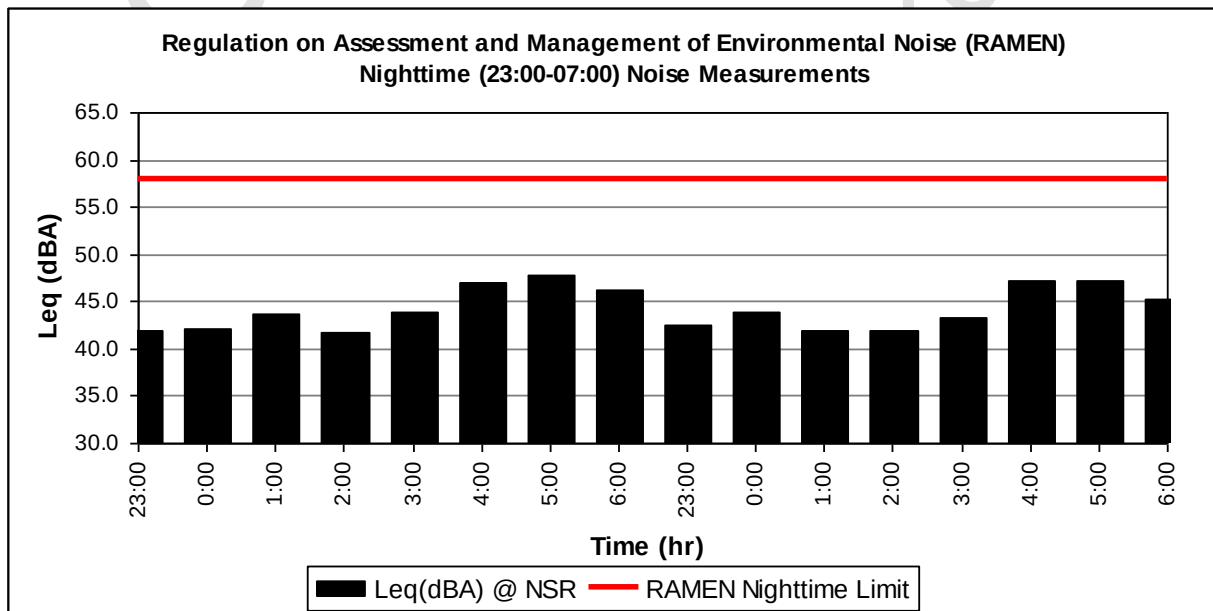


Figure 4-18 Nighttime Background Noise Measurement Results compared to Turkish RAMEN

As it is seen from Figure 4-18 above, all nighttime background noise levels measured at the receptor are below the RAMEN nighttime noise level limit of 58 dBA.

Overall, the background noise level measurement results indicate that the sound in the area do not show great variations and have stable and similar noise levels during both daytime and nighttime periods since there is no noise emitting activities in the close vicinity of NSR-1.

4.5 Geology

4.5.1 Regional Geology

Introduction

The Project site is located within the western portion of Kızılırmak Basin of Central Anatolia. Explanatory text of the geological map of Kırşehir Province with the sheet code I-30, which was prepared by the Department of Geological Survey of General Directorate of Mineral Research and Exploration Institute (MTA), is referred within this document. A site reconnaissance and a preliminary geotechnical survey have also been conducted within the scope of the project. General and local geological features of the site are described in consideration of findings that are obtained through geotechnical boreholes and literature survey.

General Geology

The geological structures that are defined in the context of I-30 Explanatory sheet of the geological map of Kırşehir are Sakarya Zone, İzmir-Ankara Zone, Kırşehir Massive and depositional rocks at the uppermost layer of these units. The lithological constituents within geological map I-31 sheet pertain to these four different geological development environments. Sakarya Zone is situated between Pentode and Anatolite-Tauride belts, and is comprised of Karakaya Massive (Elmadağ Formation, Ortaköy Formation and Keçikaya Formation), unconformably overlying Bakırköy Formation of Jurassic Age and Akbayır Formation.

İzmir-Ankara Zone is comprised of Late Cretaceous Artova Ophiolitic Melange, Kocatepe Formation, Haymana Formation; Paleocene-Early Eocene aged Dizilitaşlar Formation and Sakarya Formation all of which present a tectono-stratigraphic relation.

The rock formations that are observed within Ankara-İzmir Zone are typical depositions of a basin that experienced continental convergence during Upper Cretaceous-Lower Eocene period. Kırşehir Massive underlies İzmir-Ankara Zone tectonically where it underlies some rock formations of Sakarya Zone.

Kırşehir Massive is comprised of; Karaboğazdere Gabbros of Late Cretaceous, Çiçekdağ Formation, Kötüdağ Volcanics, Central-Anatolian Granitoids, Paleocene-Early Eocene Aged Küreboğazı Formation, Çaldağ Formation and Dizilitaşlar Formation that overlies it. The sedimentary units that are deposited within the foreland basin of the converging continents are namely; Mid-Eocene Baraklı Formation, Çayraz formation, Çavuşlu, Deliler, Tohumlar, Hüseyingazi volcanic rocks, İncik Formation of Late-Eocene, Mid Miocene-Early Pliocene Central Anatolian sedimentary group and volcanic rocks, Gölbaşı Formation, Karakeçili Formation and Quaternary Alluvium. The geological map of the project site is given in Figure 4-19.

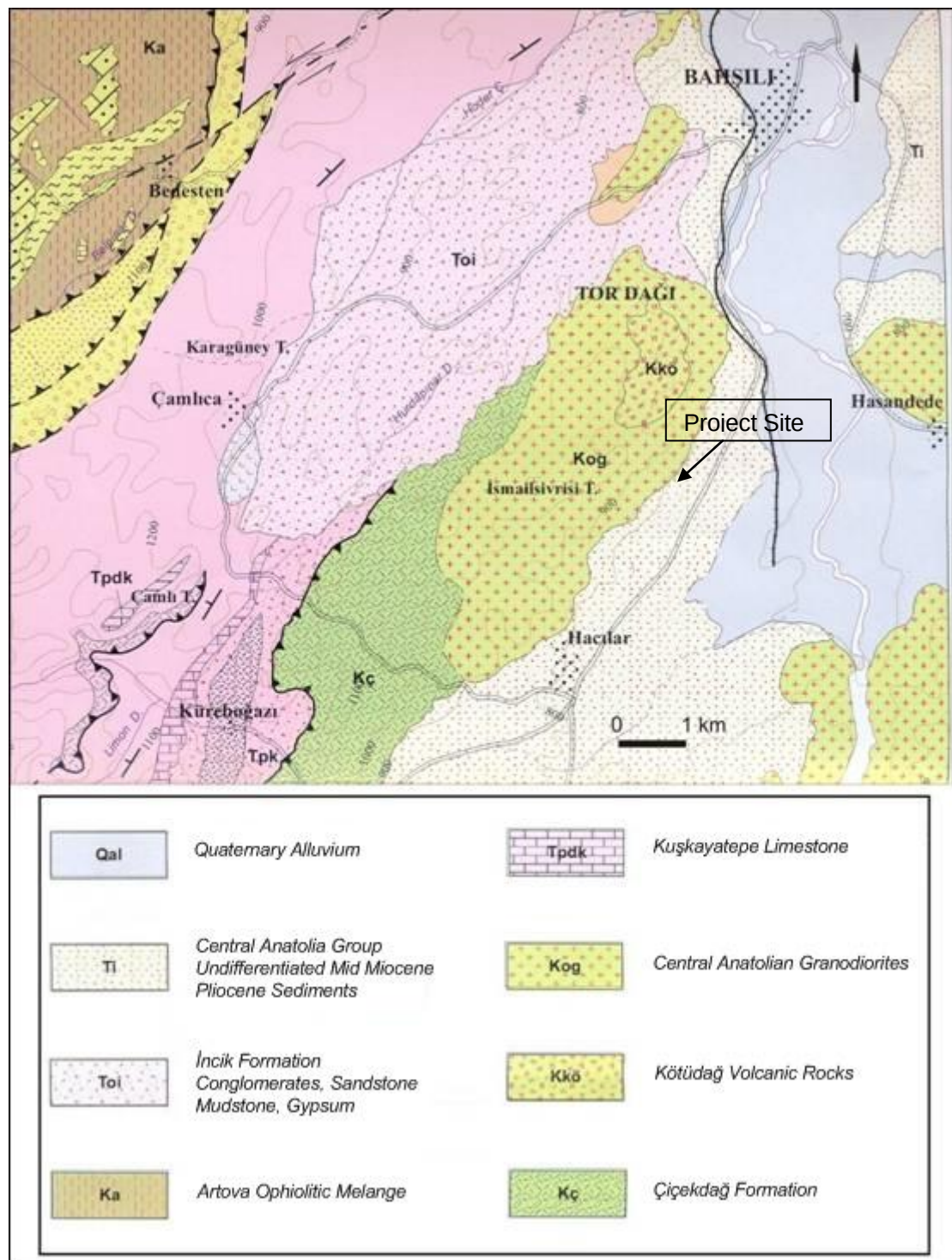


Figure 4-19 General Geological Map (Modified from 1/100,000 scale Geological Map of Kırşehir I 31 Sheet. MTA, 2008)

Stratigraphy

The lithology that presents a tectonostratigraphical relation within the project site constitutes Triassic Jurassic aged Sakarya Zone, sedimentary rocks of İzmir –Ankara Zone that are deposited within Late Cretaceous and Early Eocene and Kırşehir Massive.

The sedimentary rocks which were deposited through Mid-Eocene Transgression overlie all structures mentioned above. Sedimentary rocks present foreland basin characteristics that develop over basement rocks.

Sakarya Zone:

Sakarya Zone is situated between Pontide and Anatolite-Tauride belts and it is comprised of Karakaya Massive that presents a tectono-stratigraphical relation between each formation component (Emir Formation, Elmadağ Formation, Ortaköy Formation), Bayırköy Formation of Jurassic age that lies unconformably and Akbayır Formation that is observed transitively with Bayırköy Formation (MTA, 2008).

Karakaya Massive:

Karakaya Massive is comprised of Permian and Carboniferous limestone blocks, Triassic mélange of gravels, sandstone, quartzite, siltstone, slate, radiolarite, basalts and diabase. Karakaya Massive also bears occasional low grade metamorphism (MTA, 2008).

İzmir-Ankara Zone:

The lithological structures, that constitute İzmir-Ankara Zone, extend in a north east southwest trend between provinces of Elmadağ and Kırkkale. Late Cretaceous aged Artova Ophiolitic Melange, Kocatepe Formation, Karadağ Formation, Ilıcavınar Formation, Samanlı Formation, Haymana Formation and Paleocene Early Eocene Dizilitaşlar Formation and Sakarya Formation comprise this zone, all of which present interrelated tectono-stratigraphical structure. The sedimentary rocks are observed in flysch development peculiar to converging continents and observed as outcomes of a subduction zone. (MTA, 2008).

Kırşehir Massive:

Kırşehir Massive is comprised of Late Cretaceous Karaboğazdere Gabbros, Kötüdağ Volcanic Rocks, Central Anatolian Granodiorites, Çiçekdağ Formation and Paleocene-Early Eocene Küreboğazı Formation, Çaldağ Formation and Dizilitaşlar Formation (MTA, 2008).

Tertiary:

Continental and marine depositions that represent Tertiary, include; Küreboğazı Formation, Çaldağ Formation, Dizilitaşlar Formation, Baraklı Formation, Çayraz Formation, İncik Formation, Central Anatolian Group Sedimentary and Volcanic Rocks, Gölbaşı Formation and Karakeçili Formation (MTA, 2008).

Sedimentary Rocks

Foreland basin sediments of Mid-Eocene aged Baraklı Formation, Çayraz Formation, Çavuşlu Volcanic Rocks, Late-Eocene aged İncik Formation, Mid-Miocene Early Pliocene Central Anatolian Group sedimentary and volcanic rocks, Pliocene Gölbaşı Formation, Karakeçili Formation and Quaternary Alluvium, constitute sedimentary formations within Kırşehir Massive (MTA, 2008).

The youngest lithologies are presented with Quaternary Alluvium which occupies low lying areas and banks of water courses. The recent alluvium is comprised of beige and reddish sand, silt and clay intermixture.

4.5.2 Project Site Geology

According to the 1/25.000 scale geological map (Figure 4-20), undifferentiated Mid-Miocene Pliocene continental sediments and Central Anatolia Granodiorites (granite, granodiorite and monzonite) and Quaternary Alluvium, constitute the lithological structures in the close vicinity of the project site. In addition to the literature survey, the observations that were made through site reconnaissance and the preliminary geotechnical study were utilized in order to assess the local geological features of the site.

Kötüdağ Volcanic Rocks (Kkö): The dacite and rhyolite type rock formations that constitute the last stage of Central Anatolian Granitoid development are named as Kötüdağ Volcanic Rocks. These rocks outcrop in Tuztaşlı Crest (1.050 m amsl) which is located in the north and close proximity of the proposed project site. Although there is no evidence to determine the age of this unit, Kötüdağ Volcanic Rocks are presumed to belong to Late Cretaceous-Early Eocene range or Early Senonian (MTA, 2008).

Central Anatolian Granodiorite (Kog): Central Anatolian Granodiorite which outcrops widely in the west of proposed project site and in the close vicinity of Hacılar Village is comprised of granite, granite porphyry, granodiorite, granodiorite porphyry, quartz-diorite, quartz-monzonite, quartz-monzonite porphyry, syenite and micro-syenite rocks. The color, mineralogical composition and texture characteristics vary dependently with rock types. In accordance with radiometric dating conducted upon local intrusive rocks indicate that the rocks pertain to the range of Eocene and Late Cretaceous.

İncik Formation (Toi): Reddish-brown, gray, cross and parallel bedded, moderately-well, occasionally loosely cemented sub-angular rounded continental gravel sandstone, mudstone succession that is deposited in regressive movements was named İncik Formation in previous studies. İncik Formation which outcrops in the north of project site enveloping Central Anatolian Granodiorites, is comprised of moderately-well cemented, thin-moderate-thick bedded parallel laminated sandstone and gypsum-unhydrite and mudstone successions. Middle and upper layers of this formation are comprised of cross bedded mudstone-gravel and sandstone successions.

Central Anatolia Group (Ti): This continental group outcrops widely in Central Anatolia, comprising the base lithological structure of the project site. It is formed of reddish-brown, non-layered or slightly layered, gravel sized sandstone, gypsum-anhydrite and limestone-ignimbrite intercalations.

The sections of this continental facies, which are represented with slope debris, comprise; reddish gravels without clast support, sandstone and mudstone.

The fluvial channels are formed of stacked reddish-brown cross bedded gravels, sandstone belts and lenses (MTA, 2008). Considering the ages of transition volcanic rocks that present intercalations with sediments of Central Anatolian Group, the age of depositional rocks is included to Mid Miocene-Pliocene range. The sediments of Central Anatolia Group are considered to rest unconformably upon pre-Miocene rocks and are unconformably overlain by Quaternary alluvium.

Quaternary Alluvium: The alluvial fan of Kızılırmak River constitutes Quaternary sediments. These sediments outcrop within banks of recent and old surface water courses and they are constitute beige, reddish sand, silt and clay intermixture.

Prior to construction works, geological features and engineering properties of the site have been surveyed through a course of geotechnical study and site reconnaissance. Findings that were obtained in the light of these studies are given in the following sections.

According to the site investigation studies and literature survey that covers scientific research concerning the project site, the risks of floods, landslides, snowslides and earthquake is low. There are no mineral resources and no mines in operation in the close vicinity of the project site.

Geotechnical Studies

Field studies were conducted based on the Technical Specification of Foundation Borings for Structures published by The Ministry of Public Works. During field works, 31 boreholes with 1049.34 m total depth were drilled between 01.06.2011- 10.07.2011. Borings were drilled by using two Acker, one Mobile Drill B-53 and one SoilMec PSM-8G pallet drilling machines.

Soil samples were extracted and in-situ tests were performed during the drilling works. In order to assess the consistency of the subsoil, Standard Penetration Tests (SPT) were performed and disturbed samples were taken in accordance with technical specifications. Also from clayey soil, undisturbed (UD) samples were taken by pushing the thin-walled samplers (Shelby tubes) into the soil by hydraulic pressure. In addition to SPT and UD samples, disturbed samples (D) were taken occasionally during the boreholes.

The soils encountered during drillings, observed standard penetration values, levels and properties of disturbed (SPT&D), undisturbed (UD) samples and rock samples were examined and detailed borehole logs were prepared.

Elevations, coordinates, depths, groundwater depth and groundwater elevation of the 31 boreholes conducted during the field studies at the project site are given in the table below.

Table 4-7 List of Elevations, Coordinates, Depths and Groundwater Levels of Boreholes

Borehole No	Elevation (m)	Coordinates		Depth (m)	Groundwater Depth (m)	Groundwater Elevation (m)
		Y	X			
BH-1	765.22	538602.40	4402741.20	40.10	-	-
BH-2	766.42	538587.48	4402750.48	40.50	-	-
BH-3	766.99	538584.36	4402766.65	33.00	-	-
BH-4	769.76	538551.29	4402758.21	40.90	-	-
BH-5	770.92	538538.01	4402775.28	40.70	-	-
BH-6	772.82	538523.49	4402780.13	40.95	-	-
BH-7	770.59	538540.34	4402744.30	40.00	- 33.00	737.59
BH-8	763.47	538632.01	4402794.37	30.45	-	-
BH-9	765.89	538614.61	4402806.91	30.45	- 25.00	740.89
BH-10	770.41	538582.99	4402818.00	30.45	- 26.00	744.41
BH-11	773.71	538548.41	4402829.61	30.29	- 18.00	755.71
BH-12	777.18	538510.18	4402845.46	40.50	- 22.50	754.68
BH-13	772.39	538590.82	4402863.57	30.25	- 18.50	753.89
BH-14	770.39	538614.19	4402854.74	30.45	- 22.50	747.89
BH-15	769.90	538620.29	4402851.19	30.45	- 16.00	753.90
BH-16	763.10	538686.88	4402831.70	30.45	- 22.50	740.60
BH-17	765.32	538590.13	4402713.06	30.45	-	-
BH-18	762.41	538678.65	4402801.82	30.45	-22.50	739.91
BH-19	777.59	538475.68	4402780.99	30.40	- 23.50	754.09
BH-20	782.19	538429.94	4402802.93	30.07	- 17.00	765.19
BH-21	781.54	538445.52	4402837.71	30.13	- 18.50	763.04
BH-22	782.35	538454.77	4402861.73	30.25	- 17.50	764.85
BH-23	786.86	538410.13	4402873.70	30.25	- 18.50	768.36
BH-24	788.16	538389.71	4402828.51	32.29	- 20.00	768.16
BH-25	793.78	538351.35	4402834.16	35.27	- 20.50	773.28
BH-26	793.48	538360.82	4402864.15	35.08	- 19.00	774.48
BH-27	792.20	538377.28	4402899.08	35.12	- 18.00	774.20
BH-28	804.84	538460.55	4403086.40	46.03	- 31.00	773.84
BH-29	781.71	538584.25	4403017.16	30.13	- 18.50	763.21
BH-30	776.33	538626.14	4402981.03	30.45	- 19.00	757.33
BH-31	773.86	538507.86	4402753.62	30.08	- 20.00	753.86

The groundwater levels obtained during drillings along the project site shows a heterogenic distribution. As it can be seen in the prepared geologic sections, groundwater has been observed at talus level, at contact between talus and altered granite and altered granite level. At some boreholes, groundwater could not be observed. Therefore, it can be assumed that groundwater can be found at deeper levels than those boreholes' have. Although groundwater elevations have showed heterogenic distribution, groundwater has been observed in sandy-gravelly units generally. The flow of groundwater is from slope to base of valley.

Foundation of the buildings will be seated higher than groundwater elevations; therefore, no negative effect of the groundwater on foundations is expected.

Standard Penetration Test (SPT)

For the determination of the stiffness and density of soil, Standard Penetration Tests (SPT) were performed in all the borings at each 1,50 m intervals, with a split spoon sampler, in accordance with ASTM D-1586 and equivalent Turkish Standards (TS-1901). Samples were put into double-nylon bag not to lose their moisture; they were labeled and sent to the laboratory for the tests.

Pressuremeter Tests

For the determination of pressure-deformation relationship of soil, pressuremeter tests have been done in 10 boreholes. During the pressuremeter tests, Menard GA type pressuremeter device has been used. Tests have been performed in BH-2, 4, 6, 9, 11, 14, 19, 24, 30 and 31 for each 3 meters. For every applied tests, change of limit pressure and pressuremeter module based on depth have been graphed for each pressure level; therefore, pressure vs. volume change graphs have been obtained.

Geophysical Investigations

During the project studies, six (6) PS Logging Tests and fifteen (15) Resistivity Measurements (Electric & Thermal) were undertaken.

PS Logging Study

The suspension PS logging method has gained acceptance in Japan and USA since the 1990s and being widely used for determining seismic velocities. Method based on the double sensors recording seismic waves with three axial geophones generated by the source which was lowered into borehole via armored suspension cable. Later these seismic recordings are processed and seismic velocities determined for each measuring level. Suspension P-wave and S-wave velocity (slowness) logging instrument is a lower frequency acoustic probe. It is exclusively possible to obtain high resolution P and S waves towards depths. Reliable P and S-wave velocities can be assessed down to depths which were almost impossible from surface methods. High resolution sampling, only one borehole requirement and no masking of velocity reversal are the basic superiority of the technique.

The system basically consisted of special design of powerful hammer and two different receiver mechanisms. The probe is lowered into the borehole to a specified depth where the source generates wave. 3D receivers record waves generated by the source. Data acquisition software has ability to employ different types of data gathering parameters and to make multiple shots. With this respect, wave velocities obtain for specified depths.

The PS Logging System is consisted of a probe, driver, a source and two receivers spaced 1 meter apart, filter tubes and cable components. The armored cable serves to lower the probe and pressure wave in borehole fluid generated by the source. The pressure wave is converted to seismic waves (P and S) at the borehole wall. Along the wall at each receiver location, the P and S (shear) waves are converted back to pressure waves in the fluid and received by the geophones, which send the data to the recorder on the surface. With this manner, P and S wave records collect

between desired depths. Field records are processed by special software for assessing velocities for each level.

The digital suspension PS logging system manufactured by Robertson Geologging (UK) is used in the project. Field data was collected with MLog data acquisition software and data processed with Glog-Sus by Robertson Geologging. PS logging tests are performed in six boreholes within the project framework. During the project, data collection interval was 0.5 m in PVC pipe cased boreholes.

Soil Resistivity

Soil resistivity studies were carried out at predetermined locations with Wenner electrode configuration. Electrode spacing (a) chosen varied between 0.5, 1.0, 3.0, 5.0, 10, 20 and 30 m spacing.

In practice, voltage is measured at the inner electrodes while current is applied between two outer electrodes. Material resistivity is calculated from the expression:

$$\rho = 2 \pi a R$$

where

ρ : resistivity (ohm.m, Ω m)

a : spacing of adjacent electrodes (m)

R : resistance (ohm, Ω)

Soil Corrosion Assessment

The composition of soil largely determines its resistivity. Earth resistivity is however essentially electrolytic in nature and is affected therefore by the moisture content of the soil and by the chemical composition and concentration of soluble salts within ground and connate water. Grain size and its distribution, as well as closeness of packing are additionally contributory factors. Many of these factors vary locally and even seasonally. Local values should be verified by measurements. It should also be noted that soil temperature has some effect, but is only important near and below freezing point. The resistance to earth of a given electrode depends upon the electrical resistivity of the soil in which it is installed. This factor may therefore be important in deciding which of many protective systems to adopt (BS 7430). In buried services, corrosion is a function of chemical composition of the ground and groundwater. Water corrosivity is related to salinity concentration of the groundwater. Therefore, an assessment of in situ ground corrosivity for buried services should be determined by means of pH and geophysical electrical methods.

In terms of soil corrosivity, in general, soils can be classified into three different groups.

These are:

- a) Very corrosive soils; such as peats, humic acid and sulphuric mineral soils.
- b) Medium corrosive soils; such as agricultural earth, clay, marl, clayey soils, shale,
- c) Less corrosive soils; such as sand and gravel, sandstone, conglomerate and limestone.

According to British Standards (BS 7430; Code of Practice For Earthing 1991) for mild steel corrosion, the following assessment of corrosivity is applied:

Table 4-8 Corrosivity Assessment

Resistivity (Ωm)	Soil Corrosivity	Graphics Code
$\rho < 7$	Affected	AF
$7 < \rho < 40$	Slightly Affected	SA
$\rho > 40$	Unaffected	UN

Calculated soil resistivities are given for each electrode spacings (a), i.e., 0.5, 1.0, 3.0, 5.0, 10, 20 and 30 m respectively. Obtained resistivity values are in ohm.m (Ωm). Figures were plotted displaying the corrosivity situation for each depth taking into account the above defined corrosivity classifications.

Field Measurements

In total twenty soil resistivity locations has been tested. Battery powered direct current type resistivity meter is used in the study called AGI R1 Resistivity IP meter. Current is applied via two outer electrodes and potential difference between other two inner electrodes is measured in practice. Original electrode spacings with associated resistivity depths are taken in combination of 0.5, 1.0, 3.0, 5.0, 10.0, 20.0 and 30.0 m. For corrosivity studies, generally, obtained resistivity value is appointed to the depth which is equivalent to actual electrode spacing.

Soil resistivities are calculated for each electrode spacing. Obtained resistivity values are in ohm.m (Ωm). The corrosivity situation is classified for each depth taking into account the above corrosivity classification.

Field measurements and corrosion assessment is conducted and most of the measurements fall in unaffected or slightly affected zones.

Thermal Resistivity

Totally 15 Thermal Resistivity tests have been done on June 6th, 2011 to determine the thermal conductivity of the soil in the project site. Experiment has been performed according to IEEE 442-1981 standards, and during the experiments MTNO1 system belonging to Hukseflux has been used.

Laboratory Tests And Analysis

The disturbed (SPT&D) and undisturbed (UD) samples taken from the boreholes were subjected to laboratory tests in TOKER Soil Mechanics Laboratory to determine the geotechnical properties of the subsoil in accordance with ASTM and TS-1900-1,2 (March, 2006) standards.

Determination of Index-Physical Properties of Soils

The samples were subjected to index properties tests for classification. Atterberg limits tests were performed for the classification of soil, and sieve analysis was performed for the determination of grain size distribution.

Determination of Mechanical Properties of Soils

In order to determine the shear strength parameters and deformation properties of the soils, laboratory tests were performed. Unconfined compression tests and unconsolidated-undrained triaxial compression test (UU) were performed on undisturbed (UD) samples in order to determine the shear strength parameters. Unconfined compression tests were performed on 4 samples, unconsolidated-undrained triaxial compression test (UU) were performed on 2 samples. Consolidation tests have been performed on 12 undisturbed (UD) samples in order to determine the deformation parameters of the soil layers.

Conclusions & Recommendations

Geotechnical investigations and evaluations (including boreholes, insitu and laboratory test results) are conducted for İç Anadolu Natural Gas Combined Cycle Power Plant that will be constructed in Kırıkkale.

During field works, 31 boreholes were drilled. General soil profile at project site consists of Talus starting from surface or beneath the rarely observed non-homogenous top fill (thickness varies within 0.30 1.20m) underlain by Altered Granite or Unconsolidated Claystone.

Structures that are planned to be built within the proposed plant could be investigated in two parts. These are "Equipment Structures" and "Buildings & Other Structures". The properties of the equipment structures (type&size of foundations, approximate pressures that will be transmitted from the structure to base soil via foundations etc.) are tabulated in proceeding tables below. The approximate dimensions of structures, recommended foundation types and assumed foundation base levels for buildings & other structures are given in the proceeding tables below.

Basic assumptions in the evaluations of the foundations and the loads are;

- Self-weight of the foundations are added to structural loads given in technical specifications while calculating the foundation pressures in static case for equipment buildings.
- In the calculation assumption of seismic design loads for equipment buildings, structural loads given in technical specifications are increased by 50% as a conservative approach and self-weight of the foundation is added to this increased load.

- Final grading levels of project site as given by the project contractor are

Power Island $\pm 0.00 = 775.00\text{m}$,

Switchyard $\pm 0.00 = 780.00\text{m}$

- Approximate elevations of foundation bases are obtained by subtracting foundation thicknesses from the final grading level for equipment structures and by subtracting the foundation depth which is assumed to be as 1.50 m from the grading level for buildings & other structures.

Equipment Structures

Table 4-9 The Properties of the Equipment Structures

Structure No (in accordance with legend no.s in layout)	Structure Name	Foundation Type	Foundation Dimensions (LxBxH)	Approximate Foundation Base Level	Approximate Pressure Transferred to Soil (Static) (kPa)	Approximate Pressure Transferred to Soil (Seismic) (kPa)
1	GT-GEN Pedestal	Mat	36x10x3	772.00	225	300
1	ST-GEN Pedestal	Mat	39x16x3	772.00	225	300
3	HRSG	Mat	25x4x1.5 (x2)	773.50	135-185	185-260
4	Stack	Mat	12x12x2	773.00	170	230
19-20	GT/ST Main Trans.	Mat	25x23x0.6	774.40	105	150
7	Main Pipe Rack	Single	3x3x1.5	773.50	185-285	260-410
12	Auxiliary Pipe Rack					
68	Demineraliz ed Water Tank	Mat / Ring Foundation	D=10.50	774.00	125	175
71	Raw Water Tank		D=10.00			
72	Service and Fire Water Tank		D=12.60			

Buildings & Other Structures

The approximate dimensions of structures, recommended foundation types and assumed foundation base levels for buildings & other structures are given in the proceeding tables below.

Table 4-10 The Properties of the Buildings & Other Structures

Structure No	Structure Name	Recommended Foundation Types	Approximate Structure Dimensions (BxL),m	Assumed Foundation Base Level
1	Turbine Building	Single	30.0x 52.0	773.5
2	Electrical Building	Continuous	18.2 x 32.8	773.5
5	Feed Water Pump House	Continuous	13.0 x 16.0	773.5
9	Warehouse and Workshop Building	Continuous	14.7 x 45.0	773.5
10	CCR Building with Administrative F.	Continuous	12.0 x 24.5	773.5
24	Air Cooled Condenser	Mat	41.0 x 93.5	773.5
25	ACC Elec. And Auxiliary Services B.	Continuous	12.0 x 29.0	773.5
26	Fin Fan Cooler	Mat	13.0 x 27.0	773.5
37	Fuel Gas Performance Heater Area	Continuous	10.0 x 26.0	773.5
39	Sewage Treatment Plant	Mat	5.0 x 5.0	773.5
41	Hydrogen Storage Facility	Mat	3.5 x 6.0	773.5
50	Auxiliary Steam Boiler	Continuous	14.0 x 25.0	773.5
55	Hazardous Waste Storage Area	Mat	4.0 x 9.0	773.5
56	Grease and Gases Warehouse	Continuous	8.0 x 9.5	773.5
57	Hazardous Materials Storage Area	Continuous	7.0 x 8.0	773.5
58	Condensate Storage Tank	Mat	D=5.40	773.5
59	Equalisiton Basin	Mat	5.0 x 11.5	773.5
61	Transformer Area Oil Pit and Seperator	Mat	2.6 x 8.0	773.5
65	Pretreatment and Water Treatment B.	Continuous	14.0 x 24.0	773.5
66	Fire Water Pump	Continuous	8.0 x 14.0	773.5

	House			
74	Attenuation Pond	Mat	12.0 x 20.0	773.5
80	Gatehouse	Continuous	4.50 x 5.60	773.5
87	Switchyard Control Building	Continuous	11.0 x 18.5	778.5

Final grading level of the Natural Gas Combined Cycle Power Plant Site is assumed as $\pm 0.00 = 775.00\text{m}$ for Power Island and $\pm 0.00 = 780.00\text{m}$ for Switchyard. Existing ground elevation of area where Power Island is planned to be built on varies between 760.0 to 780.0, and area where Switchyard is planned to be built varies between 778.0 to 795.0. In this case, fills and excavations will be required along the site. Thickness of fill to be placed will be 0.5 to 15.0m for Power Island area and 0.5 to 2.0 m for Switchyard. In addition, excavations will be performed at depths of 0.5 to 5.0 m for Power Island and 0.5 to 15.0m for Switchyard. All fills will be placed in steps (stair shaped) at ground contact zone (height of each stair is recommended as 60cm) due to the sloped topography of the site. Fill body will be placed in layers from bottom to top with a minimum 2.5m flat base at tailing part. Fills will be compacted with vibrating cylinder in layers of 30 cm thick. Two alternatives could be suggested for the fill material:

Structural Fill

Structural fill being suggested for any kind of rigid lining that is sensitive to settlement should have the following properties; well graded, mix of A1 and A3 group soils (stone particles, gravel, sand, fine sand) (according to AASHTO Soil Classification System) or plantmix material that is well graded in the range of 0-25mm. In any case, fill material should be basically granular material or crushed stone that has fine content (0.075mm passing from (No:200)) $F < 12\%$ and plasticity index $PI < 6$. Fill will be placed by at most 25-30cm thick layers and compacted in optimum moisture content with vibrating cylinders to achieve minimum 98% proctor compactness.

Site Fill

Fill material that is proposed for cases having no sensitivity for settlements such as roads, landscaping purposes, green fields, backfills etc. should be granular material or scoria based that is as well graded as possible and has fine content (0.075mm passing from (No:200)) $F < 15\%$ and liquid limit $LL < 30$. Fill will be formed by 25-30cm thick layers and compacted in optimum moisture content with the vibrating cylinders to achieve minimum 95% proctor compactness.

Design and selection of fill material could be revised according to local conditions.

Foundations of equipment structures could not properly be seated directly on structural fill or Talus below without taking any precautions considering structural loads, settlement (25.00mm) and differential settlement limits. Therefore, ground improvement and deep foundation methods have been studied. As a result, the most suitable foundation type for equipment structures is chosen as using deep piles (bored) with diameter $\phi 80\text{cm}$.

Pile properties belong to the Equipment Structures are presented in the table below.

Table 4-11 Pile Properties of Equipment Structures

Structure Name	Pile Properties				Allowable Bearing Capacity of Pile Qall, kN
	Upper Level (m)	Length, L (m)	Diameter, D (m)	Grid (mxm)	
GT-GEN Pedastal	772.00	23.0	0.8	2.5x2.5	1982
ST-GEN Pedastal	772.00	23.0	0.8	2.5x2.5	1982
HRSG	773.50	25.0	0.8	2.5x2.5	1820
Stack	773.00	23.5	0.8	2.5x2.5	1680
GT/ST Main Transformers	774.40	17.0	0.8	3.0x3.0	1488
Main Pipe Rack	773.50	22.0	0.8	2.2x2.2**	1726
Auxiliary Pipe Rack		25.0			1689
Demineralized Water Tank	774.00	14.0	0.8	2.5x2.5	1271
Raw Water Tank		19.5			1271
Service and Fire Water Tank		22.0			1293

Settlements under the loads transferred to the piles (seismic condition) are presented in the table below:

Table 4-12 Settlements Under the Loads Transferred to the Piles

Structure Name	Load Transferred to Pile (Q, kN)	Settlements, s (mm)	
		Burland & Burbidge (1985)	Pressuremeter Test Results
GT-GEN Pedastal	1875	23.80	10.53
ST-GEN Pedastal	1875	33.77	14.49
HRSG	1625	23.35	7.49
Stack	1438	23.08	11.26
GT/ST Main Transformers	1350	16.03	7.30
Main Pipe Rack	1621	2.57	1.27
Auxiliary Pipe Rack		6.26	2.17
Demineralized Water Tank	1094	9.95	4.28
Raw Water Tank		16.53	4.48
Service and Fire Water Tank		16.08	5.39

Expected mean settlements for piles under the estimated superstructure loads are in the allowable limits given by technical specification ($s \leq 25\text{mm}$). Therefore, no settlement problem is expected for the piles.

For all Equipment Structures, vertical modulus of subgrade reaction, that can be used to model piles (at the pile tip) in the foundation analyses are tabulated below:

Table 4-13 Vertical Modulus of Subgrade Reaction for All Equipment Structures

Structure No	Structure Name	Vertical Modulus of Subgrade Reaction, k_v (kN/m)
1	GT-GEN Pedastal	77500
1	ST-GEN Pedastal	55000
3	HRSG	70000
4	Stack	62500
19-20	GT/ST Main Trans.	82500
7	Main Pipe Rack	500000
12	Auxiliary Pipe Rack	200000
68	Demineralized Water Tank	100000
71	Raw Water Tank	65000
72	Service and Fire Water Tank	67500

Horizontal modulus of subgrade reactions that could be used in pile design for a pile with $B=0.80\text{m}$ are tabulated in the table below:

Table 4-14 Horizontal Modulus of Subgrade Reactions for All Equipment Structures

Str. No	SOIL	Structural Fill		Talus 1		Talus 2	
	Str. No	Elevation	Horizontal Modulus Of Subgrade Reaction K_h (Kn/M3)	Elevation	Horizontal Modulus Of Subgrade Reaction K_h (Kn/M3)	Elevation	Horizontal Modulus Of Subgrade Reaction K_h (Kn/M3)
1	GT-GEN Pedastal	772>z>768	12500*z	768>z>759	6250*z	759>z>749	12500*z
1	ST-GEN Pedastal	772>z>768		768>z>759		759>z>749	

3	HRSG	773.5>z>765.5		765.5>z>750		750>z>+748.5	
4	Stack	773>z>764.5		764.5>z>750		750>z>749.5	
19-20	GT/ST Main Trans.	-		774.4>z>762		762>z>757.5	
7	Main Pipe Rack	773.5>z>768		768>z>760		760>z>751.5	
12	Auxiliary Pipe Rack	773.5>z>765.5		765.5>z>748.5		-	
68	Demineralized Water Tank	774>z>773		773>z>767		767>z>760	
71	Raw Water Tank	774>z>766		766>z>754.5		-	
72	Service and Fire Water Tank	774>z>760.5		760.5>z>754		754>z>752	

As a result of the sloped topography of the site, both fills and excavations will be required for structures to be seated on final grading levels ($\pm 0.00=775.00\text{m}$ for Power Island and $\pm 0.00=780.00\text{m}$ for Switchyard). In this case, Buildings & Other Structures could be classified in two parts. These are namely "Buildings & Other Structures that will be seated on Structural Fill" and "Buildings & Other Structures that will be seated on natural ground".

In areas where existing ground elevations are lower than final grading levels of the site, structural fill is required to be placed. Local specific excavations for foundations of some Buildings & Other Structures will be needed in order to remove the heterogeneous top fill and/or loose Talus 1 layer and also in order to balance the differences in fill thickness beneath the foundations to minimize possible differential settlement. Such type of structures and ground levels before and after the special scraping excavations are presented in the table below.

Table 4-15 Type of Structures and Ground Levels Before and After the Special Scraping Excavations

Str No	Structure Name	Approx. Minimum Existing Ground Level	Approx. Maximum Existing Ground Level	After special stripping Excavation		Structural Fill thicknesses beneath the Foundation (min-max)	Foundation Base Elevation
				Approx. Minimum Grading Level	Approx. Maximum Grading Level		
1	Turbine Building	768.00	773.50	767.00 (1.0m)*	771.00 (2.5m)	2.5 – 6.5	773.50
2	Electrical Building	771.70	776.00	770.70 (1.0m)	772.00 (4.0m)	1.5 – 2.8	773.50
24	Air Cooled Condenser	765.50	775.50	764.50 (1.0m)	771.50 (4.0m)	2.0 – 9.0	773.50
25	ACC Elec. And Auxiliary Services B.	769.00	772.00	766.50 (2.5m)	769.00 (3.0m)	4.5 – 7.0	773.50
59	Equalisiton Basin	764.50	765.50	763.00 (1.5m)	764.00 (1.5m)	9.5 – 10.5	773.50
65	Pretreatment and Water Treatment B.	768.50	771.00	767.00 (1.5m)	769.50 (1.5m)	4.0 – 6.5	773.50
74	Attenuation Pond	763.50	764.50	762.00 (1.5m)	763.00 (1.5m)	10.5 -11.5	773.50

Rest of the Buildings&Other Structures to be seated on Structural Fill require a top soil removal of minimum 0.5 m due to possible loose top layers of fill or natural ground (Talus). Max&min ground elevations before and after top soil removal are presented in table below:

Table 4-16 Type of Structures and Ground Levels Before and After 0.5 m Excavations

Str No	Structure Name	Approx. Minimum Existing Ground Level	Approx. Maximum Existing Ground Level	After 0.5 Excavation		Structural Fill thicknesses beneath the Foundation (min-max)	Foundation Base Elevation
				Approx. Minimum Grading Level	Approx. Maximum Grading Level		
5	Feed Water Pump House	766.30	767.50	765.80	767.00	6.5 – 7.7	773.50
10	CCR Building with Administrative F.	760.80	763.00	760.30	762.50	11.0 – 13.2	773.50
37	Fuel Gas Performance Heater Area	766.00	768.50	765.50	768.00	5.5 – 8.0	773.50
39	Sewage Treatment Plant	759.80	760.50	759.30	760.00	13.5 – 14.2	773.50
50	Auxiliary Steam Boiler	764.00	766.00	763.50	765.50	8.0 -10.0	773.50
55	Hazardous Waste Storage Area	764.00	765.00	763.50	764.50	9.0 – 10.0	773.50
66	Fire Water Pump House	762.50	764.00	762.00	763.50	10.0 – 11.5	773.50
80	Gatehouse	760.00	761.00	759.50	760.50	13.0 – 14.0	773.50

Net and total allowable bearing capacities of all Buildings & Other Structures are presented in the table below:

Table 4-17 Net and Total Allowable Bearing Capacities of All Buildings & Other Structures

Structure No	Structure Name	Recommended Foundation		Net Allowable Bearing Capacity q _{nem} (kPa)	Total Allowable Bearing Capacity q _{em} (kPa)
		Types	Width, B(m)		
1	Turbine Building	Single	3.00x3.00	150	
2	Electrical Building	Continuous	2.00	150	
5	Feed Water Pump	Continuous	1.50	150	

	House				
9	Warehouse and Workshop Building	Continuous	1.50	125	175
10	CCR Building with Administrative F.	Continuous	1.50	150	
24	Air Cooled Condenser	Mat	41.0x93.5	50	
25	ACC Elec. And Auxiliary Services B.	Continuous	1.50	150	
26	Fin Fan Cooler	Mat	13.0x27.0	175	195
37	Fuel Gas Performance Heater Area	Continuous	1.50	150	
39	Sewage Treatment Plant	Mat	5.00x5.00	150	
41	Hydrogen Storage Facility	Mat	3.5x6.0	150	170
50	Auxiliary Steam Boiler	Continuous	1.50	150	
55	Hazardous Waste Storage Area	Mat	4x9	150	
56	Grease and Gases Warehouse	Continuous	1.5	150	190
57	Hazardous Materials Storage	Continuous	1.5	150	200
58	Condensate Storage Tank	Mat	D=5.4	150	
59	Equalisiton Basin	Mat	5x11.5	150	
61	Transformer Area Oil Pit and Seperator	Mat	2.5x8.0	100	150
65	Pretreatment and Water Treatment B.	Continuous	1.50	150	
66	Fire Water Pump House	Continuous	1.50	150	
74	Attenuation Pond	Mat	12x20	110	
80	Gatehouse	Continuous	1.00	150	
87	Switchyard Control Building	Continuous	1.5	175	

Settlements are calculated under allowable bearing pressures. Vertical subgrade reaction modulus that will be used in foundation design and settlements under allowable bearing pressures are summarized in the table below:

Table 4-18 Vertical Subgrade Reaction Modulus That Will Be Used in Foundation Design and Settlements Under Allowable Bearing Pressures

Structure No	Structure Name	Settlement (mm)	Vertical Modulus of Subgrade Reaction, kv (kN/m3)
1	Turbine Building	10.5	14000
2	Electrical Building	25.5	6000
5	Feed Water Pump House	9.5	15500
9	Warehouse and Workshop Building	14.8	11500
10	CCR Building with Administrative F.	10.8	13500
24	Air Cooled Condenser	50.0	1000
25	ACC Elec. And Auxiliary Services B.	11.3	13000
26	Fin Fan Cooler	35.2	5500
37	Fuel Gas Performance Heater Area	10.9	13500
39	Sewage Treatment Plant	13.9	10500
41	Hydrogen Storage Facility	20.8	8000
50	Auxiliary Steam Boiler	10.8	13500
55	Hazardous Waste Storage Area	15.3	9500
56	Grease and Gases Warehouse	16.7	11000
57	Hazardous Materials Storage	16.4	12000
58	Condensate Storage Tank	31.1	4750
59	Equalisiton Basin	19.1	7500
61	Transformer Area Oil Pit and Seperator	30.2	4750
65	Pretreatment and Water Treatment B.	10.7	13500
66	Fire Water Pump House	9.3	16000
74	Attenuation Pond	50.0	2200
80	Gatehouse	5.3	28000
87	Switchyard Control Building	9.9	17500

- Recommended allowable bearing capacities and settlements under these allowable bearing pressures will be checked under each structural foundation by plate load tests after the placement of Structural Fill.

- Groundwater table is not encountered in boreholes BH-1, BH-2, BH-3, BH-4, BH-5, BH-6, BH-8 and BH-17. In other boreholes, groundwater level is observed in a depth varying between 16.00-33.00 m from the surface. Granular soils are dominant through the site. Considering that dominant soil formation is mostly dense to very dense below the groundwater level and medium dense soils are located above the groundwater table, liquefaction and/or lateral spreading problem is not expected in the site.

- Dominant soil formation is composed of granular materials through the construction site and this type of soils do not have swelling potential. In addition, consolidation tests on few undisturbed

samples indicate that interbedded clay layers rarely encountered in soil profile also do not have swelling potential. Therefore, swelling problems are not expected in the site.

- In the scope of Central Anatolia Natural Gas Combined Cycle Power Plant, excavations will be required in a depth varying between 0.5-15.0m. Considering site soil characteristics and recommended slope of excavations in Technical Specification of State of Highways for soils having similar properties, permanent slopes could be formed with H:V = 1:1 and temporary slopes H:V = 2:3. In addition, for slopes higher than 10m, a crest of minimum 3 m width will be formed.

4.5.3 Seismicity

Central Kırıkkale Province and its south where the project site is located are included in the 1st degree earthquake zone according to the earthquake risk map prepared by General Directorate of Disaster Affairs (Figure 4-20). According to the same reference map, the northern sections of the province are defined as the 2nd and 3rd degree earthquake risk zones. These facts indicate that the proposed project site is included to a tectonically active zone. The two important faults that are located in the close vicinity of the project site are namely, Kırşehir Keskin Fault and Ezinepazarı-Kırıkkale Fault. In addition to these two faults, there is a system of trike slip faults extending 10 km in Bala region, in the south west of the project site (MTA, 2005). North Anatolian Fault which is one of Turkey's greatest fault zones is approximately 134 km to the project site.

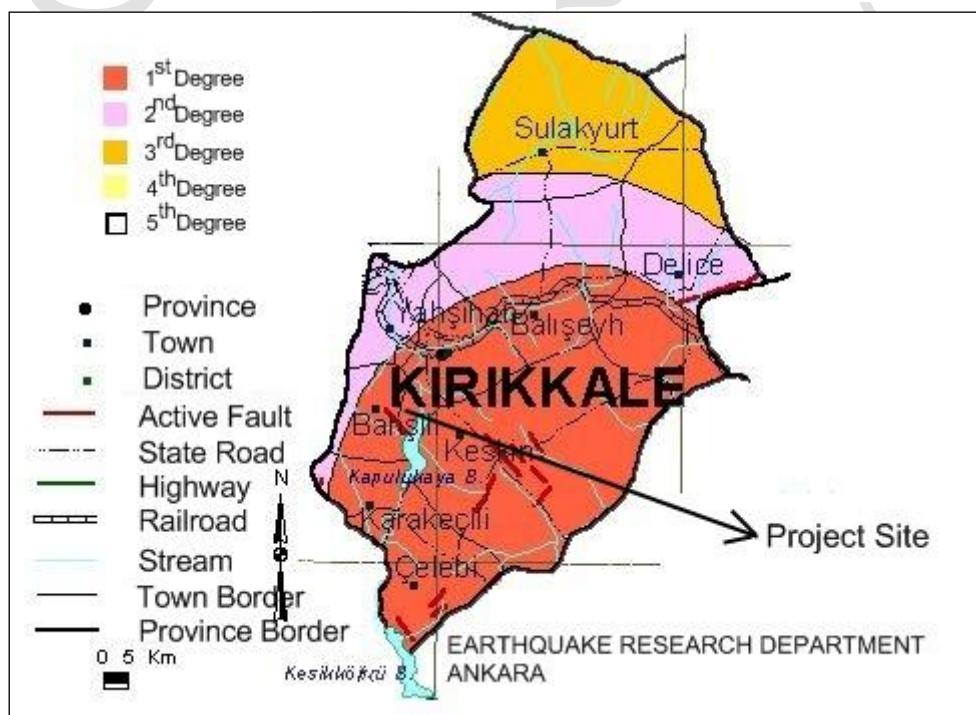


Figure 4-20 Kırıkkale Province Earthquake Zones (General Directorate of Disaster Affairs, 1998)

Upon the records of Kandilli and USGS earthquake monitoring departments, the earthquakes have magnitudes between 4 and 5.9 in the region. The distribution and magnitude map of the earthquakes that have occurred between the years 1900 and 2008 are given in Figure 4-21.

According to Disaster Guide of Year 1998, the effective peak ground acceleration of 1st degree earthquake zones are given as; $A_0 = 0.40g$.

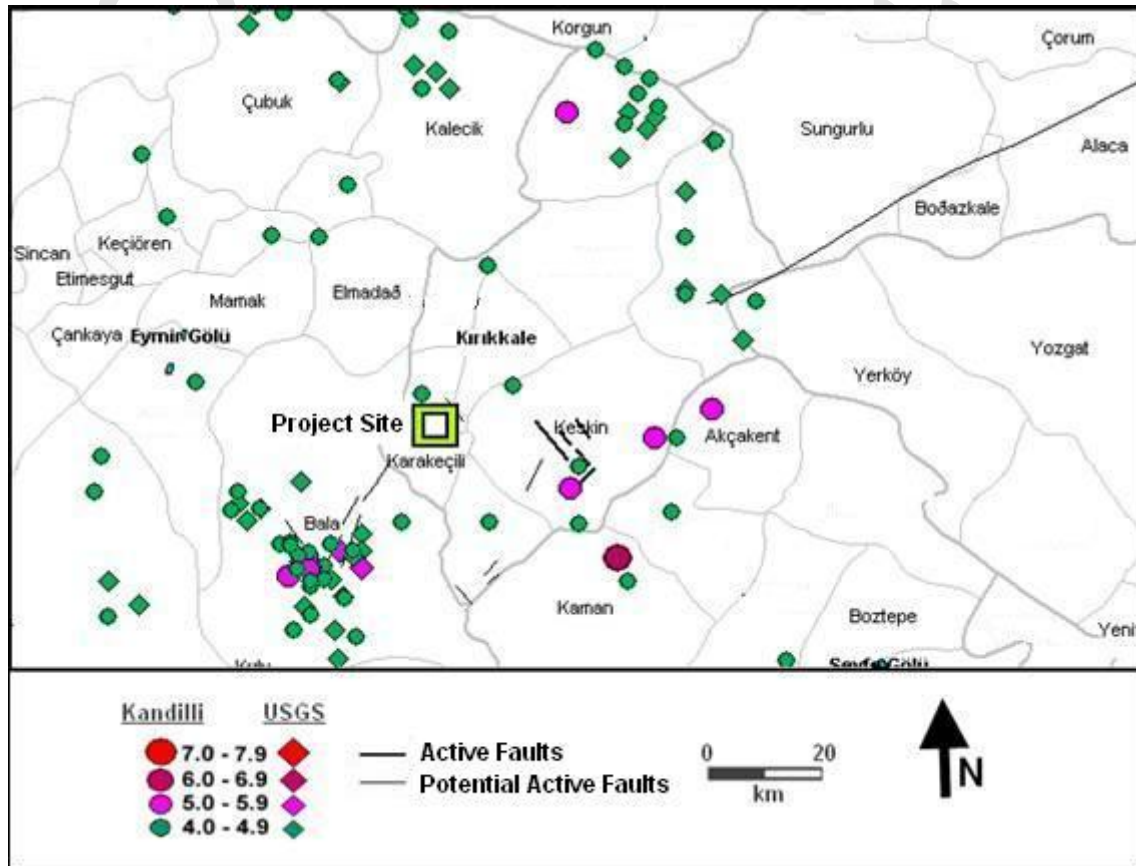


Figure 4-21 Major Earthquakes and Faults around Project Site

The project site is included in the North Anatolian Fault (NAF) Zone. North Anatolian Fault is one of the most energetic earthquake zones in the world. This active, right lateral-moving strike-slip major fault in northern Anatolia runs about 1000 km along the transform boundary between the Eurasian Plate and the Anatolian Plate, starting from Karlıova district in the east and extends to Mudurnu Valley in the west. There have been seven earthquakes with the magnitude greater than 7 on Richter scale within the 20th Century concerned with the NAF zone. The latest disastrous earthquakes occurred in 1999 on this zone are İzmit and Düzce earthquakes with the magnitudes 7.4 and 7.2, respectively. The proposed project site is located approximately 134 km to the NAF zone.

Another major active fault is Kırşehir Keskin Fault System which constitutes two components that run in the directions of northwest-southeast and northeast-southwest interruptedly. An earthquake concerned with this system has occurred in 1938 with the magnitude of 6.8 Richter scale. This fault system is about 16-20 km to the proposed project site.

The recent earthquakes with the magnitude 5 or greater on Richter scale are given in the table below.

Table 4-19 Earthquakes with the Magnitude 5 within Project Site

Date	Magnitude (Richter Scale)	Depth (km)	Co-Ordinates of the Epicenter
04.10.1928	5.7	10	40.22° N, 33.67° E
09.04.1930	5	0	39.70° N, 34.00° E
19.04.1938	6.6	10	39.44° N, 33.79° E
19.04.1938	5	30	39.65° N, 33.87° E.
21.07.1938	5	10	39.56° N, 33.68° E.
30.07.2005	5.3	5	39.44° N, 33.09° E.
20.12.2007	5.7	5	39.40° N, 33.05° E.
26.12.2007	5.5	5	39.42° N, 33.09° E.

In addition to the literature survey, an earthquake risk analysis has been conducted by AECOM in order to determine the seismicity and tectonic properties of the site. The brief explanation about the earthquake risk analysis is given below.

Seismicity Risk Analysis

In the case of major projects such as dams, power plants, tunnels and roads, a seismicity risk analysis can be referred to validate the final geotechnical status of the site where project buildings are planned to be built. The forces that act on structures in case of earthquakes depend on dynamic characteristics of the buildings, ground conditions and mass of the structures. Therefore the design of the project structures should be accomplished in accordance with earthquake engineering analyses.

The purpose of the earthquake engineering research is to determine earthquake-induced effects, make hazard and risk assessment and establish earthquake resistant design. Probabilistic methods and deterministic analysis are developed in order to assess earthquake related risks and estimate damage.

In order to determine the future maximum horizontal ground acceleration on bedrock, primarily, data records of the period 1900-2009 are obtained from the USGS and Boğaziçi University seismicity research departments. In the second phase of the research, a seismotectonic map has been prepared by correlating the seismological data and active tectonic characteristics of the site. Two linear and two areal sources have been defined in the seismotectonic map which is given in Figure 4-22.

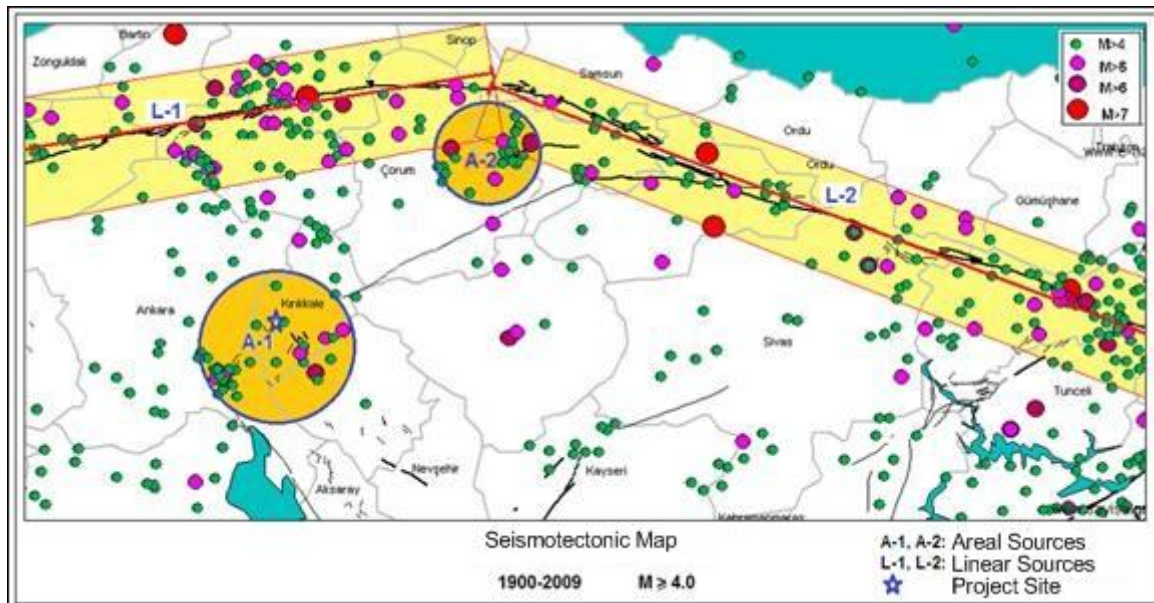


Figure 4-22 Seismotectonic Map Including the Project Site

A computer software that uses poisson probability theory has been utilized for risk analysis calculations. The ground acceleration values are obtained by introduction of point and areal sources of earthquake and energy attenuation correlation coefficients. Earthquake risk analysis results of the subject research are given in Table 4-20 and the explanations of the symbols are given below.

M_0 = The greatest magnitude of the earthquake occurred within source.

M_1 = The greatest magnitude of expected earthquake within source.

H_{avg} = Average epicenter depth.

Table 4-20 Earthquake Risk Analyses Results

Source (given in Figure 4-24)	M_0	M_1	H_{av} (km)
A-1	6.6	7.5	16
A-2	6.0	6.2	10
L-1	7.2	8.2	21
L-2	7.9	8.5	30

Earthquake Source Points

The main sources of earthquake are defined as A-1, A-2, L-1 and L-2 in the seismotectonic map. (See Figure 4-22).

Earthquake Resistant Design

The statistical earthquake magnitudes that were referred for the appropriate engineering design of earthquake resistant buildings are Maximum Design Earthquake, Operating Basis Earthquake and Maximum Credible Earthquake. The explanations of abovementioned earthquake categories are given below.

Maximum Credible Earthquake (MCE): The largest earthquake associated with a specific seismotectonic structure or source area within the region examined is called maximum credible earthquake. This statistical value is the magnitude with the probability of exceeding the value of anticipated ground acceleration by 10% within 50 year economic life of the project. The cycle period is taken as 475 within concerned calculations.

Operating Basis Earthquake (OBE): The earthquake(s) for which the structure is designed to resist and remain operational is called operating basis earthquake. It reflects the level of earthquake protection desired for operational or economic reasons and may be determined on a probabilistic basis considering the regional and local geology and seismology.

Maximum Design Earthquake (MDE): The maximum design earthquake (MDE) is the level of ground motion at the site of a structure selected as the basis for an engineering analysis. Selection of the MDE may take many factors into account, including observed local earthquake frequency and intensity, the importance and life expectancy of a structure, hazard to life and property, political considerations, and economic constraints. For a critical structure, the MDE is the same as an MCE and must be obtained by a deterministic procedure, but it must be done with agreement between the geologist-seismologist, the engineer, and the owner. The decision is that of the owner (Krintinsky, 2002).

Conclusion

A probabilistic seismic hazard assessment of the region is completed for the project site which is located 11.5 km to the southwest of the Kırıkkale Province. For further evaluation and comprehension, a deterministic assessment research concerning earthquake risk is also accomplished.

Considering the location of the project site which included to the 1st degree earthquake zone of the seismicity map of Kırıkkale and the fault zones that are present in the close vicinity, the outcomes and recommendations are distilled as follows.

MDE value: **294.7 cm/s² (0.30 g)** greatest ground acceleration (in regard with 475 year period)

OBE value: **157.1 cm/s² (0.16 g)** maximum ground acceleration (in regard with 144 year period)

MCE value: **M=7.5** on Richter Scale

Horizontal Seismic Coefficient: **k=0.18**

According to Eurocode8 (2002) – EC 8 which is a prescriptive code, implementing a set of principles and rules to be satisfied in order to meet compliance of the structural performance with the code requirements, a two phase evaluation concerning short term and long term of ground acceleration is accomplished. The results of two phase evaluation are given below.

1. Phase seismic design for 475 year cycle period

$$a = 294.7 \text{ cm/s}^2 (0.30 \text{ g})$$

2. Phase seismic design for 95 year cycle period

$$a = 129.3 \text{ cm/s}^2 (0.131 \text{ g})$$

The calculated ground acceleration value of the 1st Phase is lower but the 2nd Phase of the ground acceleration value is greater when compared to the values of seismic disaster map of Turkey which is prepared by the USGS (Figure 4-23).

Project units will be designed in accordance with the Codes of Regulations on Disaster Resistant Construction.

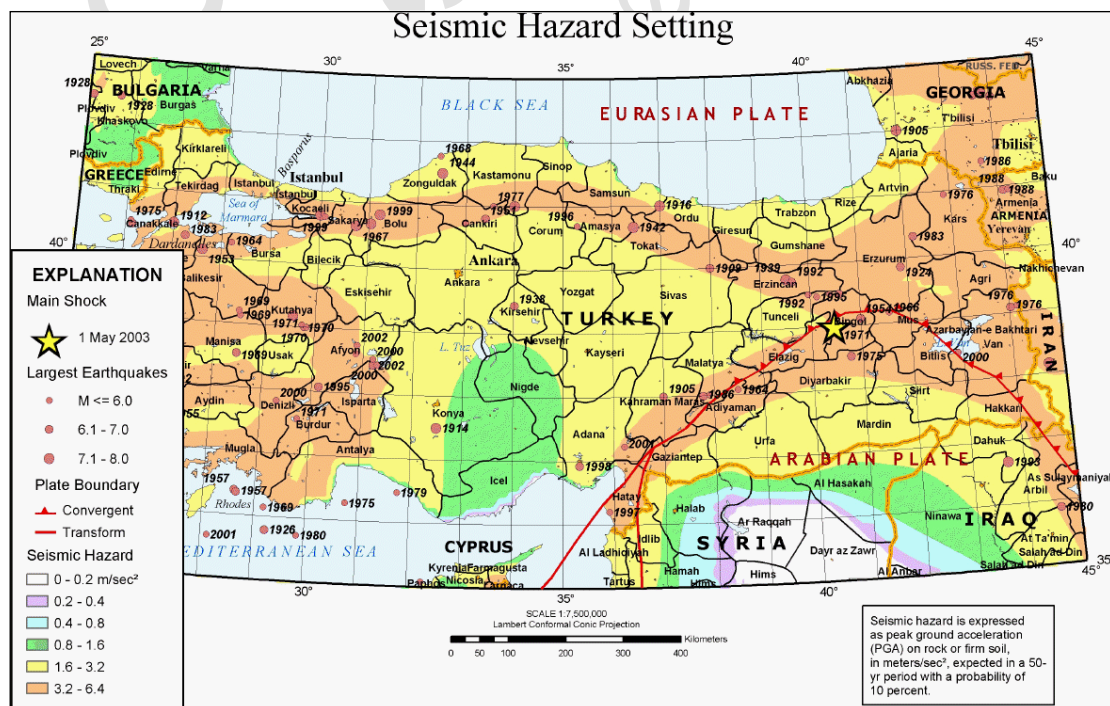


Figure 4-23 Seismic Risk Map of Turkey (USGS, 2003)

4.6 Hydrogeology and Hydrology

4.6.1 Hydrogeology

Aquifer Structures

As mentioned before the project site is located in Kırıkkale Province which includes the Central Anatolia Kızılırmak Basin. The formations which have aquifer properties are alluvium and sedimentary units like sand, gravel sandstone and conglomerates of Neocene.

Alluvium: These sedimentary units are deposited throughout beds and bankments of water courses. They are mainly comprised of gravels, sand and clay. Since it resembles the upper layers of Central Anatolian Group therefore it is occasionally hard to distinguish alluvium from Neocene formations. It is known from the earlier State Hydraulic Works' researches, the thickness of alluvium reaches up to 60 m in the close vicinity of the project site.

Central Anatolia Group (Ti); Central Anatolian Group of Neocene age comprises high porosity units of gravels, sand and clay and sandstone and conglomerates units with relatively low porosity. According to the researches on these structures with aquifer properties, it was recorded that the units with relatively high porosity constitute the upper layers. Neocene aged Central Anatolian Group is represented with only upper layers of it in the western part of Kızılırmak Basin where the project site is located.

The layers of Central Anatolian Group which are in contact with the alluvium are observed in high lands and they recharge alluvium with lateral flow. On low land plains these two units combine and comprise an unconfined aquifer. The thicknesses of the water bearing units reach up to 100 m. According to the pumping test results that was conducted within this aquifer unit in 6633-a well, the value of hydraulic conductivity was found 6.4×10^{-7} m/s (State Hydraulic Works, 1977)

The groundwater level was observed to be 1 m bgl within bankments of Kızılırmak River. The depth of groundwater level increases as one gets farther away from river course. The groundwater level is measured as 7 m bgl in Hacılar Village. However, groundwater has not been encountered within 20 m deep geotechnical boreholes that were installed at the project site. The groundwater flow direction is concurrent with the surface flow of Kızılırmak River from high lands to the river course. The average hydraulic gradient is about 0.008 in alluvium/ Neocene aquifer structure within lowland plain basins (State Hydraulic Works, 1977).

Kırıkkale Province receives the most precipitation in March, April and May. Groundwater levels rise within the same period of abundant precipitation or within a month of delay. Correlatively groundwater levels fall within arid reasons. Groundwater levels are also dependent upon surface water flow rate. It is observed that the thickness of saturated layer increases with increased rate of surface water discharge. There is an interrelation with precipitation groundwater and surface water courses. Groundwater bearing units receive direct recharge from precipitation and groundwater flows into surface water.

There are many production wells within Kızılırmak Basin which are mainly used for irrigation. The eastern section of the basin was surveyed for water management by State Hydraulic Works and the average sustainable yield was determined as 25 l/s through exploration wells.

The nearest production well (6634-a) which was installed by State Hydraulic Works is 2 km to the project site. This well is on alluvium formation and has a sustainable yield of 0.2 l/s. A deeper production well (6634-b) which has a depth of 218 m bgl has a sustainable yield of 4 l/s (State Hydraulic Works, 1977).

The groundwater supply is utilized for irrigation in the close vicinity of Kızılırmak River and its tributaries within Kızılırmak Basin. Groundwater is not widely used in the close vicinity of the project site. However, groundwater is used for the irrigation of the orchards in Hacılar Village which is the closest residential area to the project site.

The analytical results of water samples which were taken from three production wells, closest to the project site are given below in Table 4-21. According to these results, the salinity and total hardness within TPAO named production well within the property of Tüpraş oil refinery, are relatively high. The locations of the production wells are given in Figure 4-24.

Table 4-21 Analytical Results of the Production Wells (DSI, 2001)

Well ID	TPAO	Dam	Gun Powder Mill.
East (UTM ED50 Zone 36)	540.150	541.520	540.270
North (UTM ED50 Zone 36)	4.393.100	4.398.607	4.405.600
Date of Start	6/26/1993	5/18/1977	7/12/1965
EC (Microhm/cm)	1344	370	760
pH	8.18	7.7	7.4
Sodium (meq/l)	5.43	1.32	2.6
Potassium (meq/l)	0.07	0.05	0.11
Carbonate (meq/l)	0.44	0	0
Hydrocarbonate (meq/l)	2.75	2.4	3.3
Chloride (meq/l)	5.28	0.92	1.24
Sulphate (meq/l)	5.53	1.05	3.27
Sodium Percentage (%)	39.285	31.35	33.29
Hardness (Fs)	42.5	15	25.5
Nitrite (mg/l)	0	0	Not Detected
Ammonia (mg/l)	0	0	Trace
Organic Substance (mg/l)	1.2	0.8	2.08
Boron (mg/l)		0.1	
SAR	2.633	1.077	1.63
Total Salinity	860	236	
Depth (m)	-	-	27

There are six springs which have discharge rates greater than 1 l/s in Kızılırmak Basin. All of these springs are formed with the rising groundwater table within alluvium. In this basin the springs issue

from points where phreatic surface reaches ground level and then they recharge surface water courses forming perennial streams. Most of these springs are located about 40 km northeast of the project site. There are many springs apart from the abovementioned ones with yields less than 1l/s, within 1 km vicinity of the project site. The spring that emerges from the fractures of the volcanic rocks in the west of the project site has been facilitated as a fountain. The results of the analytical tests of the previous water quality studies upon production wells with yields greater than 1 l/s are given below in Table 4-22.

Table 4-22 Analytical Results of the Springs (DSI, 1977)

Spring ID	Karapınar	Sığircınarı
East (UTM ED50 Zone 36)	538.100	539.120
North (UTM ED50 Zone 36)	4.406.400	4.408.410
Formation	Alluvium	Alluvium
Yield (l/s)	10	4
Temperature (C)	12	13
EC Mho/cm	1.000	850
Sampling Date	23-Oct-75	24- Oct-75
pH	7.3	7.6
EC 10 ⁻⁶ 25c	1,000	850
Sodium (mg/l)	3.25	2.5
Potassium (mg/l)	0.2	0.03
Calcium + Magnesium (mg/l)	7.5	6.5
Carbonate (mg/l)	0	0
Bicarbonate (mg/l)	5.8	5.3
Chloride (mg/l)	1.4	1.08
Sulphate (mg/l)	3.75	2.65
Sodium Percentage (%)	29.68	27.68
SAR	1.68	1.38
Irrigation Water Class	C3S1	C3S1
Hardness (Fs)	37.5	32.5
Nitrite (mg/l)	Not Detected	Not Detected
Ammonia (mg/l)	Not Detected	Not Detected
Organic Substance O ₂ mg/l	2	1,6

The locations of the wells and springs that are mentioned above are given in Figure 4-26.

Since the proposed power plant will use air-cooled condenser (ACC) system, the amount of process water demand will be low.

The major process water need will be for HRSG blow downs, demineralization, regeneration water supply, turbine wash and limited amount of domestic usage of the personnel. Process and domestic water will be supplied through the Hacilar District water line utility which is 500 m to the south of project units. No means of production wells or surface water sources will be utilized for the project.

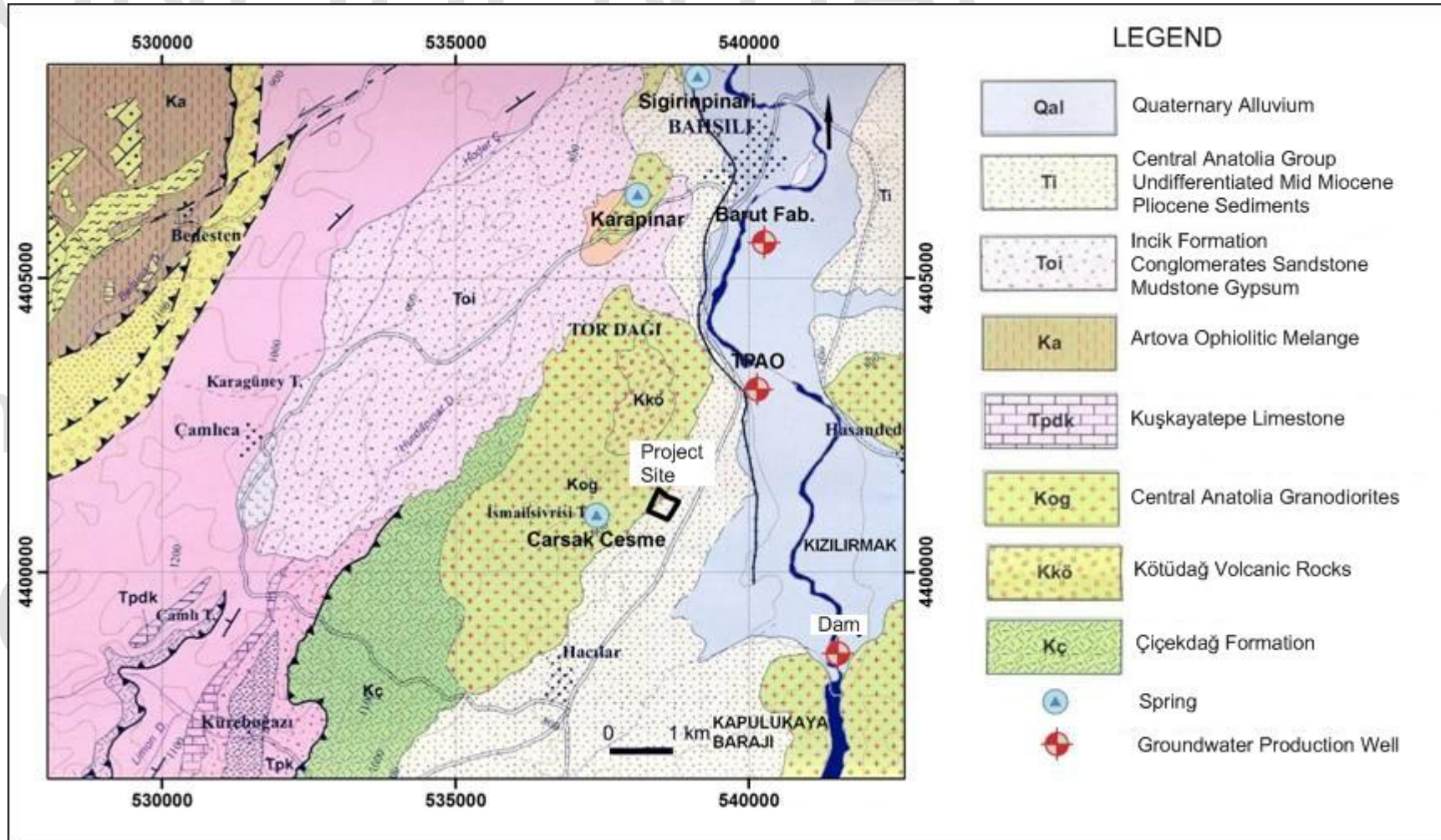


Figure 4-24 Hydrogeological Map of the Project Site

4.6.2 Hydrology

There are two major surface water courses within the basin where project site is located. These are;

Kızılırmak River; Kızılırmak is the longest river of Turkey. It starts in the east of Turkey and draws a big loop in central Anatolia before it rises northwards and flows into the Black Sea. The length of the river is 1355 km. Deliceirmak, Devrez and Gökırmak are main tributaries of the river. It rises from the southern flanks of Kızıladağ in the northeast Central Anatolia and reaches the Black Sea through Bafra Promontory. The main recharge sources of this river are snowmelt and rainfall. Water levels decline during the period between July and February and in March water levels rise with increased recharge and reach to a peak in April.

The nearest tributary of Kızılırmak to the project site is the Çoruhözü Stream. It flows along with the railroad, passes through Kızılırmak Province and has a length of 48 km. It has a great contribution to irrigation of the agricultural lands along its course.

According to Yahşihan surface flow gauging station records of years 1939-2003, the average flow of Kızılırmak River is 77.94 m³/sec. The long term average records of Yahşihan surface water flow gauging station are given below in Figure 4-25.

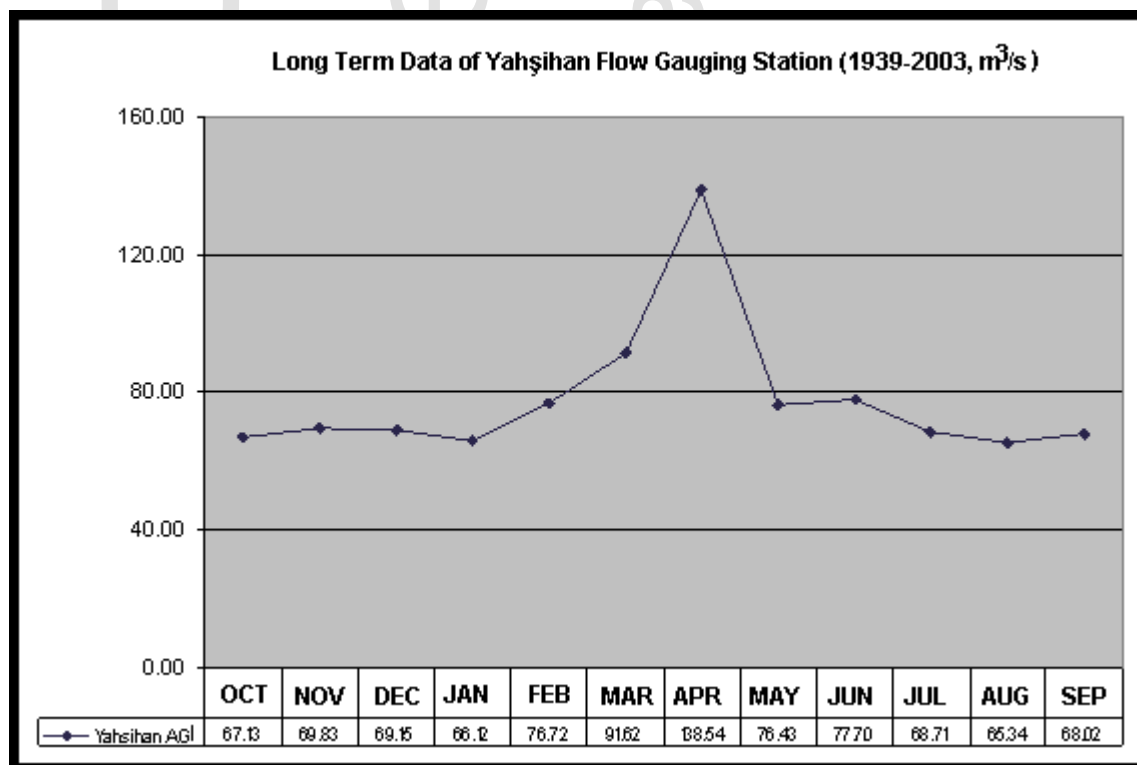


Figure 4-25 Yahşihan Flow Gauging Station Long Tem Average Data (1939-2003)

According to the Water Quality Assessment Report (2004) which was prepared by Department of Potable Water and Sewage System of State Hydraulic Works, the water quality of different points in regard with the parameters of NH₃-N, NO₂-N, PO₄, TDS, BOD₅ and heavy metals are as follows;

- According to NH₃-N parameter concentration; the water quality of Kapulukaya effluent water is Class I. In regard with the same parameter, water quality of Çoruhözü Stream is Class IV which is exposed to industrial and domestic waste water of Kırıkkale Province. Kızılırmak River is of Class II in the neighborhood of Yahşihan Bridge.
- In regard with NO₂-N parameter, Kızılırmak River is Class IV throughout the basin.
- In regard with PO₄ parameter concentration the water quality of Kapulukaya effluent is Class II.
- In regard with total dissolved solids (TDS), Kapulukaya effluent water is Class II. In regard with salinity Çoruhözü Stream is Class II with a greater concentration of dissolved electrolytes. The greatest concentration of salinity is observed in Delice River.
- In regard with BOD₅ parameter Kapulukaya effluent water is Class I. The water quality in Çoruhözü Stream is Class IV in regard with the same parameter.
- Analyses of the water samples for Heavy Metals were also accomplished for the basin. The results are given in Table 4-23.

Table 4-23 The Results of Heavy Metal Analyses upon Inflow and Outflow Samples within Kırıkkale Plain of The River Kızılırmak

Parameter	Kapulukaya	Yahşihan
Fe average	0.43	0.76
Fe maximum	1.97	2.96
Mn average	0.01	0.03
Mn maximum	0.04	0.16
Cr average	0.013	
Cr maximum	0.051	0.2
Cu average	0.019	0.01
Cu maximum	0.04	0.03
Pb average	0.021	0.019
Pb maximum	0.023	0.037
As average	0.003	0.005
As maximum	0.003	0.015

There are six dams on Kızılırmak River. These dams are Yamula Dam in Kayseri Province, Kesikköprü, Hirfanlı and Kapulukaya dams near Ankara and Altınkaya and Derbent dams within Bafra Plain. Kızılırmak River is 2.5 km to the project site and it flows in north south orientation in the east of the project site. The locations of Kızılırmak River and the project site are given in Figure 4-26.

Kapulukaya Dam and Reservoir

Kapulukaya dam has the largest reservoir in Kırıkkale Province. The area and the volume of the dam reservoir are 20.7 km² and 282 hm³ respectively. This dam is utilized for power generation and for domestic usage and potable water supply. This dam reservoir is about 7 km to the project site (Figure 4-28).

Current Usage and Management of Water Resources and Proposed Plans

Kapulukaya Dam has been put into operation in 1989 as a hydroelectric power plant by the State Hydraulic Works. Kapulukaya dam supplies domestic and potable water as well as being utilized as a power generation plant. According to State Hydraulic Works' Section V records; 142.5 hm³/year has been allocated for potable water and domestic water usage supply. The management and maintenance of this facility has been conducted by TEİAŞ.

The flow rates and surface areas of the main surface water courses are given below in Table 4-15 (State Hydraulic Works Chief Engineering Office of Kırıkkale).

Table 4-24 Kırıkkale Province Stream Flow Rates and Surface Water Areas

		Flow Rate (hm ³ /year)	Total (hm ³ /year)	Area (ha)	Total (ha)
Surface Water (Total Average Flow from Province Border)	Kızılırmak River	2,500	3,250	595	669.7
	Delice Stream	750		74.7	

There are no natural lakes in Kırıkkale Province. The greatest surface water body is Kapulukaya Dam reservoir. Fishery is done in this reservoir, in Kızılırmak River and in Delice Stream. There are 15 potable water reservoirs for livestock and 4 small dams for irrigation. The greatest irrigation reservoir is Keskin Cinali Reservoir and it has an area of 35 km².

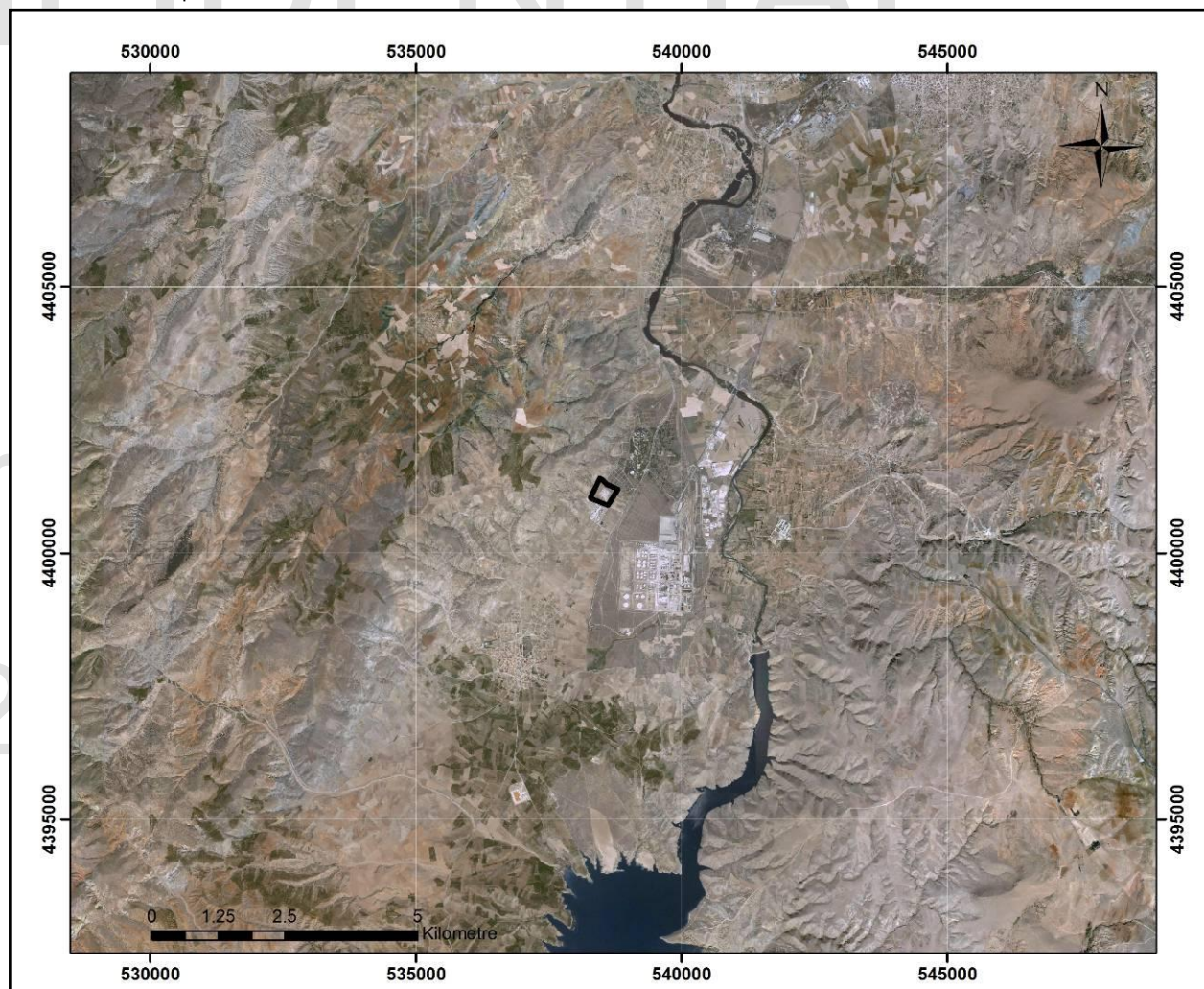


Figure 4-26 Kızılırmak River and Kapulukaya Dam South of Project Site (Google Earth, 2010)

4.7 Flora

The project area has terrestrial characteristics. Depending on these characteristics, generally short lived, herbaceous plants are widely distributed in the area. The forest areas are either rare or totally removed from the area.

In scope of İç Anadolu Natural Gas Combined Cycle Power Plant (CCPP) project, floristic site surveys were conducted within the project site and its vicinity. These surveys were conducted by an expert biologist Haşim Altınözlü from the Department of Biology (Botany) in Hacettepe University during 2010. Additional literature studies were carried out within İç Anadolu Natural Gas Combined Cycle Power Plant Capacity Increase Project by Lütfiye Özdirek biologist from AECOM in 2012.

Flora inventory is prepared using the results of the site survey, literature studies and referencing floristic studies of the similar ecological characteristics. Flora and vegetation structure of the area, the conservation status of the plant species in this area and the environmental risks and appropriate mitigation measures were included.

As a result of these survey and literature studies, an inventory of flora species identified on project site was prepared and presented in Table 4-25 below.

The methodology used while preparing the specified list is summarized below.

Methodology

In the scope of the flora survey, flora is identified and recorded; the plant samples were collected in the project site. Plant collections help to identify the family, genus and species more accurately. The samples then dried in accordance with the herbarium technique. Flora of Turkey and East Aegean Islands (David, P. 1985; Güner et al., 2000) were used as the main guides in the identification procedure of the species forming the flora of the region. In addition to the field survey data, literature is also used in the formation of inventory.

The list of the flora of the region is shown in table. The flora species in the table are listed in alphabetical order for the ease of check. In the table: the family, scientific name, common name, habitat, endemism, phytogeographical region and conservation status of the species according to International Union for Conservation of Nature's (IUCN) and Red List of Threatened Species are presented accordingly. In the nomenclature, "Büyük Bitki Kılavuzu" (Akalin, 1954) and "Türkçe Bitki Adları Sözlüğü" (Baytop, 1997) are used.

In order to determine conservation status of the identified flora species "Red Data Book of Turkish Plants" (Ekim et al., 2000) that is published by Turkish Association for the Conservation of Nature (Türkiye Tabiatını Koruma Derneği) was used. The IUCN commission categories of each plant are listed in this book. Additionally, for the habitat and endemism categories of the flora species, Turkish Plant Information Service (TÜBİVES), which is prepared by The Scientific and Technological Research Council of Turkey (TÜBİTAK) is used. The categories of conservation status according to Red Data Book are as follows:

EX: Extinct	NT: Near Threatened
EW: Extinct In The Wild	LC: Least Concern
CR: Critically Endangered	DD: Data Deficient
EN: Endangered	NE: Not Evaluated
VU: Vulnerable	

Floristic Analysis

İç Anadolu Natural Gas Combine Cycle Power Plant (CCPP) Project site is in Hacilar town border in Kırıkkale. There is a vacated thermal plant power site present near the project site.

The floristic list of the project site is identified from the evaluation of the collected plant species from the close vicinity especially from the areas with similar ecological characteristics. In this list, 25 families, 69 genus, 77 species and 1 variety are identified. Plants identified in this area are mainly Iran-Turan element.

The distribution of elements according to phytogeographic regions is as: 14 Iran-Turanian, 3 European-Siberian and 8 Mediterranean elements. There are 52 species of which phytogeographical region is either unknown or they have composite phytogeographical regions. Two endemic plant species are identified in the project site. These species are: *Stachys cretica* L. subsp. *anatolica* Rech. Fil. and *Centaurea urvillei* DC. subsp. *stepposa* Wagenitz. together with the other plant species, these endemic flora species are Least Concern (LC) category. Moreover, these endemic species are broadly distributed species in Turkey. Details of these two endemic species according to TUBIVES are given below in Figure 4-27. Views of the some plant species present in the project area are given in Figure 4-28.

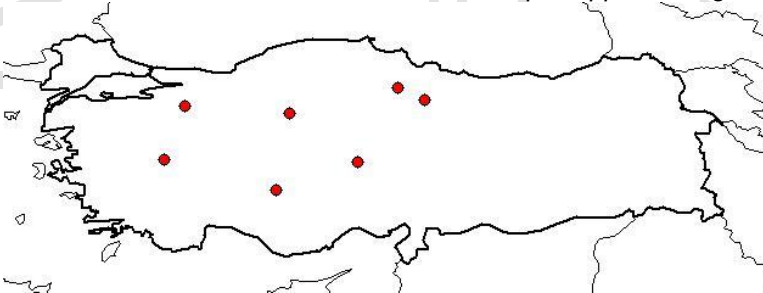
a) <i>Stachys cretica</i> L. subsp. <i>anatolica</i> Rech. Fil	
	Type: Perennial Structure: Grass Flowering: 5-9 Habitat: calcareous slopes, prairie, flat meadows Height: : 100-2900 Endemism: Endemic Phytogeographical region: Iran-Turan Turkey distribution: N., C. and S. Anatolia
Turkey Distribution of the <i>Stachys cretica</i> L. subsp. <i>anatolica</i> Rech. Fil 	
b) <i>Centaurea urvillei</i> DC. Subsp. <i>stepposa</i> Wagenitz	
	Type: Perennial Structure: Grass Flowering: 6-7 Habitat: step, stony slope Height: : 500-1500 Endemism: Endemic Phytogeographical region: Iran-Turan Turkey distribution: Central Anatolia
Turkey Distribution of the <i>Centaurea urvillei</i> DC. Subsp. <i>stepposa</i> Wagenitz 	

Figure 4-27 Features of the endemic plant species in the project area (Source: TÜBİVES)



Aethionema arabicum



Alyssum hirsutum var. *hirsutum*



Colutea cilicica



Crataegus monogyna subsp. *monogyna*



Reseda lutea L. var. *lutea* (Muhabbet çiçeği)



Cruciata taurica (Pallas ex Willd.) Ehrend

	
<i>Arenaria leptoclados</i> (Reichb.) Guss. (Kum otu)	<i>Sanguisorba minor</i> Scop. subsp. <i>minor</i> (Küçük çayır düğmesi)

Figure 4-28 The Images of the Plant species of the Project Site

Table 4-25 Flora Species Inventory Table

Family Name	Scientific Name	Turkish name	English Name	Habitat								Endemism			IUCN Category
				1	2	3	4	5	6	7	8	L	R	C	
SPERMATOPHYTA															
ANGIOSPERMAE															
DICOTYLEDONES															
Apiaceae	<i>Echinophora tournefortii</i> Jaub. & Spach	Tarhanotu	Turkish hyssop					x		x					LC
	<i>Eryngium campestre</i> L. var. <i>virens</i> Link	Çakır diken	Sea holy/ hulver/ holme					x							LC
	<i>Scandix australis</i> L. subsp. <i>grandiflora</i> (L.) Thell.	Fesçi tarağı	Southern shepherd's needle					x							LC
Asteraceae	<i>Anthemis austriaca</i> Jacq.	Papatya	Austrian chamomile					x		x					LC
	<i>Cnicus benedictus</i> L. var. <i>benedictus</i>	Mübarekdiken, Bostan otu, Şevketibostan, Şevket otu	Blessed thistle							x					LC
	<i>Carduus nutans</i> L. subsp. <i>leiophyllus</i> (Petr.) Stoj. & Stef.	Saka diken, Deve diken, eşek diken, eşek gengeri	Musk thistle							x					LC
	<i>Carthamus dentatus</i> Vahl.	Kartam, Aspir	Toothed thistle					x							LC
	<i>Centaurea urvillei</i> DC. subsp. <i>stepposa</i> Wagenitz	Yanar döner, peygamber çiçeği, gelin düğmesi	Knapweed					x					x		LC
	<i>Centaurea virgata</i> Lam.	Yanar döner	Squarrose knapweed							x					LC
	<i>Cichorium intybus</i> L.	Hindiba, sakız otu, sakız	Chicory, succory					x		x					LC

		çiçeği																
	<i>Cirsium arvense</i> (L.) Scop. subsp. <i>vestitum</i> (Wimmer & Grab.) Petrak	Deve diken, Köy göçüren	Creeping thistle, Canada thistle							x								LC
	<i>Crepis sancta</i> (L.) Babcock	Hindiba, Radika, kokarot	Hawk's beard							x								LC
	<i>Crupina crupinastrum</i> (Morris) Vis.	—	Common crupina							x		x						LC
	<i>Echinops pungens</i> Trautv. Var. <i>pungens</i>	Kirpi başı, topuz diken	Blue globe thistle									x						LC
	<i>Picnoman acarna</i> (L.) Cass.	—	Soldier thistle							x								LC
	<i>Senecio vernalis</i> Waldst. & Kit.	Kanarya otu	Eastern groundsel, spring groundsel							x								LC
	<i>Tragopogon pratensis</i> L. subsp. <i>pratensis</i>	Teke sakalı	Yellow goat's beard									x						LC
	<i>Xanthium strumarium</i> L. subsp. <i>cavanillesi</i> (Schouw) D. Löve & D. Dansereau	Pıtrak, Büyük pıtrak	Common/rough cocklebur									x						LC
Boraginaceae	<i>Anchusa undulata</i> L. subsp. <i>hybrida</i> (Ten.) Coutinho	Siğır dili, ballıkotu, benekli ot	Undulate alkanet									x						LC
	<i>Echium italicum</i> L.	Engerek otu	Coastal-Italian viper's/pale bugloss									x						LC
	<i>Heliotropium europaeum</i> L.	Bambul otu	European heliotrope							x								LC
Brassicaceae	<i>Aethionema</i>	Taş çanta								x								LC

	<i>arabicum</i> (L.) Andr. Ex DC.																		
	<i>Alyssum desertorum</i> Stapf. var. <i>desertorum</i>	Kuduz otu	Desert madwort, desert alyssum							x									LC
	<i>Alyssum strigosum</i> Banks & Sol. subsp. <i>strigosum</i>	Kuduz otu, deli otu	Hairy alyssum							x									LC
	<i>Crambe orientalis</i> L. var. <i>orientalis</i>	Deniz Lahanası	Oriental sea-kale							x									LC
	<i>Sinapis arvensis</i> L.	Tarla Hardalı	Wild mustard, charlock							x		x							LC
Caryophyllaceae	<i>Arenaria leptoclados</i> (Reichb.) Guss.	Kum otu	Lesser thyme-leaved sandwort							x									LC
	<i>Silene cappadocica</i> Boiss. & Heldr.	Nakil								x									LC
	<i>Velezia rigida</i> L.	---	Velezia							x		x							LC
Chenopodiaceae	<i>Chenopodium album</i> L. subsp. <i>album</i> var. <i>album</i>	Kaz ayağı	Fat heen, pigweed, white goosefoot							x		x							LC
	<i>Noaea mucronata</i> (Forssk.) Aschers. & Schweinf. subsp. <i>mucronata</i>	—	Hebrew with vowels							x									LC
Convolvulaceae	<i>Convolvulus</i> <i>arvensis</i> L.	Gündüz sefası, Mamıza, Çadır çiçeği, Hamıza, Kaplumbağa otu, Kuzu sarmaşığı, Tarla sarmaşığı	Field bindweed							x									LC
Dipsacaceae	<i>Scabiosa argentea</i> L.	Uyuz otu, Zivan, Ukrayna uyuzotu	Silvery scabious							x									LC
	<i>Scabiosa rotata</i> Bieb.	Uyuz otu	Devil's bit scabious							x			x						LC

Euphorbiaceae	<i>Andrachne telephioides</i> L.	Sandal	Andrachne, false orpine, bastard orpine							x							LC
	<i>Euphorbia falcata</i> L. subsp. <i>falcata</i> var. <i>falcata</i>	Sütleğen	Sickle spurge, crescent spurge							x			x				LC
	<i>Euphorbia macroclada</i> Boiss.	Sütleğen	Spurge										x				LC
Fabaceae	<i>Astragalus angustifolius</i> Lam. subsp. <i>pungens</i> (Willd.) Hayek	Geven	Dwarf milk vetch										x				LC
	<i>Colutea cilicica</i> Boiss. & Bal.	Patlangaç	Turkish bladder senna							x							LC
	<i>Medicago x varia</i> Martyn	Yonca	Alfalfa							x							LC
	<i>Trifolium hirtum</i> All.	Tüylü üçgül	Rose clover										x				LC
	<i>Trifolium pratense</i> L. var. <i>pratense</i>	Çayır üçgülü	Red clover							x			x				LC
	<i>Trigonella velutina</i> Boiss.	Buy, Boy	Fenugeek							x							LC
	<i>Trigonella crassipes</i> Boiss.	Buy, Boy	Fenugeek							x							LC
	<i>Vicia sativa</i> L. subsp. <i>nigra</i> (L.) Ehrh. var. <i>nigra</i>	Fiğ	Common/sping vetch							x			x				LC
Geraniaceae	<i>Erodium cicutarium</i> (L.) L'Herit. subsp. <i>cicutarium</i>	Turna gagası	Redstem filaree, storksbill							x							LC
Illecebraceae	<i>Herniaria incana</i> Lam.	Kırık otu	Gray rupturewort										x				LC
	<i>Paronychia kurdica</i> Boiss. subsp.	Dolama otu	Witlow-wort							x							LC

	<i>kurdica</i> var. <i>kurdica</i>																		
Lamiaceae	<i>Acinos rotundifolius</i> Pers.	Güzel nane	Roundleaf calamint							x									LC
	<i>Stachys annua</i> L. subsp. <i>annua</i> var. <i>annua</i>	Karabaş, dağ çayırı	Annual yellow-woudwort, hedgenette betony							x									LC
	<i>Stachys cretica</i> L. subsp. <i>anatolica</i> Rech. Fil.	Karabaş, dağ çayırı	Mediterranean woundwort										x				x		LC
	<i>Teucrium polium</i> L.	Kısa mahmut	Felty germander, mary's plant, cat thyme, hulwort, mountain germander										x						LC
Malvaceae	<i>Alcea pallida</i> Waldst. & Kit.	Hatmi	Hollyhock										x						LC
Papaveraceae	<i>Glaucium corniculatum</i> (L.) Rud. subsp. <i>corniculatum</i>	Boynuzlu gelincik	Blackspot hornpoppy										x						LC
	<i>Hypecoum procumbens</i> L.	Boynuzlu kimyon	Sickle-fruited hypecoum							x									LC
	<i>Papaver commutatum</i> Fisch. & Mey.	Gelincik	Laydybird, flander's poppy							x									LC
Plumbaginaceae	<i>Plumbago europaea</i> L.	Sergil, kurşunkök	European plumbago, european leadwort, dentallaria							x									LC
Primulaceae	<i>Androsace maxima</i> L.	Kaya yasemini	Greater rockjasmine							x									LC
Ranunculaceae	<i>Ceratocephalus falcatus</i> (L.) Pers.	Orak yapraklı düğün çiçeği	Bur buttercup, curve seed butterwort							x									LC
	<i>Nigella arvensis</i> L. var. <i>glauca</i> Boiss.	Çörek otu	Wild fennel, field black cumin, wild black cumin, oat or horse black cumin							x			x						LC
Resedaceae	<i>Reseda lutea</i> L. var. <i>lutea</i>	Muhabbet çiçeği	Wild mignonette							x									LC

Rosaceae	<i>Armeniaca vulgaris</i> Lam.	Kaysı	Apricot							x							LC
	<i>Crataegus monogyna</i> L.	Alıç	Medlar, hawthorn, mary's mayflower									x					LC
	<i>Pyrus elaeagnifolia</i> Pallas subsp. <i>elaeagnifolia</i>	Ahlat	Oleaster-leafed pear							x		x					LC
	<i>Sanguisorba minor</i> Scop. subsp. <i>muricata</i> (Spach) Brig.	Küçük çayır düğmesi	Salad burnet, garden burnet, small burnet							x		x					LC
Rubiaceae	<i>Galium incanum</i> Sm. subsp. <i>elatus</i> (Boiss.) Ehrend.	Yoğurt otu	Cleavers, goose grass, sticky weed, sticky leaf, catch weed, robin-run-the-hedge and coach weed.							x							LC
Scrophulariaceae	<i>Linaria simplex</i> (Willd.) DC.	Nevruz otu	Toadflax							x							LC
	<i>Scrophularia catariifolia</i> Boiss. & Heldr.	Sıraca otu	Figworts							x							LC
	<i>Verbascum lasianthum</i> Boiss. ex Benth	Sığır kuyruğu	Mullein									x					LC
Vitaceae	<i>Vitis vinifera</i> L.	Asma	Common grape vine									x					LC
Zygophyllaceae	<i>Tribulus terrestris</i> L.	Demir otu	Puncture vine, caltrop fruit, maltese cross							x							
MONOCOTYLEDONES																	
Poaceae	<i>Bromus tectorum</i> L.	Dam Bromu	Drooping/downy brome, downy chess, cheatgrass							x							LC
	<i>Elymus hispidus</i> (Opiz) Melderis subsp. <i>hispidus</i>	Elym, ayrik otu	Intermediate wheatgrass							x		x					LC

	<i>Koeleria cristata</i> (L.) Pers.	Parlak ot	Junegrass, crested hairgrass, koeler's-grass						x	x					LC
	<i>Phragmites australis</i> (Cav.) Trin ex Steudel	Kamış	Common reed						x						LC
	<i>Stipa lessingiana</i> Trin. & Rupr.	Stipa, Sorgu otu, Kıl aç, Kırtil	Feather grass. Hardiness degree, needle grass, and spear grass						x						LC
	<i>Pennisetum orientale</i> L.C.M. Richard	Doğu gök darısı	Oriental fountain grass, tall tails						x						LC

ABBREVIATIONS

EX: Extinct
EW: Extinct in the Wild
CR: Critically Endangered
EN: Endangered
VU: Vulnerable
NT: Near Threatened
LC: Least Concerned
DD: Data Deficient
NE: Not Evaluated

Habitat Classes:

- 1- Forest
- 2- Maquis
- 3- Frigana (Generally thorny, low height and ball-cushion forming plants)
- 4- Garden
- 5- Dry grass
- 6- Wet grass, marshes and Wetlands
- 7- Roadside
- 8- Rock

Relative Abundance Classes:

1- Very rare
2- Rare
3- Medium
4- Abundant
5- Very abundant

Endemism:

L- Local endemic
R- Regional endemic
C- Common endemic

Vegetation

The main vegetation type in Kırıkkale Province is steppe. Kırıkkale has a very limited forest structure. There is very few degraded forested land around city; the land is surrounded by Koçubaba at north and with dwarf oak and junipers Denek Mountain at south. The species consists of the flora in the region, show susceptibility to dry and dusty environment (Kırıkkale Governorship, 2010). The vegetation map of the region is given in Figure 4-29.

The dominant vegetation in the project site and its vicinity was determined in the scope of the site surveys. Dominant vegetation type in the project site is steppe (Figure 4-30).

There are afforestation sites and agriculture land owing to Tüpraş Orta Anadolu Refinery around the project site. The adjacent regions together with having quite inclination, have similar topography and habitat types. The view of the region is shown in Figure 4-30.

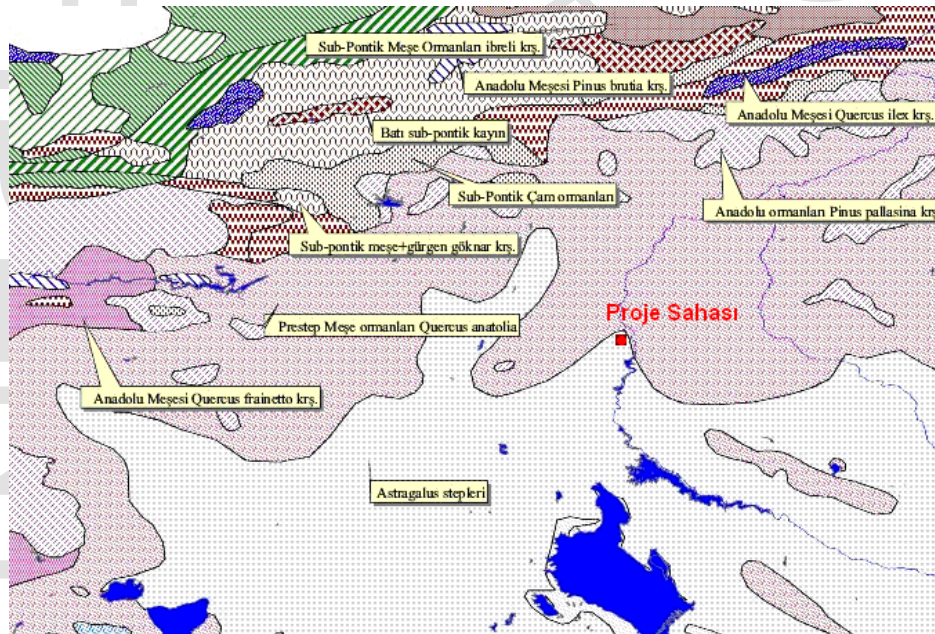


Figure 4-29 Natural Vegetation Map (Ankara Regional Forestry Directorate)

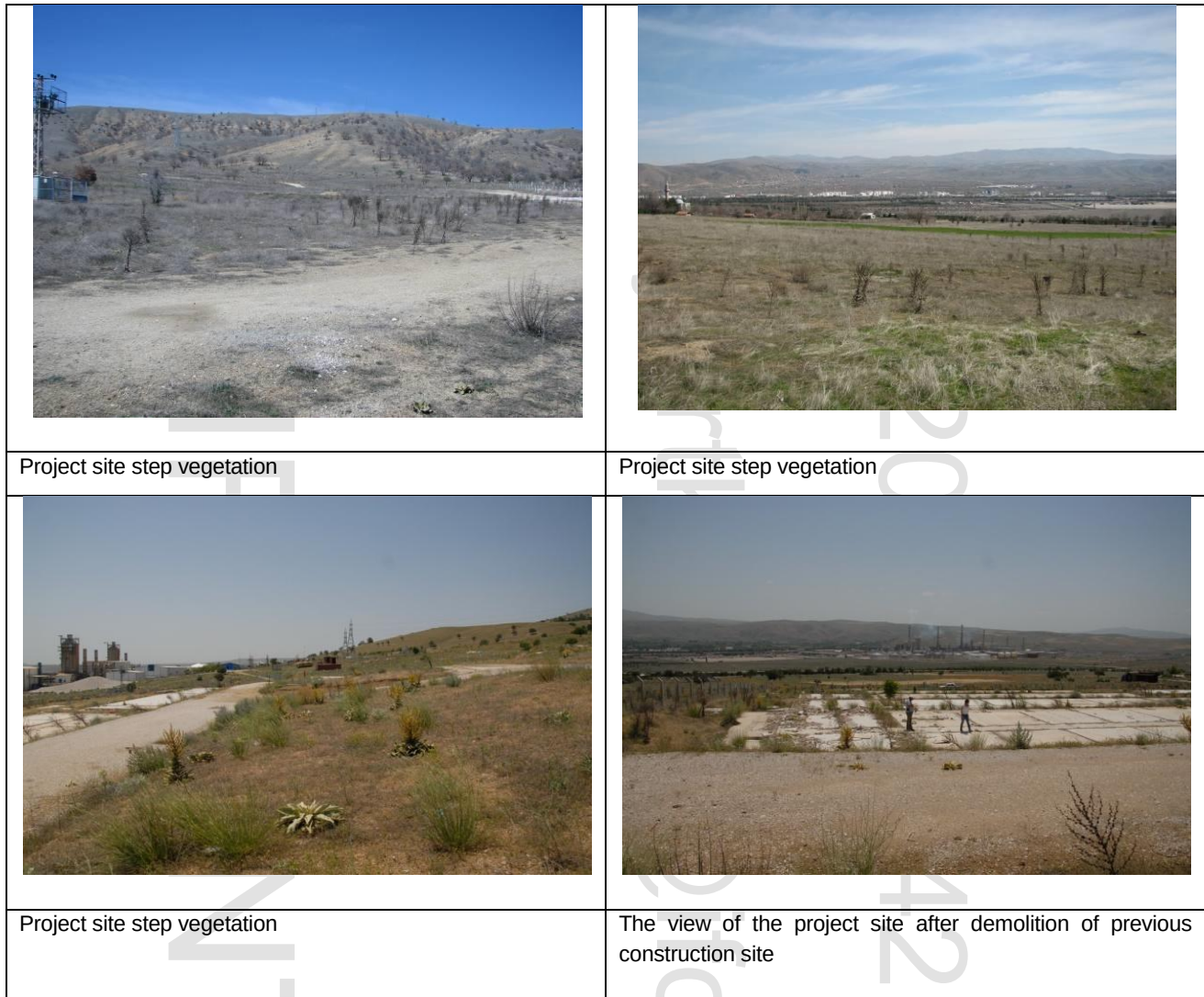


Figure 4-30 İç Anadolu Natural Gas Combined Cycle Power Plant (CCPP) Project site

The project site is quite poor in terms of perennial plant species and trees. In the project site only few fruit trees are observed. Besides, in the agricultural lands few grape vines are observed.

Conservation Measures

It is evaluated that there are no flora species in the project site and its vicinity in accordance with the CITES (Convention on International Trade in Endangered Species of Wild Fauna and Flora), which was ratified in Washington, D.C. on March 3, 1973.

The Convention on the Conservation of European Wildlife and Natural Habitats known as the Bern Convention was first signed in Bern in 1979. Turkey has signed this Convention in 1984. The Bern Convention is a binding international legal instrument in the field of nature conservation, which covers the whole of the natural heritage of the European continent and extends to some states of Africa. Its aims are to conserve wild flora and fauna and their natural habitats and to promote European co-operation in that field. Accordingly, each party signed the convention will specially

guarantee the preservation of the wild flora and fauna species listed in the Appendix I by making necessary legal and regulatory arrangements. The tearing off of these plants on purpose, picking up of them, cutting down or collection of the roots will be prohibited strictly. Each party will prohibit the existence of these species in the stocks of bodies and trading. The flora species in the project area were evaluated for the Bern Convention and no species were determined that are protected by Bern Convention.

Bern Conventions Appendices and the explanations:

Appendix I	Strictly Protected Flora Species
Appendix II	Strictly Protected Fauna Species
Appendix III	Protected Fauna Species

There are no plant species that is involved in Bern convention lists.

The endemic plant species recorded in the project site are: *Stachys cretica anatolica* Rech. Fil. and *Centaurea urvillei* DC. subsp. *stepposa* Wagenitz. These two species have broad distribution and have Least Concern category according to IUCN conservation categories. For this reason, during construction no conservation measure is necessary in the project area.

Important Plant Areas (IPA), is defined as "areas with very rich in plant diversity, rare and / or endemic (grows naturally nowhere else in the world) species rich communities and habitats (natural habitats)".

The concept of the IPA, was developed under the leadership of three-organizations co-operating in order to protect the natural flora in Turkey: DHKD (Nature Conservation Society), FFI (Fauna & Flora International) and ISTE (Istanbul University, Faculty of Pharmacy, Department of Botany) in the early 1990s

The same period, gained an international dimension with Plantlife International's coordination in England and the criteria are established.

The project area is 60 km away from Lake Mogan which is the closest Important Plant Area (IPA) (Figure 4-31).



Figure 4-31 The distance of the Project Area to Important Plant Areas

Source: <http://www.obanettr.net/>

IPAs provide a very important infrastructure that will contribute to the implementation of international conventions, strategies and programs that Turkey is a party.

IPAs includes botanical and scientific data about protecting nature which will be used for compliance and implementation of international environmental protection conventions, network of protected areas, biodiversity conservation strategies and policies.

4.8 Fauna

In order to determine the wild fauna species in and around the project site a comprehensive search is performed by Prof. Dr. Levent Turan from Hacettepe University. This study included site surveys in the project field, the evaluation of literature, interviews with the local people about the existence of the animal species in the region. The site surveys were conducted in June 2010. In addition to these studies within the İç Anadolu NGCC Capacity Increase Project additional literature research was carried out by an expert biologist Lütfiye Özdirek from AECOM in March 2012. The fauna lists were created through evaluation of existing and the potential species likely to exist in the region in the lighting of these studies. In the inventory, the identification method of the composites of fauna and biodiversity elements is shown in “report type” columns.

In the scope of the terrestrial fauna study, amphibians, reptiles, birds and mammals identified within the project site and its vicinity and their habitats are assessed. In addition to the observations the interpretations of the people living at the site was also referenced during the preparation of the fauna list of the project area. The results of the studies conducted around the project area for determination of terrestrial animals, the evaluations conducted are given in the following sections.

The national and international conservation status of the fauna species identified at the project site was assessed during the literature review of this study. In the scope of the fauna study, the animal species that are present in the project area are listed. In addition, the natural and international conservation statuses of the species were evaluated considering the latest and most updated versions of Bern Convention Annexes, European Red List (ERL) and 2011-2012 Decisions of Central Hunting Commission (CHC) of Ministry of Forestry and Water Affairs. Additionally for the Birds (=Aves), the RED DATA BOOK categories, "Turkish Birds Red List" (Kiziroglu, 2008), have been used for the determination of the conservation status and analyzing the threat levels of the bird species of Turkey.

The categories classified according to the Central Hunting Commission decision for 2011-2012 are shown in the table below.

1	Wild Animals under Protection by the Ministry of Environment and Forestry
2	Wild Animals under protection by the Central Hunting Commission
3	Wild Animals permitted for Hunting in Specific Periods

The fauna species that are protected by the Bern Convention are grouped under two categories:

Annex II	Strictly protected species
Annex III	Protected species

Annex II- Strictly Protected Species

The following activities are strictly prohibited:

- Any kind of deliberate capturing- keeping and illegal methods of killing;
- Deliberate damage and destruction of the breeding or sheltering areas;
- Deliberately disturbing the wild fauna especially during their breeding, development and winter hybernation seasons in a manner contrary to the intended purpose of this convention;
- Collecting eggs from the wild or deliberately destructing such eggs or keeping such eggs even if they are empty;
- Being in possession of or domestic trading of the fauna species either alive or dead.

Annex III- Protected Fauna Species

Temporary or regional prohibition under appropriate conditions should be taken in order to ensure that the related wild fauna reach to the satisfactory population levels. There are prohibited hunting

seasons and the other national principles according to the decisions of the Central Hunting Commission.

The related works and activities will not certainly lead to any negative impacts on the species specified in the fauna lists above and the other wildlife species. During the related works and activities, the decisions taken by the General Directorate of Nature Conservation and National Parks, Central Hunting Commission for the season 2011-2012 and the decisions of the Central Hunting Commission to be declared in future years and the provisions of the Bern Convention will be strictly followed.

The fauna species under protection by **IUCN** are classified as follows:

EX (EXTINCT)	The taxon that has become extinct.
CR (CRITICALLY ENDANGERED)	Severely endangered taxon. The population of the species in this category are facing high risk of extinction appearing nearly imminent.
EN (ENDANGERED)	Endangered taxon. The populations of the species in this category are not critically endangered; but are facing a risk of extinction in near future.
VU (VULNERABLE)	Vulnerable.
LR/NT (LOWER RISK/Near Threatened)	Lower risk taxon, the populations of which are not endangered.
LR/LC (LOWER RISK/Least Concern)	Lower risk taxon, the populations of which are not endangered even in future.

4.9 Amphibians

In order to determine the reptilian species and their characteristics inhabiting within the Project site and its vicinity, the field surveys were conducted in June 2010. In addition to the site observations, interviews have been performed with the local people and the results have been checked with the literature data.

There were 2 amphibian species detected at the Project area and its close surroundings. The Amphibians exist in the project area and their national and international protection status was evaluated and the information is listed in Table 4-26.

In the field surveys no wetlands in the project area and in close vicinity is observed.

Most important elements of amphibians are tailed amphibians (Urodela) which are salamanders and frogs (Anura) which are tailless amphibians. These species need wetlands at least during breeding. Therefore, appropriate habitats of amphibians within the project site were searched in the first hand in the scope of this study. The only suitable habitat for amphibian species is an old, abandoned watering depot. *Bufo viridis* individuals were observed in this depot (Figure 4-32). This

species lives in a wide range of forests, forest steppe, scrubland, grassland and alpine habitats. Animals may be present in modified areas including urban centers (e.g. Bucharest), city parks and gardens - and often benefits from disturbed habitats. Spawning and larval development occurs in a diverse range of temporary and permanent water bodies including swamps, ponds, lakes, pools in streams and rivers, reservoirs, ditches and puddles (IUCN, 2010).

The other amphibian species, which is observed 2.5 km away from the project area, along the Kızılırmak River, is *Pelophylax ridibundus*. It is a highly opportunistic amphibian, living in mixed and deciduous forests, forest steppe, and steppe and other grasslands, semi-desert and desert zones. Arid areas are largely colonized through river valleys and channels. The frog prefers open, well-warmed areas with abundant herbaceous vegetation. It is a semi-aquatic species, inhabiting (and breeding in) a wide variety of flowing and stagnant water habitats, from shallow puddles and ponds to large lakes, reservoirs, rivers and brooks. It may also be found in slightly saline water (IUCN, 2010).



Figure 4-32 View of the European Green Toad (*Bufo viridis*) in the Abandoned Watering Depot Present in the Project Site

From the 2 amphibian species identified in the project sites and its vicinity, *Bufo viridis* is defined to be in Annex II- Strictly Protected Species; and *Rana ridibunda* (so called *Pelophylax ridibundus* in IUCN) to be included in Annex III- Protected Fauna Species in Bern Convention lists. According to European Red List of Conservation by IUCN the conservation category of the species determined in the project site is Least Concern (LC).

The Amphibians exist in the project and their national and international protection statuses were evaluated and the results are listed in Table 4-26.

There is not an endemic species between amphibians that have been recorded within the project area and its vicinity.

Table 4-26 The Amphibians at the Project Area and Their Protection Status

Scientific Name	English Name	Project Site	Environment	BERN	ERL (IUCN)	Record Type
ANURA (tail-less)						
RANIDAE						
<i>Pelophylax ridibundus</i>	Marsh Frog	--	+	Annex -III	LC	G
BUFONIDAE (true toad true toads)						
<i>Bufo viridis</i>	European Green Toad	+	+	Annex -II	LC	G
The abbreviations in the list						
BERN = Bern Convention on the Conservation of European Wildlife and Natural Habitats			O: Observation L: Literature			
CITES = Convention on International Trade in Endangered Species of Wild						
BERN CONVENTION						
Annex-II: SPFS (Strictly Protected Fauna Species)						
Annex-III: PFS (Protected Fauna Species)						
IUCN (International Union of Conservation Nation) Status						
LC: Least Concern						

These species were not recorded in the project site, rather they are recorded nearby areas. Therefore, they will not be directly affected from the construction and operation activities. Both amphibians have a broad distribution in Turkey. Even they are affected, there are alternative habitats.

4.10 Reptiles

In order to determine the reptilian species and their characteristics inhabiting within the project site and its vicinity, the areas that are preferred as a habitat by the reptiles were searched. The observations were then carried out in the surrounding areas that are ecologically similar.

During the site surveys the amphibian species in the Project area and the properties of them is searched. For this reason, the tree holes, especially *Salix spp.* and *Populus spp.*, cavities on the dense plant roots, spaces between the rocks and their bottoms, the historical remains, especially the walls, and the soil cavities were examined. Considering the adverse impacts, the animals were not captured-handled. The photographs of the species were taken when necessary. When it was

difficult to identify the recorded species, the assessment of these records were carried out with the help of reference books and experts.

As a result of site survey, interviews with the local people and the literature research, 6 reptiles were identified in the project site and its vicinity. These are: *Testudo graeca*, *Laudakio stellio*, *Trapelus ruderatus*, *Ophisops elegans*, *Parvilacerta parva* and *Eirenis modestus*. The most abundant reptilian species among these are *Ophisops elegans* (Figure 4-33).



Figure 4-33 The most abundant reptilian species present in the project field: *Ophisops elegans*)

The reptilian species found in the project area and close vicinity are presented in Table 4-18. In the same table the national and international conservation status are also given.

As it can be seen in Table 4-27, 4 of the 6 reptilians are tabulated in the Bern Convention as Appendix II: "Strictly Protected Fauna Species". The other 2 of these species is in Appendix III: "Protected Fauna Species" list. According to the evaluations conducted by the IUCN, among these species only *Testudo graeca ibera* is stated as VU (Vulnerable). According to the European Red List of Conservation 3 of the species is in the Least Concern (LC) category. The other 2 species are not present in the ERL.

According to the evaluation of Central Hunting Commission 2011-2012 conservation lists, the reptilian species recorded in the project site and in its vicinity are in the Annex 1 list. Annex 1 is the list indicates the species under conservation by the Turkish Government.

There are not any endemic reptilian species found in and around the project site.

Table 4-27 The Reptilians at the project area and their protection status

Scientific Name	Common Name	Turkish name	Project Area	Environ- Ment	ERL (IUCN)	BERN	CHC	Record Type
Chelonia (turtles, tortoises and terrapins)								
Testudinidae (Tortoises or land turtles)								
<i>Testudo graeca</i>	The Spur-thighed Tortoise	<i>Tosbağa</i>	+	+	<i>VuA1cd</i>	<i>App-II</i>	<i>App-I</i>	<i>O</i>
Squamata (scaled reptiles) (amphisbaenians, lizards, and snakes)								
Agamidae (lizard family, agamas)								
<i>Laudakio stellio</i>	Starred Agama	<i>Dikenli keler</i>	+	+	<i>LC</i>	<i>App-II</i>	<i>App-I</i>	<i>O</i>
<i>Trapelus ruderatus</i>	Horn-scaled Agama	<i>Bozkır keleri</i>	--	+	--	<i>Annex-III</i>	<i>App-I</i>	<i>O</i>
Lacertidae (wall lizards or true lizards)								
<i>Ophisops elegans</i>	Snake-eyed Lizard	<i>Tarla kertenkelesi</i>	+	--	<i>LC</i>	<i>App-II</i>	<i>App-I</i>	<i>O</i>
<i>Parvilacerta parva</i>	Dwarf Lizard	<i>Cüce kertenkele</i>	--	+	--	<i>App-II</i>	<i>App-I</i>	<i>O</i>
Colubridae (snake)								
<i>Eirenis modestus</i>	Dwarf Snake	<i>Uysal yılan</i>	+	+	<i>LC</i>	<i>App-III</i>	<i>App-I</i>	<i>O</i>
The abbreviations in the table								
BERN = Bern Convention on the Conservation of European Wildlife and Natural Habitats CITES = Convention on International Trade in Endangered Species of Wild Fauna and Flora					O=Observation L=Literature			
BERN CONVENTION Annex-II: SPFS: Strictly Protected Fauna Species Annex-III: PFS: Protected Fauna Species								
IUCN (International Union of Conservation Nation) Status Vu : Vulnerable LC : Low Concern A1 : Globally threatened Cd : Conservation Dependent								
2011-2012 Decisions of Central Hunting Commission (CHC): Appendix -I : species protected by the MoEF Appendix-II : species protected by the Central Hunting Commission Appendix –III : species allowed to be hunted for a time period								

4.11 Aves

In order to identify the bird species within the project site and its vicinity, their habitats, the reasons of their existence in this area and conservation status, ornithological observations have been carried out during 2010. The observations and literature research carried out for other purposes in the near vicinity of the project site have also been used in the scope of this study. In addition to the site observations, interviews have been performed with the local people and the results have been checked with the literature data.

In the field observations the behaviors and attitudes as feeding, resting and nesting of the bird species in the project area are noted. Also, this bird species are classified according to their status as local, migrating or transit; and the population densities are identified.

Collins Bird Guide (1999) is used in the identification of bird species in the project area. Moreover, the "Important Bird Areas in Turkey" (Yarar, M., Magnin, G., 1997) is used for obtaining the literature data about population and Important Bird Areas criteria. The conservation status of the bird species involved in the inventory prepared by the observations and the other studies is shown in the relevant table.

The species forming the avian fauna of the project site and the conservation status of the bird species were evaluated according to the updated lists of the Bern Convention Annexes, the European Red List (ERL) prepared by the IUCN (International Union for the Conservation of Nature) and the RED DATA BOOK categories, "Turkish Birds Red List" (Kızıroglu, 2008).

Moreover, the decisions of the Central Hunting Commission for 2011-2012 are added in the relevant columns.

The bird fauna at the project area was determined by evaluation of the possibility of existence of the species. Although the real existence status of these species in the area is different they were subjected to a Red Data Book classification. The Red Data Book Classifications for birds (Aves) and their explanations are as follows:

There are no endemic birds species exist at and around the project area.

A .1.2	Endangered
A .2	Severely Endangered
A .3	Threaded
A .4	Potentially Threaded
B Categories	Permanent – Transit species
Y	Native Species
KZ	Winter visitors
G	Migratory species
T	Transit Migratory species

As a result of site observations, habitat inspections and assessments, 32 birds have been identified in the project site and its vicinity. The evaluations according to the conservation conventions are given below:

- a) According to the Bern Convention, among the bird species identified in the project site, 19 birds are included in Annex II of Bern Convention which lists strictly protected fauna species and 9 species are included in Annex III of Bern Convention which lists protected fauna species. The rest 4 birds are not included by the Bern Convention annexes.
- b) According to the European Red List (ERL) prepared by International Union for Conservation of Nature (IUCN), all the bird species present in the project field are included in the Least Concern category.
- c) According to 2011-2012 Decisions of Central Hunting Commission (CHC), 20 bird species are determined to be in Appendix -I (species protected by the MoFWA) and 6 bird species to be in Appendix-II that defines the species protected by the Central Hunting Commission and 6 species to be in Appendix-III: species allowed to be hunted for a time period.
- d) According to the criteria of 2008 dated RDB: **Red Data Book for Birds of Turkey**:

1 bird species is from **A.1.2 category**. This category is defined as: Populations of these species has decreased throughout Turkey. They are found to be 1 individual-10 pairs (=1-20 individuals) where they are observed. They are considered to be facing a high risk of extinction; therefore, these species should be protected in Turkey.

5 species are from **A.2 category**. Population of these species varies around 11-25 pairs (22-50 individuals). They are considered to be facing risk of extinction.

8 species are from **A.3 category**. Population of these species varies around 26-250 pairs (52-500 individuals). They are also considered to be facing a high risk of extinction.

6 species are from **A.3.1 category**. Population of these species has decreased in recent years. Population of these species varies around 251-500 pairs (502-1000 individuals) and has decreased comparing to the previous records.

2 species is from **A.4 category**. According to the criteria of IUCN, these species are not considered yet to be facing a high risk of extinction, but their populations have decreased locally and have potential of facing risk of extinction in time. Population of these species varies around 501-5000 pairs (1002-10000 individuals).

According to the same book, the statuses of these bird species in Turkey are classified as follows;

G: Migratory species	T: Transit migratory species
Y: Native species	KZ: Winter visitor species

The bird species found in the area and their protection status are shown in Table 4-28.

Table 4-28 Bird species in the Project Site and its Vicinity; Conservation Statuses and Habitat Characteristics

Scientific name	Turkish name	English name	Project Area	Surroundings	B.D	ERL (IUCN)	BERN	CHC	RDB	Status	Record type
Nonpasseres											
Ciconiiformes											
Ciconiidae											
<i>Ciconia ciconia</i>	Akleylek	White stork	--	+	*	LC	ANNEX-II	ANNEX-I	A.3.1	YZ,Y	O
Accipitriformes											
Accipitridae											
<i>Circus pygargus</i>	Çayır Delicesi	Mantagu's harrier	--	+	*	LC	ANNEX-II	ANNEX-I	A1.2	YZ	O
<i>Buteo ruffinus</i>	Kızıl şahin	Long legged buzzard	+	+	*	LC	ANNEX-II	ANNEX-I	A.3	Y	O
Falconiformes											
Falconidae											
<i>Falco tinnunculus</i>	Kerkenez	Common kestrel	+	+		LC	ANNEX-II	ANNEX-I	A.2	Y	O
Columbiformes											
Columbidae											
<i>Columba livia</i>	Kaya güvercini	Rock pigeon	+	+	*	LC	ANNEX-III	ANNEX-III	A.5	Y	O
<i>Streptopelia decaocto</i>	Kumru	Euroasian collared dove	+	+	*	LC	ANNEX-III	ANNEX-II	A.5	Y	O
Strigiformes											
Strigidae											
<i>Athene noctua</i>	Kukumav	Little owl	--	+		LC	ANNEX-II	ANNEX-I	A.2	Y	O
Apodiformes											
Apodidae											
<i>Apus apus</i>	Ebabil, Kara sağan	Common swift	+	+		LC	ANNEX-III	ANNEX-I	A.3.1	YZ	O
Meropidae											
<i>Merops apiaster</i>	Arıkuşu	European Bee eater	+	+		LC	ANNEX-II	ANNEX-I	A.3.1	YZ	O
Coraciiformes											
Upupidae											
<i>Upupa epops</i>	İbibik, çavuşkuşu,	Euroasian	+	+		LC	ANNEX-II	ANNEX-I	A.2	YZ	O

	hüt hüt	hoopoe									
Passeres											
Passeriformes											
Alaudidae											
<i>Melanocorypha calandra</i>	Boğmaklı tarlakuşu	Calandrita lark	+	+	*	LC	ANNEX-II	ANNEX-I	A.5	Y	O
<i>Galerida cristata</i>	Tepeli toygar	Crested lark	+	+		LC	ANNEX-III	ANNEX-II	A.3	Y	O
<i>Alauda arvensis</i>	Tarlakuşu	Euroasian skylark	+	+	*	LC	ANNEX-III	ANNEX-II	A.3	Y	O
Hirundinidae											
<i>Hirundo rustica</i>	İs kırlangıcı	Barn swallow	+	+		LC	ANNEX-II	ANNEX-I	A.5	YZ	O
<i>Delichon urbica</i>	Pencere kırlangıcı	Northern house martin	--	+		LC	ANNEX-II	ANNEX-I	A.3	YZ	O
Motacillidae											
<i>Motacilla alba</i>	Ak kuyruksallayan	White wagtail	--	+		LC	ANNEX-II	ANNEX-I	A.3.1	Y	O
Turdidae											
<i>Turdus merula</i>	Karatavuk	Euroasian blackbird	--	+	*	LC	ANNEX-III	ANNEX-III	A.3	Y	O
<i>Oenanthe oenanthe</i>	Kuyrukkakan	Northern wheateater	+	+		LC	ANNEX-II	ANNEX-I	A.3	YZ	O
<i>Oenanthe isabellina</i>	Maskeli kuyrukkakan	Isabelline wheateater	+	+		LC	ANNEX-II	ANNEX-I	A.3	Y	O
Sylviidae											
<i>Sylvia atricapilla</i>	Karabaş Ötleğen	blackcap	--	+		LC	ANNEX-II	ANNEX-I	A.2	YZ	O
<i>Phylloscopus collybita</i>	Cif cağ	Common chaffinch	--	+		LC	ANNEX-II	ANNEX-I	A.3.1	Y	O
Oriolidae											
<i>Oriolus oriolus</i>	Sarıasma	Euroasian golden oriole	--	+		LC	ANNEX-II	ANNEX-I	A.2	YZ	O
Laniidae											
<i>Lanius collurio</i>	Çekirgekuşu	Red backed shrike	--	+	*	LC	ANNEX-III	ANNEX-I	A.3	YZ	O
Corvidae											
<i>Pica pica</i>	Saksağan	Black billed magpie	+	+	*	LC	--	ANNEX-III	A.5	Y	O
<i>Corvus monedula</i>	Cüce karga	Euroasian jackdaw	+	+	*	LC	ANNEX-II	ANNEX-III	A.5	Y	O
<i>Corvus frugilegus</i>	Annexin kargası	rook	+	+	*	LC	--	ANNEX-III	A.5	Y	O

Sturnidae												
<i>Sturnus vulgaris</i>	Sığırcık	Common starling	+	+	*	LC	--	ANNEX-II	A.5	Y	O	
Passeridae												
<i>Passer domesticus</i>	Ev serçesi	House sparrow	+	+		LC	--	ANNEX-III	A.5	Y	O	
Fringillidae												
<i>Fringilla coelebs</i>	İspinoz	Euroasian chaffinch	--	+	*	LC		ANNEX-III	ANNEX-II	A.4	Y	O
<i>Carduelis carduelis</i>	Saka	European goldfinch	+	+		LC		ANNEX-II	ANNEX-I	A.3.1	Y	O
Emberizidae												
<i>Emberiza melanocephala</i>	Karabaşlı kirazkuşu	Black-headed bunting	+	+		LC		ANNEX-II	ANNEX-I	A.4	YZ	O
<i>Emberiza calandra</i>	Tarla kirazkuşu	Corn bunting	+	+		LC		ANNEX-III	ANNEX-II	A.6	Y	O
Abbreviations												
BERN = Bern Convention on the Conservation of European Wildlife and Natural Habitats CHC : Decisions of Central Hunting Commission (RDB) : Red Data Book IUCN : International Union of Conservation Nation ERL : European Red List						G: Migratory species Y: Native species KZ: Winter visitor species T: Transit migratory species YZ: Summer visitor species			O=Observation L=Literature			
IUCN (International Union of Conservation Nation) Status LC: Least Concern												
	BERN CONVENTION Annex-II: SPFS (Strictly Protected Fauna Species) Annex-III: PFS (Protected Fauna Species)											
	2009-2010 Decisions of Central Hunting Commission (CHC): Appendix -I : species protected by the MoEF Appendix-II : species protected by the Central Hunting Commission Appendix -III : species allowed to be hunted for a time period											
	<u>2008 Red Data Book Categories for Birds of Turkey</u> The species includes the birds that are either resident: they spent their time all along year in Turkey, or are summer visitors: they come Turkey in spring and after spending breeding period leave. A.1.2= The populations of this species decreased all over Turkey. they are represented by 1-10 couples (=1-20 individuals) in the monitoring site. A.2= The number of the species are represented by 11-25 couples (22-50 individuals) in the monitoring sites. A.3= The number of the species are represented by 26-250 couples (52-500 individuals) in the monitoring sites.											

	A.3.1= There is a decrease in the number of population along the monitoring sites. The number of the species are represented by 251-500 couples (502-1000 individuals) in the monitoring sites A.4= Although the density of the species in the region have not yet come under threat of extinction according to the ATS criteria and IUCN, there is a local decrease in the population number. Moreover, if this trend continued over time the species are candidates to be under threat of extinction The number of the species are represented by 501-5000 couples (1002-10000 individuals) in the monitoring sites. A.5= There is not yet a threat of reduction or depletion in the observed populations of this bird species A.6= This category contains the species that have not been studied adequately and that have non reliable data Since the species coincidental and are recorded only one or at most two times, for now they have not evaluated confidentially and need to be investigated.

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4.12 Mammals

In the scope of the fauna survey carried out in the Project site and its close vicinity in June 2010, mammals such as insectivores, bats, rabbits, rodentia, predators, and ungulates and characteristics of their habitats have been investigated. Literature checks were also carried out as a complement.

The method of the study carried out for the mammals is similar to the study for the amphibians and reptiles. It is relatively difficult to track a mammalian compare to other vertebrates because of their level of complexity. In addition, since mammals are the first species to be affected from the ecocide and habitat losses, their habitats and accordingly their numbers are decreasing. Therefore, the rest of the species have developed strategies for adaptation and hiding in order to survive. Hence, special tracking and capture methods have been used during these studies. Trap used capture methods which are successfully applied for the other groups of species were not preferred for the mammals. This method was considered as the last method to be applied on the unsuccessful cases. After all, there is a risk of injury and even killing of a rare species. Therefore, trace, feather and feces of animals were used to track them. In addition, the local people were interviewed with supplementary visual materials. Besides, literature research has been carried out during the control of the identified species.

The inventory of mammals formed as a result of site survey and habitat inspections are presented in Table 4-29. The conservation status of the mammals that are considered as existing in the project site and its vicinity is presented in the table in accordance with,

- a) Annex II and Annex III of Bern Convention;
- b) European Red List (ERL) prepared by IUCN; and
- c) 2011-2012 Decisions of Central Hunting Commission (CHC) of MoFWA.

As a result of site observations, habitat inspections and assessments, 8 mammals have been identified in the project site and its vicinity.

1 species *Nannospalax nehringi* is classified as Data Deficient category. 5 mammal species are classified as LC (least concern) category. and the remaining 2 species is not included in ERL.

According to the Bern Convention, among the mammal species identified in the project site, 1 species are included in Annex II of Bern Convention which lists strictly protected fauna species and 2 species are included in Annex III of Bern Convention which lists protected fauna species. The rest 5 mammals are not included by the Bern Convention annexes.

According to the 2011-2012 Decisions of Central Hunting Commission,

- 2 mammals are included in Appendix -I which lists the species protected by the MoFWA.
- 2 mammals are included in Appendix -III which lists species allowed to be hunted for a time period. The remaining 4 mammal species are not included in the conservation lists.

There are no endemic mammalian species exist at and around the project area.

Table 4-29 Mammalian Species Recorded in the Project Site and its Close Vicinity, Conservation Status and Habitat Characteristics

Scientific Name	Turkish Name	English name	Project Field	Surrounding Area	ERL (IUCN)	BERN	CHC	Record Type
INSECTIVORA								
ERINACEIDAE								
<i>Erinaceus concolor</i>	Kirpi	Hedgehog	+	+	LC	--	Annex-I	O
CHIROPTERA								
RHINOLOPHIDAE								
<i>Rhinolophus hipposideros</i>	Fare kulaklı yarasa	The Lesser Horseshoe Bat	--	+	LC	Annex-II	Annex-I	O
VESPERTILIONIDAE								
<i>Pipistrellus pipistrellus</i>	Cüce yarasa	The Common Pipistrelle	--	+	--	Annex-III	-	O
LAGOMORPHA								
LEPORIDAE								
<i>Lepus europeus</i>	Yabani tavşan	The European Hare	+	+	LC	Annex-III	Annex-III	O
MICROTINAE								
<i>Microtus lydius</i>	Tarla Faresi	West Anatolian vole	+	+	--	--	-	O
RODENTIA								

SPALACIDAE									
<i>Nannospalax leucodon</i>	Körfare	Blindmole	• +	• +	• DD	--	--	O	
MURIDAE									
<i>Apodemus sylvaticus</i>	Adi Tarla Faresi	The Wood Mouse	+	+	LC	--	--	O	
CARNIVORA									
CANIDAE									
<i>Vulpes vulpes</i>	Kızıl tilki	Red fox	+	+	LC	--	Annex-III	O	
THE ABBREVIATIONS IN THE TABLE									
BERN = Bern Convention on the Conservation of European Wildlife and Natural Habitats CHC : Decisions of Central Hunting Commission RDB : Red Data Book IUCN : International Union of Conservation Nation ERL : European Red List			O=Observation L=Literature						
IUCN (International Union of Conservation Nation) Status LC: Least Concern									
BERN CONVENTION Annex-II : SPFS (Strictly Protected Fauna Species) Annex-III : PFS (Protected Fauna Species)									
2011-2012 Decisions of Central Hunting Commission (CHC): Appendix -I : species protected by the MoEF Appendix-II : species protected by the Central Hunting Commission Appendix –III : species allowed to be hunted for a time period									

4.13 Soil Quality

AECOM collected soil samples at two different depths (0.5-5 m) at five different locations and analyzed for heavy metals and total petroleum hydrocarbons (TPH). The sampling locations are presented in Figure 4-34.

The analyses of the soil samples were carried out by Agrolab Laborgruppe. The results of the analyses are given at Table 4-30 below.



Figure 4-34 Soil Sampling Locations

Table 4-30 Soil Analyses Results and Comparison According to Turkish Soil Pollution Control Regulation

Soil	Unit	Swallowing of soil or skin contact (mg/kg dry soil)	Vapor generation and ambient air exposure (by breathing) (mg/kg dry soil)	Dust generation and ambient air exposure (mg/kg dry soil)	Leaching of chemicals to groundwater and drinking of groundwater SF = 10	848827	848828	848829	848830	848831	848832	848833	848834	848835	848836
						SS1-S (0.5m)	SS1-D (5.0m)	SS2-S (0.5m)	SS2-D (5.0m)	SS3-S (0.5m)	SS3-D (5.0m)	SS4-S (0.5m)	SS4-D (5.0m)	SS5-S (0.5m)	SS5-D (5.0m)
Analyze of the entire fraction						++	++	++	++	++	++	++	++	++	++
Dry matter	%					94.8*	93.6*	91.3*	92.7*	94.7*	89.8*	94.8*	94.6*	94.5*	925.7*
Digestion with aqua regia						++	++	++	++	++	++	++	++	++	++
Arsenic (As)	mg/kg	0,4	-	471	3	22	28	30	31	17	17	15	26	22	25
Lead (Pb)	mg/kg	400	-	-	135	8	8	9	9	6	8	<4	6	7	7
Cadmium (Cd)	mg/kg	70	-	1124	27	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Chromium (Cr)	mg/kg	235	-	24	900000	8	8	7	12	9	16	5	8	8	9
Copper (Cu)	mg/kg	3129	-	-	514	10	12	11	14	8.5	12	6.8	9.8	10	11
Nickel (Ni)	mg/kg	1564	-	-	13	6.2	5.3	5.4	7.6	6.5	17	3.8	5.5	5.6	6.8
Mercury (Hg)	mg/kg	23	3	-	3	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Zinc (Zn)	mg/kg	23464	-	-	6811	30	26	31	31	23	27	24	26	29	26
Hydrocarbons total C10-C40	mg/kg	-	-	-	-	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50

	Swallowing of soil or skin contact
	Vapor generation and ambient air exposure (by breathing)
	Dust generation and ambient air exposure
	Leaching of chemicals to groundwater and drinking of groundwater

The new Soil Pollution Control Regulation (SPCR) was published on June 8, 2010. However, the adaption period will continue until 2012 and the new SPCR will be fully enforced in 2012. In accordance with the SPCR, it is obligatory to prevent pollution, stop pollution in the polluted areas and determine the extent of pollution and carry out. The facility is liable to assure that any type of waste and residue are not discharged, stored directly or indirectly to the receiving environment in compliance with the standards and procedures stated in the Environmental Law and the relevant Regulations in a way that they do not harm soil and cause soil pollution. According to the SPCR, it is the responsibility of the facility owner to remediate (i.e., clean-up) contaminated soil. In addition, after remediation parameters listed in the regulation should be analyzed and the samples should comply with the limit values for these parameters. Moreover the updated SPCR is a risk based regulation in contrary to the previous one.

New soil pollution control regulation sets limit values for selected chemicals under given different scenarios. These scenarios are;

- 1) Swallowing of soil or skin contact,
- 2) Vapor generation and ambient air exposure (by breathing),
- 3) Dust generation and ambient air exposure, and
- 4) Leaching of chemicals to groundwater and drinking of groundwater.

When the soil concentrations are compared with the given values in the Turkish Soil Pollution Control Regulation, it can be noted that Arsenic concentrations exceed the given limit values for all of the soil samples for “swallowing of soil or skin contact” and “Leaching of chemicals to groundwater and drinking of groundwater”. Furthermore, Nickel concentration exceeds the limit values for “Leaching of chemicals to groundwater and drinking of groundwater” at SS3-D (5.0m) sample.

The analyses results indicated that Arsenic concentrations are elevated in all samples. However, the recorded concentrations can be considered as background concentrations since the project area is located on a greenfield site with no previous industrial activity.

The analysis results indicated that there was no petroleum based impact at the project area.

4.14 Naturally Protected Areas

In accordance with the national environmental legislation, there are no national parks, nature reserves, natural monuments, wildlife protection areas, wildlife improvement areas and key biodiversity areas within the project site or in its vicinity.

4.15 Archeological Areas

There are no archaeological, historical and cultural assets in the close vicinity of the project site. However, if any archaeological or cultural asset is found during construction, relevant authorities will be contacted in accordance with the Law on Protection of Cultural and Natural Assets No. 2863.

Cultural assets in the Centre District of the Kırıkkale where the Hacılar Town is located are: Hasandede Tomb Mosque, Necropolis from the Roman Age and archaeological site located at Hacilar-Cumaovası. However, none of these assets are located in the project area or its vicinity.

4.16 Biological Resources

There are no protection areas natural parks, wetlands, natural monuments, natural protection areas, wild life protection areas, biogenetic reserve areas, biosphere reserves, natural/cultural protection areas and monuments, special protection areas, touristic areas and centers, the areas conserved as pasture land by the law within the project area.

4.17 Socio-Economic Characteristics

In this section, socio-economic environment of the project area, demography, land ownerships, economics and public infrastructure of the settlements to be affected from the project is analyzed in three main subtitles: (i) Settlements and Demographics, (ii) Livelihoods and Economics and (iii) Education.

4.17.1 Settlements and Demographics

According to the results of the Address Based Population Census conducted by Turkish Statistical Institute (TurkStat), the total population of Kırıkkale Province was 274,992 in 2011. Urban population was 233,768 and 85% of total population whereas rural population was 41,224 and 15% of total population.

Growth rate of the province is approximately -16.5%. Population of Central District on which the project is located is 202,098 and 95.97% of this population lives in urban and 4.03% of the population live in rural areas. Urban and rural population data of Kırıkkale Province is provided in Table 4-31.

Table 4-31 Urban and Rural Population of Kırıkkale Province

Settlements	Total Population	Urban Population		Rural Population	
		Population	(%)	Population	(%)
Kırıkkale Province	274,992	233,768	85.0	41,224	15.0
Central District	202,098	193,950	95.97	8,148	4.03

Source: TurkStat, 2011 Address Based Population Census Database

The closest settlement to the project area is Hacılar Town of Central District. According to results of the 2011 Address Based Population Census, population of this town was 2,786.

4.17.2 Livelihoods and Economics

According to results of “Socio-Economical Development Rankings of Districts Research” prepared by State Planning Organization in 2004, the most active sector in Central District of Kırıkkale Province is the service industry and 60.39% of total population works in this sector. The other active

sectors in the province are the agriculture with the rate of 21.17% and the industry sector with the rate of 18.45% (Official Website of Kırıkkale Governorate, 2010).

According to financial indicators, gross domestic income per capita (with current prices) is 13,367 TL (10,436 USD).

According to the 2008 data of TurkStat Labor Force Database, labor force participation rate in Kırıkkale Province is 37.8% and the unemployment rate is 10.1%.

According to results of “Socio-Economical Development Rankings of Districts Research”, unemployment rate of Central District of Kırıkkale Province is 16.91%.

4.17.3 Education

According to results of “Socio-Economic Development Rankings of Provinces and Regions Research” conducted by the State Planning Organization and completed in 2003 and “Socio-Economic Development Rankings of Districts Research” completed in 2004, the ratio of literate population in Kırıkkale is 89.12% and in Central District is 91.29%. There are 8 faculties, 6 institutes and 4 vocational schools of higher education in Kırıkkale University.

5.0 ENVIRONMENTAL and SOCIAL IMPACTS

Impact Assessment Methodology

To identify and evaluate potential impacts (positive or negative) of the proposed project on identified receptors and resources, an impact assessment is carried out and associated mitigation measures are recommended for the project. Mitigation measures are developed and described measures to be taken to avoid or minimize any potential adverse effects and enhance potential benefits. The study also assesses the significance of the residual impacts that remain following mitigation.

Impact Types and Definitions

An impact can be defined as the change in any manner to source or receptor caused by the project or project related activities. The assessment study is carried out to evaluate and describe how the physical, chemical, biological and socio-economic environment can be affected by the proposed project. Impacts of the project may be categorized as Positive, Negative, Direct, Indirect and Cumulative. To define them briefly:

Positive Impact: Improvement occurs on the baseline conditions, or cause improvement,

Negative Impact: Adverse change from the baseline, or cause a new undesirable condition,

Direct Impact: Direct interaction between a proposed project activity and the receiving environment/receptors,

Indirect Impact: Result from other activities that occur as a consequence of the project,

Cumulative Impact: Consider and include other project impacts to affect the same resources and/or receptors as the project.

Significance

“Significance” is used to describe the impact which is a function of the magnitude of the impact and the probability of the impact occurring (i.e. likelihood). Impact magnitude, or severity, is a function of the extent, duration and intensity of the impact.

The impact significance and its components are presented in a matrix structure as shown in Table 5-1 below.

Table 5-1 Significance Rating Matrix with Significance Color Scale for Negative Ratings

SIGNIFICANCE				
		LIKELIHOOD		
		Unlikely	Likely	Definite
MAGNITUDE	Negligible	Negligible	Negligible	Minor
	Low	Negligible	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major
LIKELIHOOD: Likelihood: The likelihood that an impact will occur. Unlikely: The impact is unlikely to occur. Likely: The impact is likely to occur under most conditions. Definite: The impact will occur.				
MAGNITUDE: Negligible: The impact on the environment is not detectable. Low: The impact affects the environment in such a way that natural functions and processes are not affected. Medium: Where the affected environment is altered but natural functions and processes continue, however in a modified way. High: Where natural functions or processes are altered to the extent that it will temporarily or permanently cease.				
SIGNIFICANCE: Negligible: A resource or receptor will not be affected in any way by a particular activity, or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background levels. Minor: An effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards, and/or the receptor is of low sensitivity/value. Moderate: Within accepted limits and standards. Major: An accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors.				

Mitigation of Potential Impact

Mitigation is measures and acts that will be implemented to reduce or eliminate the adverse direct or indirect impacts. Minor impacts generally do not require mitigation measures since the impacts is within the accepted standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is reasonably low. This does not always mean that “moderate” impacts have to be reduced to “minor” impacts or to “negligible”, but that medium impacts are being managed effectively and efficiently.

An ESIA study aims not to have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, it is possible that there may be major residual impacts after all practicable mitigation options have been applied. Visual impacts of the projects may be an example for that. However, positive impacts of the project such as employment should be weighted against the negative ones before come up to the decision about the project by the stakeholders.

Residual Impact

Suitable and practical mitigation measures required to be identified and fully implemented for the significant impacts brought about by the project. An EMP (which can be seen at the Table 9-1 at the end of this Report) ensures the implementation of the mitigation measures. After the implementation of the mitigation, each impact is re-evaluated, assuming that the mitigation measure is effectively applied, and any remaining impact is rated once again using the process outlined above. The result is a significance rating for the residual impact.

5.1 Air Emissions

5.1.1 Construction

Prior to construction of the proposed power plant, top soil removal, ground leveling and foundation excavation works will be carried out at the project site. Existing roads will be used for the transportation, thus there will be no new road construction at the project site.

The proposed power plant and switchyard will be constructed on a total area of 139,000 m². The project site is not flat and the lowest elevation is 765 m whereas the highest elevation is 800 m. Prior to the installation of power plant units, the project site will be leveled and the total amount of excavated soil will be 450,000 m³.

Total volume of excavation for foundations will be 63,990 m³ on an area of 57,815 m². Area and excavation volume for each unit of the power plant are given in **Error! Reference source not found.2**.

During construction, topsoil will be separated from sub-soil. Topsoil will be stored on an area having slope not more than 5% and the quality of top soil will be protected. At the end of the construction, topsoil will be used for landscaping.

The excavated material obtained from site leveling will be used in refilling of the lower portion of the project site. In addition, excavated foundations and pits will be refilled according to standard methods. Refilled area will be compacted for foundations. Excavated material that will not be used in refilling will be transported to an area that will be designated by Hacılar Municipality.

Dust emissions will be mainly caused by excavation works and transportation of excavated material on unpaved roads at the project site. The project site is classified as "Industrial Zone" by Hacılar Municipality. There will be no new road construction since the roads near the project site are sufficient and paved. Thus, dust emissions caused by transportation of excavated materials are expected to be negligible.

During the site leveling, dust emissions will be caused by excavation, loading, transportation and unloading works. Emission control methods stated in Turkish IAPCR Annex-1 will be used such as; watering, covered hauling vehicles with tarpaulin, loading and unloading materials without throwing into the air etc. Turkish IAPCR Table 12.6 provides uncontrolled and controlled dust emission factors used in determining dust emission amounts from each construction activity mentioned above. Controlled dust emission factors are presented in Table 5-44 below.

Table 5-2 Excavation Amounts During Construction Phase

Unit	Total Area (m ²)	Volume of Excavation (m ³)
Power Hall	4,890	16,000
Electrical Building	740	3,000
HRSG	1,135	5,000
Stack	225	1,000
Feed Water Pumpset	590	1,200
Workshop and Warehouse Building	655	2,000
Main Transformer	1,385	2,600
Auxiliary Transformer	170	700
ACC	10,975	7,500
ACC Electrical and Service Building	385	1,000
Fan Cooler	865	800
RMS	510	1,500
Gas Boilers	270	500
Wastewater Treatment Plant	255	600
GT Inlet Air Filter	610	700
Auxiliary Steam Boiler	400	1,800
Grease and Gas Storage	55	30
Hazardous Material Storage Area	55	30
Condensate Tank	25	300
Neutralization Pond	200	300
Gas Entrapment Area	60	150
Transformer, Oil Trap	255	700
Water Treatment Building	160	350
Fire & Raw Water Pump House	105	150
Demineralization Tank	145	50
Potable Water Tank	145	300
Fire & Raw Water Tank	190	100
Switchyard Control Building	555	1,000
Maintenance Area	1,650	1,000
380 kV Switchyard	27,600	8,000
Auxiliary Water Pump House for Fin Fan Coolers	170	400
Administration and CCR Building	365	1,400
Gatehouse	25	200
Emergency Generator	40	50
H2 Storage	60	80
Nitrogen Storage	25	80
Sewerage Treatment Plant	100	150
Car Parking Area	600	200
Chemical Injection Skid	170	70
Other	1,000	3,000
Total (Foundation Excavation)	57,815 m²	63,990 m³
Total (Site Leveling)	145,000 m²	450,000 m³

The list of machines that will be used during construction phase is given in Table 5-3 below.

Table 5-3 List of Construction Machines

Machine	Number
Mobile crane (50 t)	6
Mobile crane (100 t)	1
Mobile crane (150 t)	1
Mobile crane (250 t)	1
Mobile crane (500 t)	1
Dump Truck (18 t)	12
Mixer	3
Excavator	3
Backhoe Loader	3
Grader	1
Cylinder	2
Concrete Pump	2
Pile Driver	3
Bulldozer	2

Table 5-4 Controlled Dust Emission Factors Given in Turkish IAPCR

Activity	Controlled Dust Emission Factors (kg/ton)
Excavation	0.0125
Loading	0.005
Transportation (total distance)	0.35
Unloading	0.005

Dust emission calculations for site leveling and foundation excavations are presented in the following sections.

Site Leveling

Dust Emission

Total excavated material volume resulted from site leveling works will be 450,000 m³. Soil density is assumed 1.6 tons/m³ and mass of excavated material is calculated as 720,000 tons. It is expected that site leveling works will take 12 months (360 days). The activities that will generate dust emissions in site leveling works are excavation, loading, transportation and unloading. Dust emissions caused by each activity are calculated as follows;

Excavation

$$\begin{aligned} \text{Dust emission} &= 720,000 \text{ ton} * 0.0125 \text{ kg dust/ton} / (12 \text{ month} * 30 \text{ day/month} * 8 \text{ hrs/day}) \\ &= 3.13 \text{ kg/hr} \end{aligned}$$

Loading

$$\begin{aligned}\text{Dust Emission} &= 720,000 \text{ ton} * 0.005 \text{ kg dust/ton} / (12 \text{ month} * 30 \text{ day/month} * 8 \text{ hr/day}) \\ &= 1.25 \text{ kg/hr}\end{aligned}$$

Transportation

$$\begin{aligned}\text{Dust Emission} &= 720,000 \text{ tones} / (12 \text{ month} * 30 \text{ day/month} * 8 \text{ hr/day} * 20 \text{ tones/trip}) * 0.35 \text{ kg} \\ &\text{dust/vehicle-km} * 0.1 \text{ km} \\ &= 0.44 \text{ kg/hr}\end{aligned}$$

Unloading

$$\begin{aligned}\text{Dust Emission} &= 720,000 \text{ ton} * 0.005 \text{ kg dust/ton} / (12 \text{ month} * 30 \text{ day/month} * 8 \text{ hr/day}) \\ &= 1.25 \text{ kg/hr}\end{aligned}$$

Total Dust Emission

$$\begin{aligned}\text{Dust Emission} &= 3.13 \text{ kg/hr} + 1.25 \text{ kg/hr} + 0.44 \text{ kg/hr} + 1.25 \text{ kg/hr} \\ &= \mathbf{6.06 \text{ kg/hr}}\end{aligned}$$

Turkish IAPCR states that if the total dust emission from fugitive sources is above 1 kg/hr, then an air quality modeling should be carried out in order to assess the impact to ambient air. Therefore, an air dispersion modeling is conducted using AERMOD model in order to determine TSP and PM₁₀ concentrations caused by the construction activities during site leveling.

TSP Dispersion Modeling

Model Inputs

In order to implement AERMOD modeling, the following input parameters are used in the modeling:

- Modeling options;
- Emission rate;
- Receptors;
- Topography; and
- Meteorological data.

Modeling Options

The modeling options are given in Table 5-55. One of the most important parameters is the dispersion coefficient. The project site and the surrounding area can be classified as “rural” according to land use procedure of Auer (1978) described in the U.S. EPA Guideline on Air Quality Models (EPA,2005). Therefore, rural dispersion coefficients are used in the modeling.

Table 5-5 AERMOD Modeling Options

Modeling Option	Value
Dispersion Coefficient	Rural
Terrain Options	Elevated
Anemometer Height	10 m
Decay Coefficient	0.0
Stack-tip Downwash	Used

Emission Rate

The TSP emission rate used in the modeling is calculated as follows:

$$\begin{aligned}\text{TSP Emission} &= 6.06 \text{ kg/hr} * 3,600 \text{ second/hr} / 1,000 \text{ g/kg} \\ &= 1.68 \text{ g/s}\end{aligned}$$

Receptors and Topography

In TSP and PM₁₀ dispersion modeling studies, a comprehensive Cartesian receptor grid extending to 6.3 km from the project site was used. In addition to the 6.3 km receptor grid, a 2 km inner Cartesian receptor grid with 100 m interval is used as the second fine grid.

The Cartesian receptor grids consist of the following nested receptor spacing:

- 100-m increments out to 2 km;
- 500-m increments out to 6.3 km.

The Cartesian receptor grids used in the modeling are shown in **Error! Reference source not found..** Total number of receptors is 630.

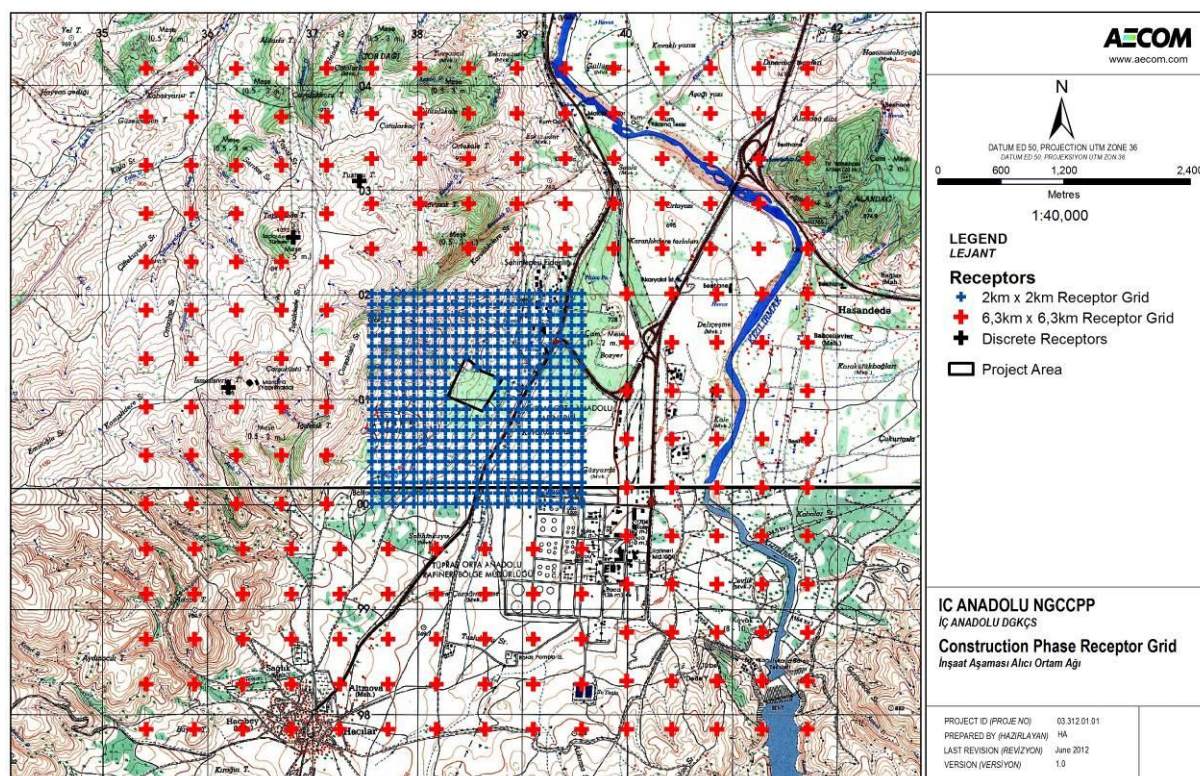


Figure 5-1 Cartesian Receptor Grids

Meteorological Data

The meteorological data recorded at Kırıkkale Meteorology Station in 2011 are evaluated for use in the modeling. In the determination of the meteorological data used in the modeling, the wind speed and direction data recorded in the last ten years were evaluated together with Turkish State Meteorological Service. According to official opinion of Turkish State Meteorological Service, it was decided that the data recorded in the year 2011 represents the best long term meteorological conditions. Thus, the hourly wind speed, wind direction, ambient temperature, cloud cover and cloud ceiling height data recorded between January 1, 2011 and December 31, 2011 are used as the meteorological input in the modeling in accordance with the official opinion of Turkish State Meteorological Service.

TSP Dispersion Modeling Results

Daily TSP concentrations are calculated by modeling TSP emissions associated with site leveling works during construction phase and given in Table 5-66 together with Turkish IAPCR limit values.

Table 5-6 Site Leveling TSP Concentrations and Turkish IAPCR Limit Values

TSP	Concentration (mg/m ² -day)	Turkish IAPCR Limit Value (mg/m ² -day) ¹
Monthly Maximum	91.00	390
Annual Maximum	64.35	210

¹ Turkish IAPCR Limit value for 2013

Monthly TSP concentration contours are presented in Figure 5-2 below. Monthly TSP concentrations are below $21 \text{ mg/m}^2\text{-day}$ at a distance of 200 m from the project site. Monthly TSP concentrations drop below $11 \text{ mg/m}^2\text{-day}$ before reaching to Tüpraş Social Facilities.

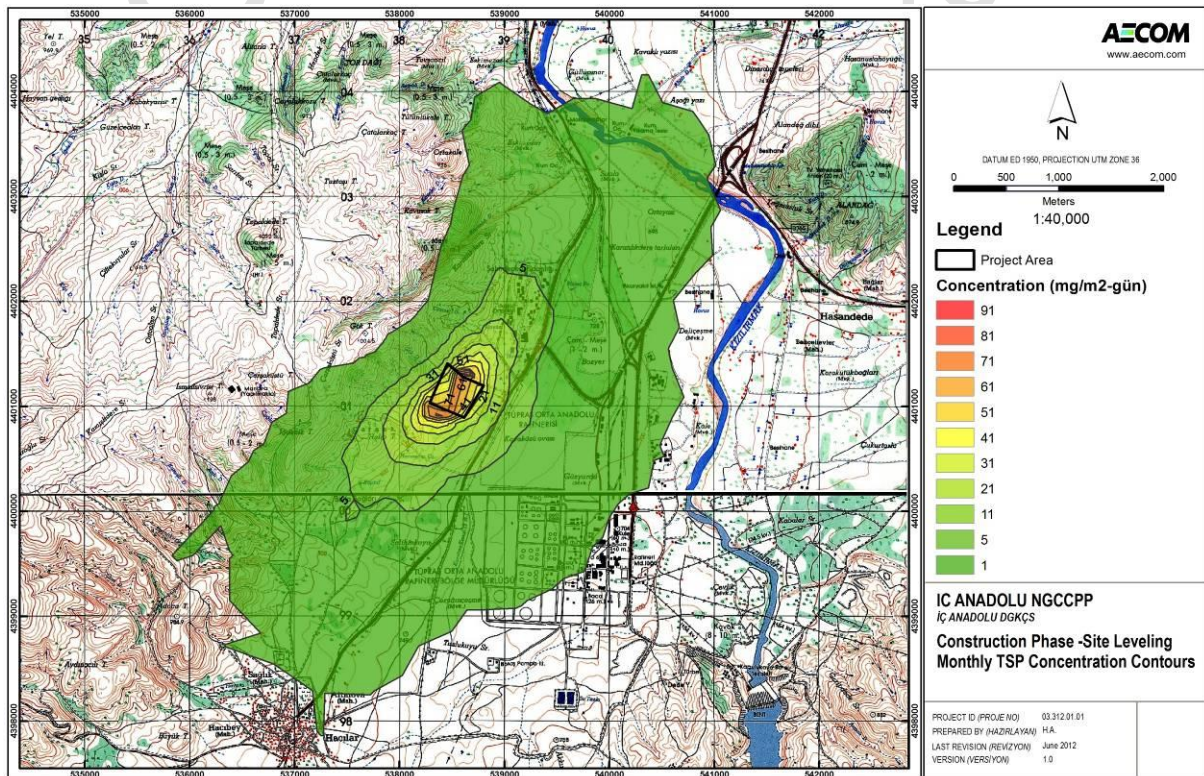


Figure 5-2 Maximum Monthly TSP Concentration Contours During Site Leveling

Annual TSP concentration contours are presented in Figure 5-3 below. Annual TSP concentrations are below $20 \text{ mg/m}^2\text{-day}$ at a distance of 200 m from the project site. Annual TSP concentrations drop below $10 \text{ mg/m}^2\text{-day}$ before reaching to Tüpraş Social Facilities.

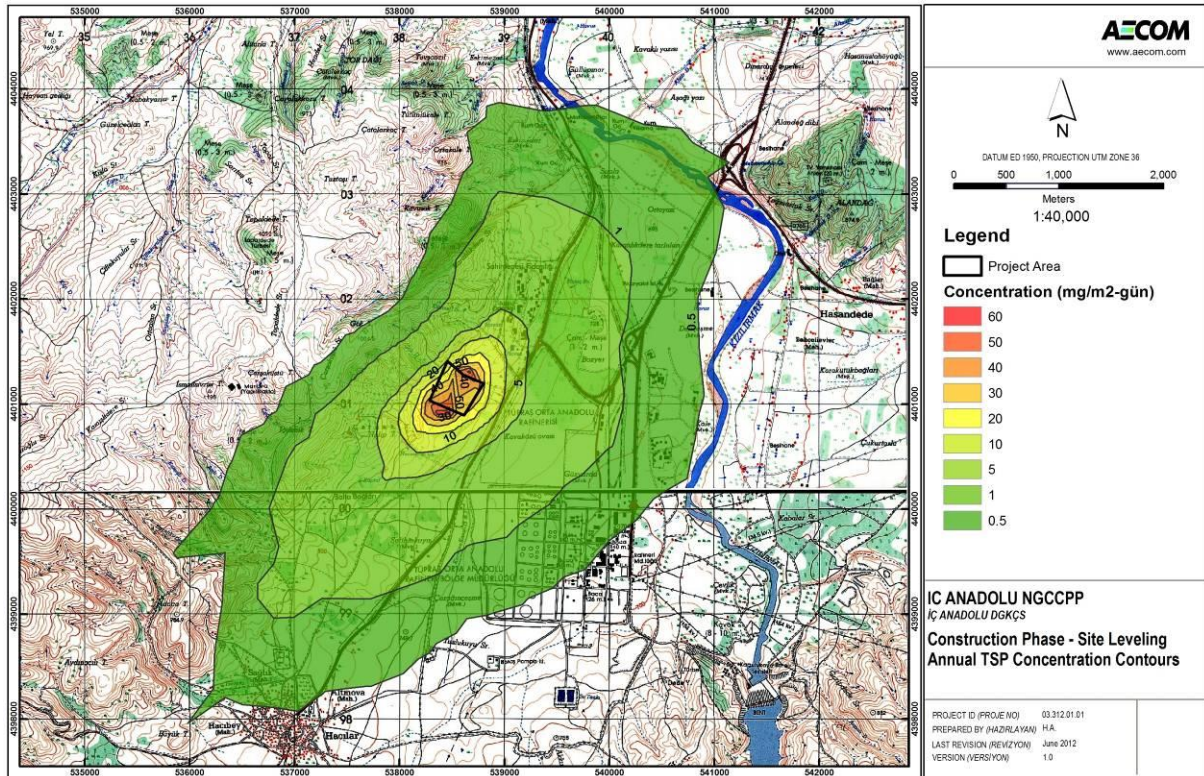


Figure 5-3 Maximum Annual TSP Concentration Contours During Site Leveling

According to the results of AERMOD modeling in order to determine TSP concentration dispersion resulted from site leveling works during construction phase, both monthly and annual TSP concentration values will be in compliance with the limit values given in Turkish IAPCR.

PM₁₀ Dispersion Modeling

AERMOD model is used in order to determine PM₁₀ concentrations associated with site leveling works in the construction phase.

Model Inputs

All input parameters are taken as same parameters used in TSP concentration modeling except the emission rate value. The PM₁₀ emission rate is calculated as follows;

$$\begin{aligned} \text{PM}_{10} \text{ Emission} &= 6.06 \text{ kg/hr} * 0.349 * 3,600 \text{ s/hr} / 1,000 \text{ g/kg} \\ &= 0.59 \text{ g/s} \end{aligned}$$

PM₁₀ Dispersion Modeling Results

Daily and annual PM₁₀ concentration results are given in Table 5-77 together with Turkish IAPCR limit values for 2013 in which the construction phase is assumed to be carried out.

Table 5-7 Site Leveling PM₁₀ Concentrations and Turkish IAPCR and IFC/WB Limit Values

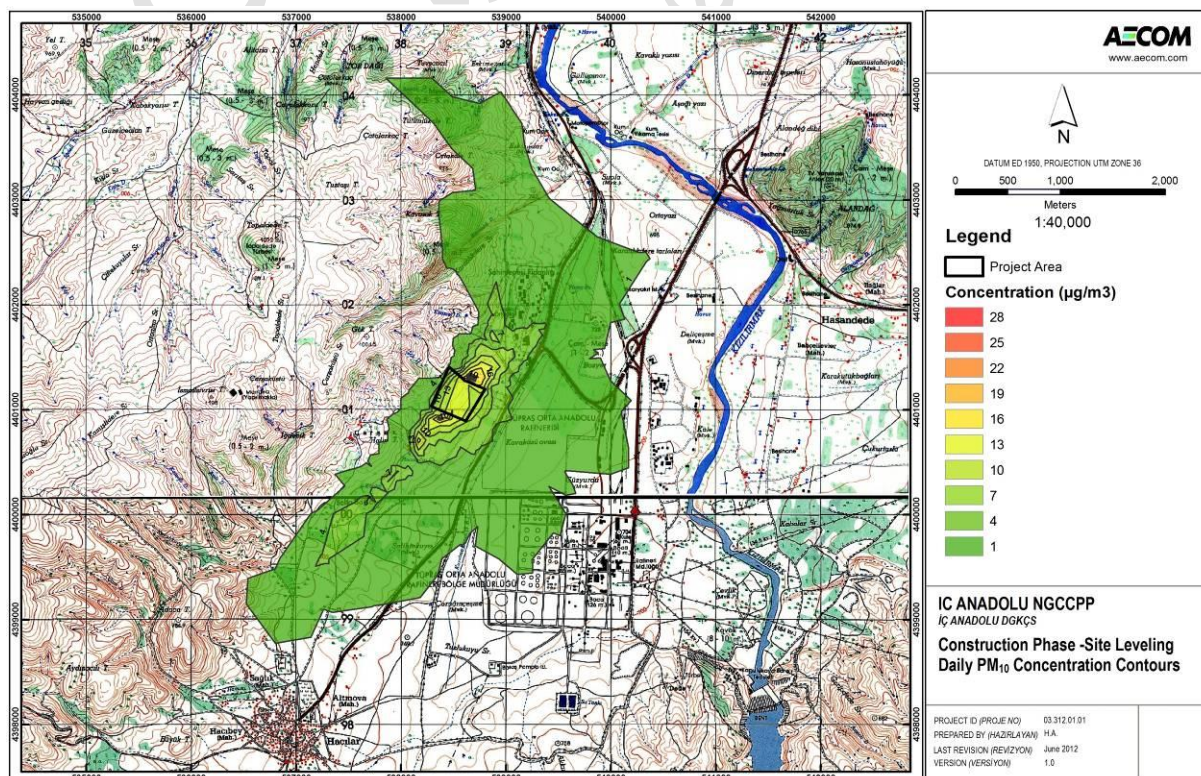
PM ₁₀	Concentration (µg/m ³)	Turkish IAPCR Limit Values (µg/m ³) ¹	Turkish RAMAQ Limit Values (µg/m ³) ²	IFC/WB Guideline Limit Values (µg/m ³)
24-Hour Maximum	28.12	100	50	-
24-Hour (99 th Percentile)	17.03	-	-	50
Annual	3.41	60	40	20

¹ Turkish IAPCR Limit value for 2013

² Turkish RAMAQ Limit value for 2019

According to the AERMOD modeling results, maximum PM₁₀ concentration for 24-hr averaging period is calculated as 28.12 µg/m³. The 99th percentile value of PM₁₀ concentrations for 24-hr averaging period is calculated as 17.03 µg/m³. These results are much lower than the limit values of 50 µg/m³ given in IFC/WB Guideline for 99th percentile value, 100 µg/m³ given in Turkish IAPCR for 2013 and 50 µg/m³ given in Turkish RAMAQ for 2019.

The 24-hr PM₁₀ concentration contours are presented in Figure 5-4 below. As can be seen in Figure 5-4, the receptors at which maximum concentration values are calculated are located near the project site. 24-hr PM₁₀ concentrations are below 10 µg/m³ at a distance of 300 m from the project site.

**Figure 5-4 Maximum 24-Hr PM₁₀ Concentration Contours During Site Leveling**

As it is given in Table 5-7, the annual maximum PM₁₀ concentration is calculated as 3.41 µg/m³. This value is much lower than the limit value of 60 µg/m³ given in Turkish IAPCR for 2013 and 40 µg/m³ given in Turkish RAMAQ for 2019. In addition, it is also below the limit value of 20 µg/m³ stated in IFC/WB Guideline. The annual PM₁₀ concentration contour map is presented in Figure

5-5. According to the results of AERMOD modeling, both 24-hr and annual PM₁₀ concentrations are in compliance with the limit values given in Turkish IAPCR, Turkish RAMAQ and IFC WB Guideline.

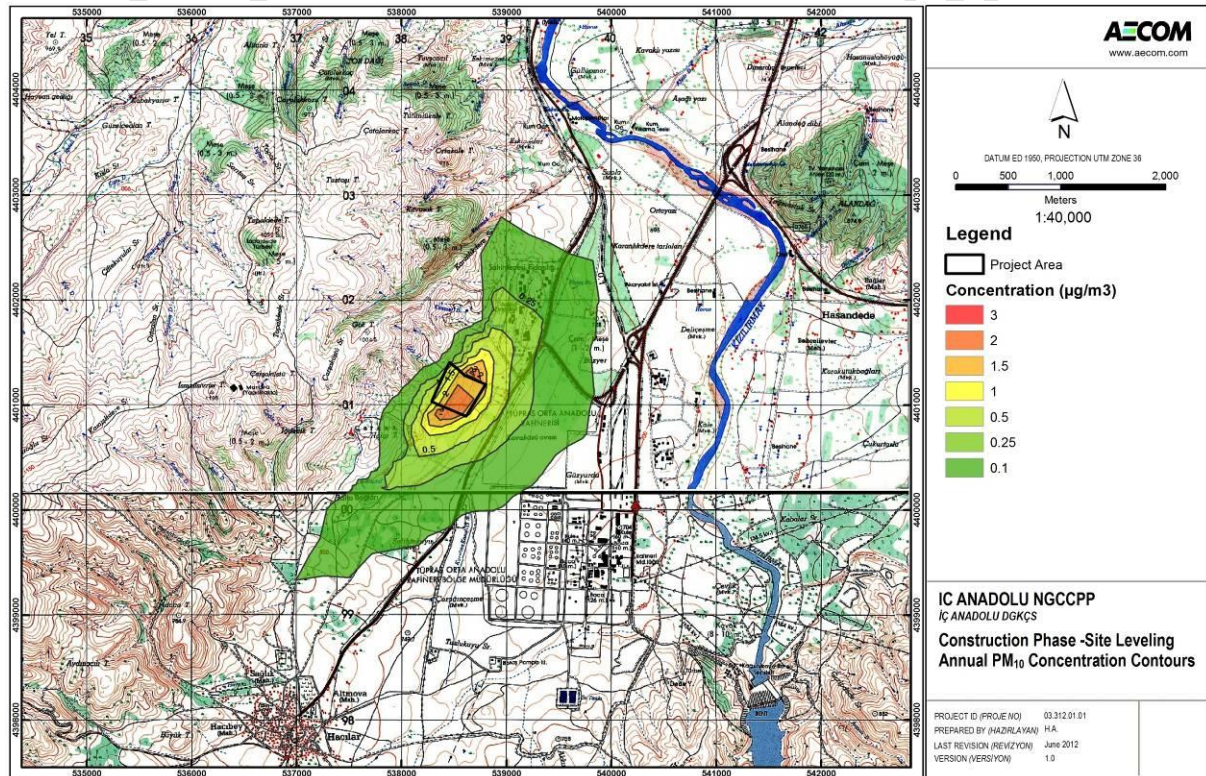


Figure 5-5 Maximum Annual PM₁₀ Concentration Contours During Site Leveling

Foundation Excavation

Dust Emissions

Total excavated material volume resulted from excavation works will be 63,990 m³. Soil density was assumed 1.6 tons/m³ and mass of excavated material is calculated as 102,384 tons. It is expected that site leveling works will take about 3 months (90 days). The activities that will generate dust emissions will be excavation, loading, transportation and unloading. Dust emissions caused by each activity are calculated as follows;

Excavation

$$\text{Dust emission} = 102,384 \text{ ton} \times 0.0125 \text{ kg dust/ton} / (3 \text{ month} \times 30 \text{ day/month} \times 8 \text{ hrs/day})$$

$$= 1.78 \text{ kg/hr}$$

Loading

$$\text{Dust Emission} = 102,384 \text{ ton} \times 0.005 \text{ kg dust/ton} / (3 \text{ month} \times 30 \text{ day/month} \times 8 \text{ hr/day})$$

$$= 0.71 \text{ kg/hr}$$

Transportation

$$\begin{aligned}\text{Dust Emission} &= 102,384 \text{ ton} / (3 \text{ month} * 30 \text{ day/month} * 8 \text{ hr/day} * 20 \text{ ton/trip}) * 0.35 \text{ kg} \\ &\text{dust/vehicle-km} * 0.1 \text{ km} \\ &= 0.75 \text{ kg/hr}\end{aligned}$$

Unloading

$$\begin{aligned}\text{Dust Emission} &= 102,384 \text{ ton} * 0.005 \text{ kg dust/ton} / (3 \text{ month} * 30 \text{ day/month} * 8 \text{ hr/day}) \\ &= 0.71 \text{ kg/hr}\end{aligned}$$

Total Dust Emission

$$\begin{aligned}\text{Dust Emission} &= 1.78 \text{ kg/hr} + 0.71 \text{ kg/hr} + 0.75 \text{ kg/hr} + 0.71 \text{ kg/hr} \\ &= \mathbf{3.45 \text{ kg/hr}}\end{aligned}$$

Turkish IAPCR states that if total dust emission from fugitive sources is above 1 kg/hr, then air quality modeling should be carried out in order to assess the impact on to ambient air. Therefore, AERMOD modeling for TSP and PM₁₀ are conducted in order to determine dust concentrations caused by construction activities during foundation excavation works.

TSP Dispersion Modeling

Model Inputs

The TSP emission rate during foundation excavation works is calculated as follows:

$$\begin{aligned}\text{TSP Emission} &= 3.45 \text{ kg/hr} * 3,600 \text{ second/hr} / 1,000 \text{ g/kg} \\ &= 0.96 \text{ g/s}\end{aligned}$$

TSP Dispersion Modeling Results

Monthly TSP concentration results are calculated by modeling TSP emissions caused by foundation excavation works during construction phase and given in Table 5-8 together with Turkish IAPCR limit values.

Table 5-8 Foundation Excavation TSP Concentrations and Turkish IAPCR Limit Values

TSP	Concentration (mg/m ² -day)	Turkish IAPCR Limit Value (mg/m ² -day) ¹
Monthly Maximum	57.38	390
Annual Maximum	37.68	210

¹ Turkish IAPCR Limit value for 2013

Monthly TSP concentrations results of the modeling are below the Turkish IAPCR as presented in Table 5-8.

The monthly TSP concentration contour map is presented in Figure 5-6 below. As can be seen in Figure 5-6, the receptors at which maximum concentration values are calculated are located near the project site. Monthly TSP concentrations are below 20 mg/m²-day at a distance of 200 m from the project site. Monthly TSP concentrations drop below 10 mg/m²-day before reaching to Tüpraş Social Facilities.

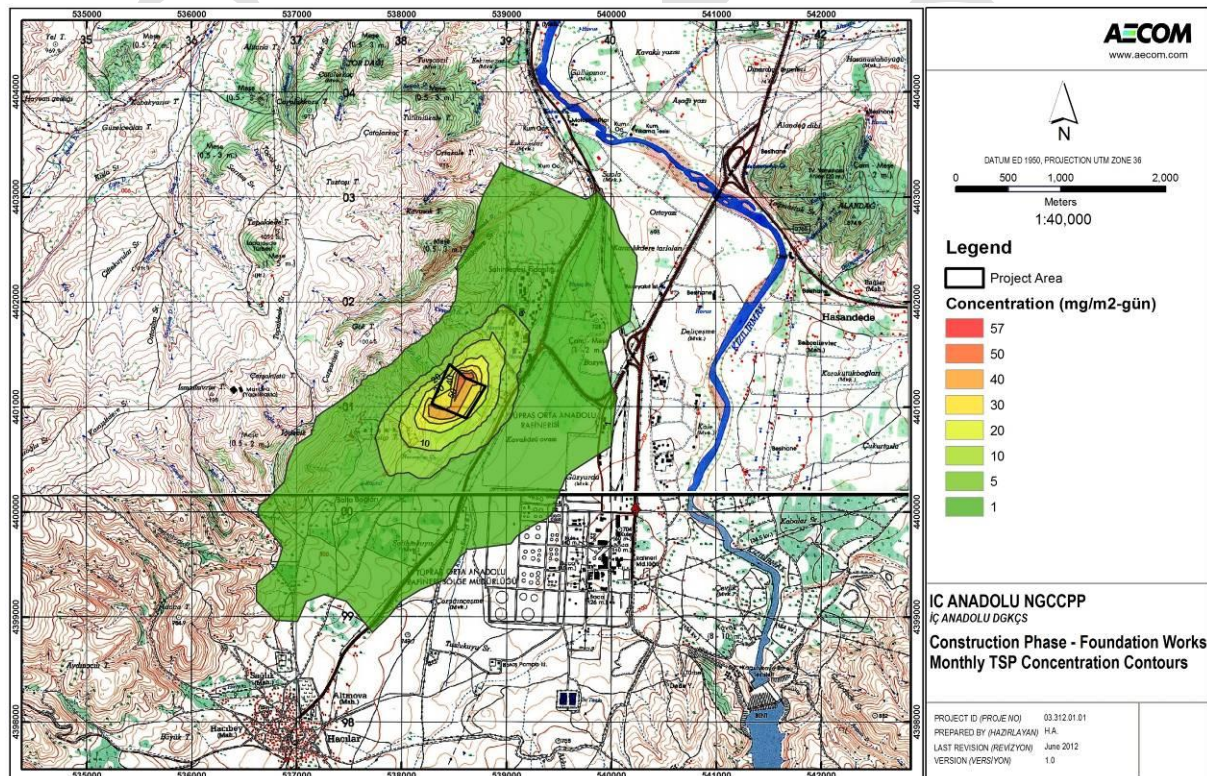


Figure 5-6 Maximum Monthly TSP Concentration Contours During Foundation Excavation

Annual TSP concentration contours are presented in Figure 5-7 below. Annual TSP concentrations are below 10 mg/m²-day at a distance of 200 m from the project site. Annual TSP concentrations drop below 5 mg/m²-day before reaching to Tüpraş Social Facilities.

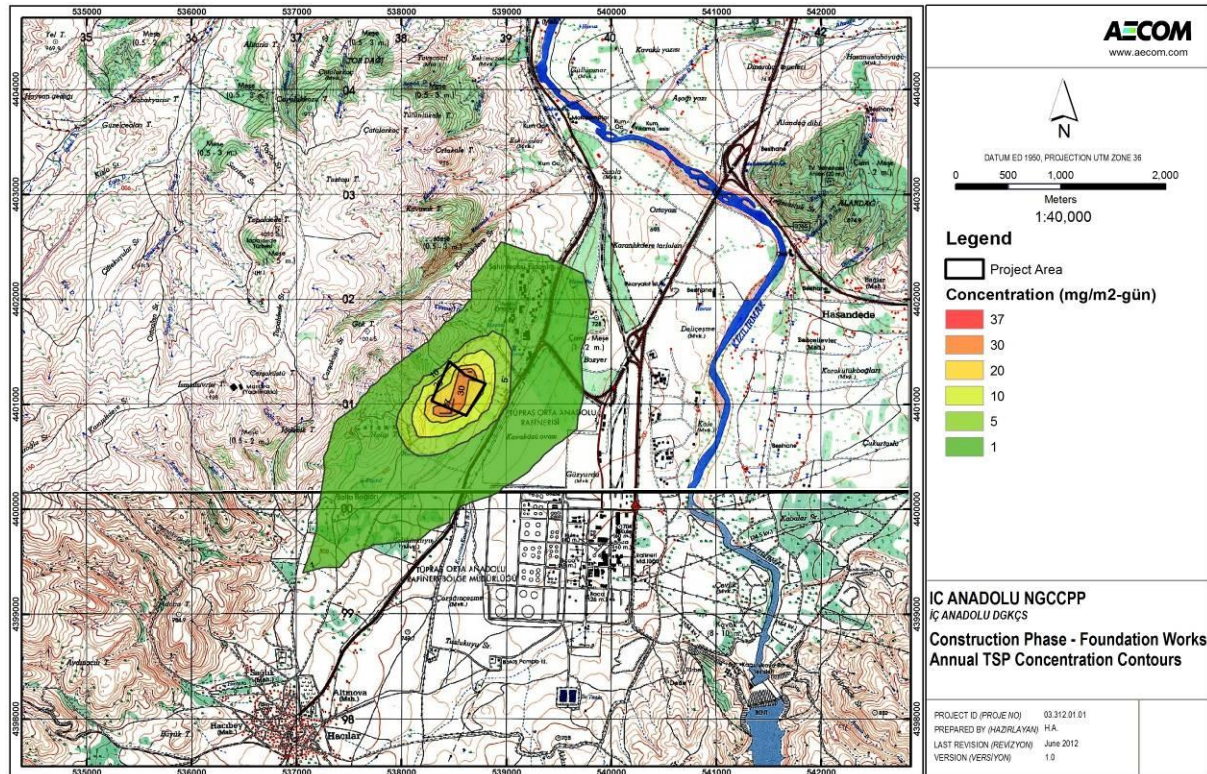


Figure 5-7 Maximum Annual TSP Concentration Contours During Foundation Excavation

According to the results of AERMOD modeling in order to determine TSP concentration dispersion resulted from foundation excavation works during construction phase, both monthly and annual TSP concentration values will be in compliance with the limit values given in Turkish IAPCR.

PM₁₀ Dispersion Modeling

Model Inputs

All input parameters are taken as same parameters used in the TSP modeling except the emission rate. The PM₁₀ emission value used in the modeling is calculated as follows;

$$\begin{aligned} \text{PM}_{10} \text{ Emission} &= 3.45 \text{ kg/hr} * 0.349 * 3,600 \text{ s/hr} / 1,000 \text{ g/kg} \\ &= 0.33 \text{ g/s} \end{aligned}$$

PM₁₀ Dispersion Modeling Results

24-hr and annual PM₁₀ concentrations are calculated by modeling PM₁₀ emissions caused by foundation excavation works during construction phase and given in Table 5-99 together with Turkish IAPCR limit values for 2013 and Turkish RAMAQ limit values for 2019.

Table 5-9 Foundation Excavation PM₁₀ Concentrations and Turkish IAPCR and IFC/ WB Limit Values

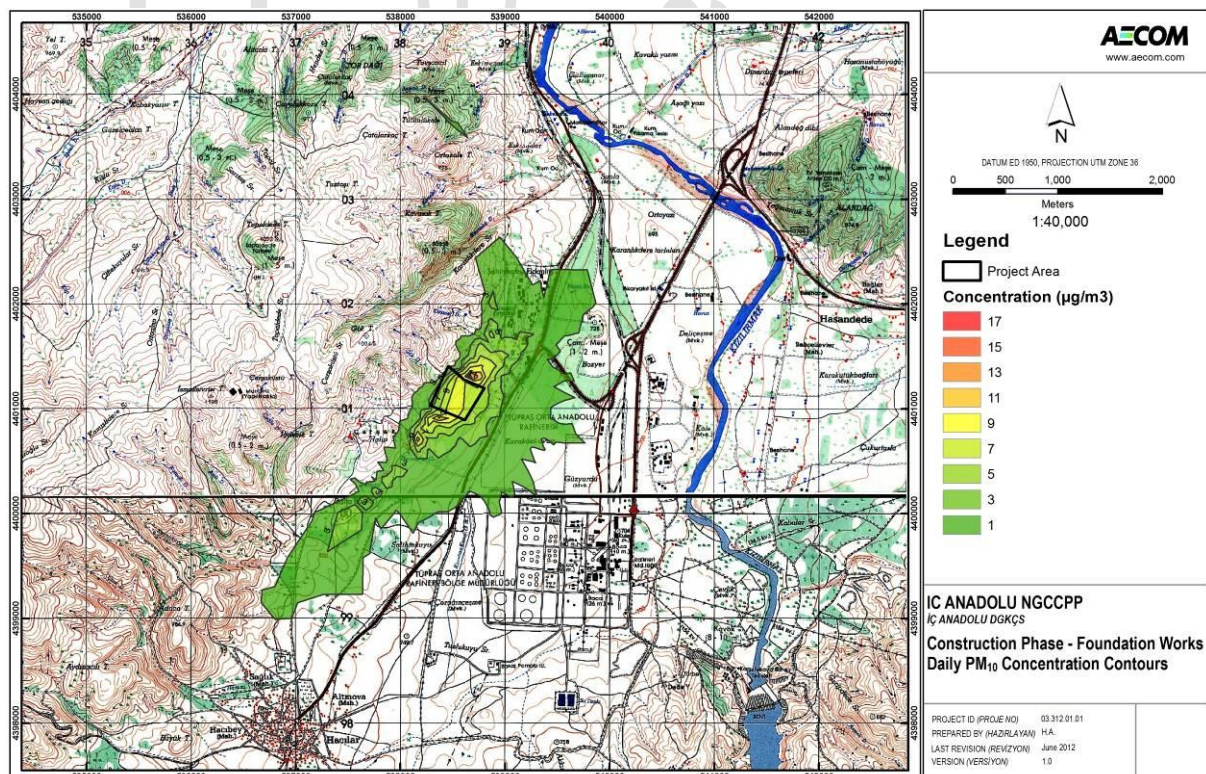
PM ₁₀	Concentration (µg/m ³)	Turkish IAPCR Limit Values (µg/m ³) ¹	Turkish RAMAQ Limit Values (µg/m ³) ²	IFC/WB Guideline Limit Values (µg/m ³)
24-Hour Maximum	17.29	100	50	-
24-Hour (99 th Percentile)	10.13	-	-	50
Annual	1.99	60	40	20

¹ Turkish IAPCR Limit value for 2013

² Turkish RAMAQ Limit value for 2019

According to AERMOD modeling results, the maximum PM₁₀ concentration for 24-hr averaging period is calculated as 17.29 µg/m³. The 99th percentile value of PM₁₀ concentrations for 24-hr averaging period is calculated as 10.13 µg/m³, which is much lower than the limit values of 50 µg/m³ given in IFC/WB Guideline for 99th percentile value.

The 24-hr PM₁₀ concentration contour map is presented in Figure 5-8 below. As presented in Figure 5-8, the receptors at which maximum concentration values are calculated are located in the close vicinity of the project site. 24-Hour PM₁₀ concentrations are below 9 µg/m³ at a distance of 200 m from the project site.

Figure 5-8 Maximum 24-Hour PM₁₀ Concentration Contours During Foundation Excavation

As presented in Table 5-9, the annual maximum PM₁₀ concentration is calculated as 1.99 µg/m³. This value is much lower than the limit value of 60 µg/m³ given in Turkish IAPCR for 2013 and 40 µg/m³ given in Turkish RAMAQ for 2019. In addition, it is also below the limit value of 20 µg/m³ stated in IFC/WB Guideline. The annual PM₁₀ concentration contour map is presented in Figure 5-9. According to the results of AERMOD modeling both 24-hr and annual PM₁₀ concentration

values will be in compliance with the limit values given in Turkish IAPCR, Turkish RAMAQ and IFC/WB Guideline.

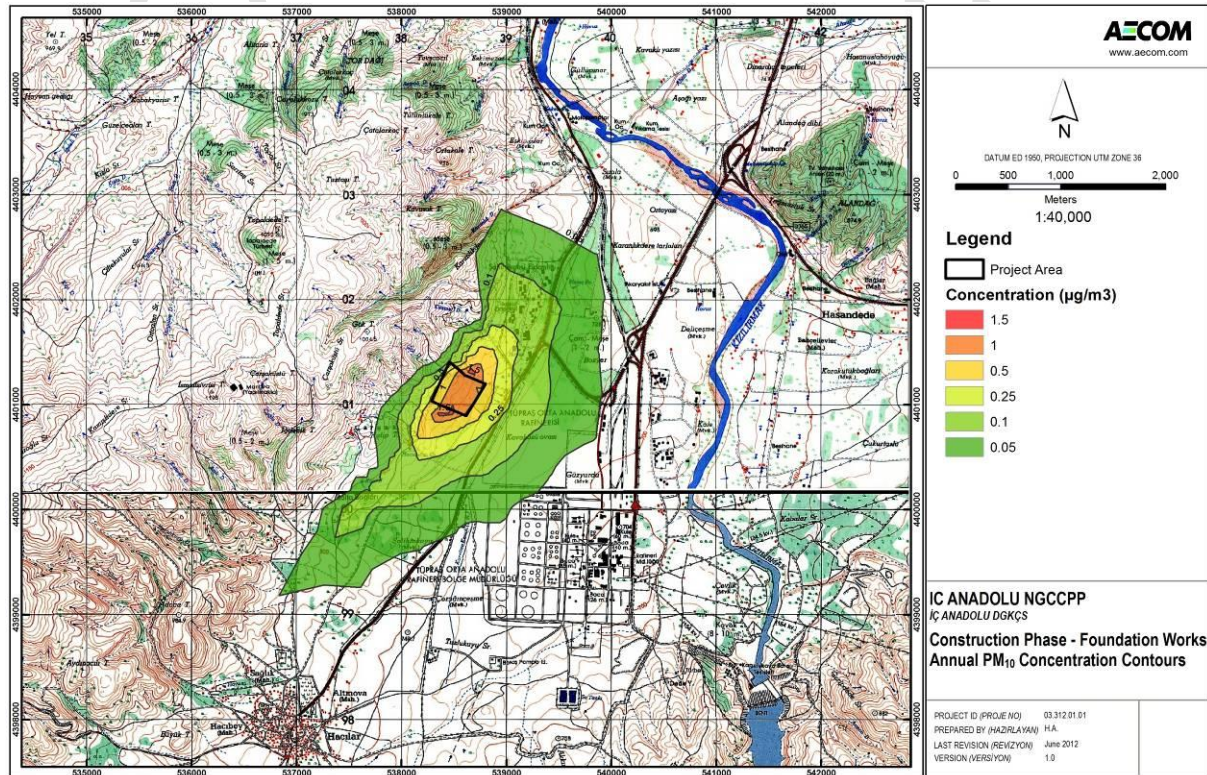


Figure 5-9 Maximum Annual PM10 Concentration Contours During Foundation Excavation

Summary

The impact significance of dust emissions that will be generated during construction is determined as minor since the ambient concentrations will be all below the limits.

Nevertheless, the project will still implement mitigation measures for dust generation during the construction. To prevent dust generation during construction activities, roads will be sprinkled with water regularly, loading and unloading of material that could generate dust will be done without throwing into the air; loads on the hauling vehicles will be covered with tarpaulin type material while in transport. Materials deposited on stockpiles on site will be closely monitored for any emission of dust and if required they will be damped down, covered or treated with a dust suppressant.

All commercial heavy vehicles leaving the site will be washed to prevent the transmission of soil and mud from the site to the public roads. Vehicles will be encouraged to reduce their speed while moving around the site during dry weather to minimize disturbance.

Mitigation measures will further reduce the amount of dust generated and therefore it is expected that dust generated from site leveling and foundation excavation works during construction activities will not create significant adverse impacts on local air quality. After these mitigation measures are taken residual impacts will be negligible or no residual impact will be expected. The proposed

project will comply with the Turkish IAPCR and RAMAQ and IFC/WB Guideline. Thus, no negative long-term air quality impacts are likely to occur.

5.1.2 Operation

5.1.2.1 Turbine Emissions

The Turkish “Large Combustion Plants Regulation (No. 27605, 2010)” provides emission standards for stationary sources. The proposed project must also comply with the Equator Principles. EPFIs use applicable IFC Performance Standards under Principle 3. The projects must demonstrate overall compliance with the IFC/WB “Environmental, Health and Safety Guidelines on Thermal Power Plants”. Proposed power plant emissions will be at or below both the Turkish and the IFC/WB limits. **Error! Reference source not found.** presents the guaranteed emissions from the HRSG stack at the proposed power plant with CGT/HRSG set operating at maximum rated capacity. A discussion of the pollutant emissions, corresponding controls and regulatory limits is provided in the following sections.

Table 5-10 Turkish and IFC/WB Emission Limits

Parameter	Units	Project Value	Emission Limits	
			Turkish	IFC/WB
NO _x	mg/Nm ³ @15% O ₂ , dry	50	50	51
CO	mg/Nm ³ @15% O ₂ , dry	-	100	-
PM/PM ₁₀	mg/Nm ³ @15% O ₂ , dry	Negligible	-	-
SO ₂	mg/Nm ³ @15% O ₂ , dry	Negligible	11.7	-

Nitrogen Oxides (NO_x)

Nitrogen oxide (NO_x) is formed through combustion processes in two ways: (1) the combination of elemental nitrogen and oxygen in the combustion air within the high temperature environment of the combustor (thermal NO_x); and (2) the oxidation of nitrogen contained in the fuel. The rate of thermal NO_x formation is dependent on the residence time, amount of free oxygen and peak flame temperature. Virtually all NO_x emissions originate as nitric oxide (NO), as both nitrogen and oxygen disassociate into the atomic form at the high temperatures within the combustion zone and then recombine to form NO. A minor fraction of the NO is further oxidized in the flue gas system to form NO₂. Because natural gas has negligible nitrogen content, the bulk of the NO_x formation will be through thermal oxidation of nitrogen from the combustion air, referred to as thermal NO_x.

The combustion system of the gas turbine is Dry Low NO_x (DLN) system for control of emissions of NO_x. The DLN combustor is a single stage multi-mode combustor capable of operation with gaseous fuel. A typical DLN combustion system is shown in **Error! Reference source not found.** below. The burning zone is formed by the combustion liner and the face of the cap. The majority of the combustion air is introduced through premix chambers surrounding fuel nozzles. The fuel nozzles have multiple injection locations. Diffusion gas is necessary to achieve stable operation

where turbine fuel-air ratios are too lean to support an entirely premixed (low NO_x) flame. Premix gas is injected through radial spokes upstream of the burning zone in the premix chamber. The ratio of premix to diffusion gas increases as load increases, typically to about 50 percent load, where all the fuel is injected in the premix passages. The minimum NO_x emissions are achieved under such conditions. Premix operation is utilized up to full load operation from this point.

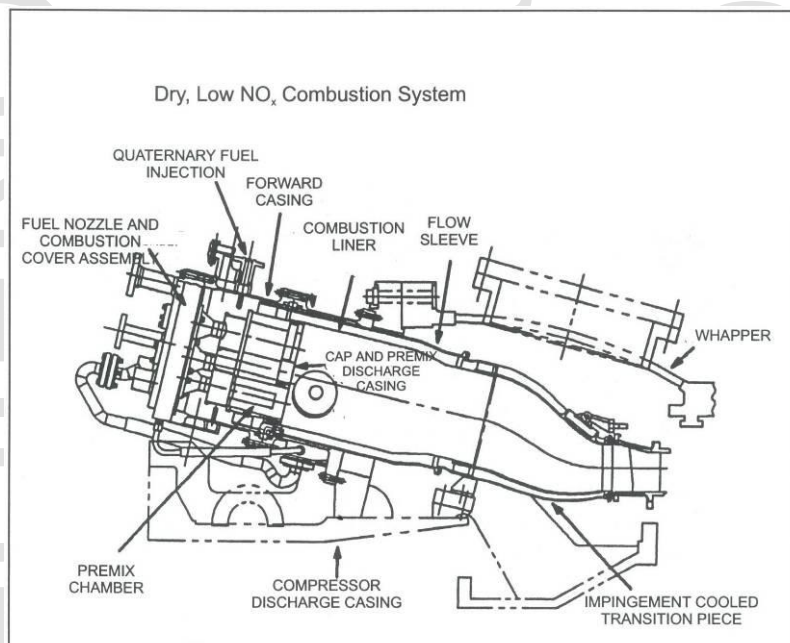


Figure 5-10 Dry Low NO_x Combustion System

Dry low NO_x combustor, GE DLN 2.6, will be used in the proposed Project. The key feature of GE DLN 2.6 is the addition of a sixth burner located in the center of the five existing burners. The presence of the center nozzle enables the DLN 2.6 to extend its 9/9 turndown well beyond the five nozzles. By fueling the center nozzle separately from the outer nozzles, the fuel-air ratio can be modulated relative to the outer nozzles leading to approximately 200°F of turndown from baseload with 9 ppm NO_x .

NO_x emission levels will be in compliance with The IFC/WB limit of 51 mg/ Nm^3 for natural gas referenced to dry conditions and 15 percent oxygen in the flue gas. A normal cubic meter of flue gas is referenced to 0°C and 1 atmosphere of pressure. NO_x emissions will also be in compliance with the Turkish limit of 50 mg/ Nm^3 , dry basis at 15 percent excess oxygen.

Particulate Matter (PM)

Due to the clean burning nature of combined cycle power plants, add-on controls such as baghouses and electrostatic precipitators are not required to control particulates. The most stringent particulate control method available is the use of low ash fuel such as natural gas as primary fuel. Particulate emission during firing natural gas is negligible. The project will emit negligible amounts of PM. Turkey and IFC/WB do not have a PM emission limit.

Sulfur Dioxide (SO₂)

SO₂ is produced by oxidation of sulfur in the fuel. Natural gas contains only traces of sulfur. Use of natural gas is considered best Available Control Technology in the U.S. to minimize SO₂ emissions. In addition, European Commission's "Integrated Pollution Prevention and Control Directive Reference Document on Best Available Techniques for Large Combustion Plants" states that fuel sulphur in natural gas in the form of H₂S is washed out at the production site. Thus, fuel qualities are obtained which directly meet SO₂ emission limit values for all applications. The Project will emit negligible amounts of SO₂, far below Turkish limit of 11.7 mg/Nm³ for natural gas referenced to dry conditions and 15 percent oxygen in the flue gas.

Carbon Monoxide (CO)

CO is formed as a result of the incomplete combustion of carbon and organic compounds in the fuel. CO emissions are a function of oxygen availability (excess air), flame temperature, residence time at flame temperature, combustor design and turbulence. The project will emit negligible amounts of CO, far below Turkish limit of 100 mg/Nm³ for natural gas referenced to dry conditions and 15 percent oxygen in the flue gas.

Green House Gas Emissions and Climate Change Adaptation

Climate change effect of direct CO₂ emissions generated from the proposed power plant is assessed by calculating CO₂ emissions and comparing with total CO₂ emissions of Turkey. CO₂ emissions resulting from the CCGT Power Plant can be calculated as follows:

$$CO_2 \text{ Emission} = \text{FuelEnergyUsed}(TJ) * \text{CarbonIntensity}(tC / TJ) * \text{CarbonFractionOxidised} * (CO_2 / C) \\ (\text{EBRD, 2009})$$

Total fuel used by the Plant assuming 7,000 hours of operation in a year is calculated as follows:

$$\text{FuelEnergyUsed}(TJ) = 1452.8MW * 7000 \frac{\text{hrs}}{\text{year}} * \frac{36 * 10^8 J}{MWh} * \frac{TJ}{10^{12} J} = 36,610.56TJ / \text{year}$$

For natural gas;

$$\text{CarbonIntensity} = 15.3tC / TJ ; \text{ and}$$

$$\text{CarbonFractionOxidised} = 0.995 (\text{EBRD, 2009})$$

Hence, CO₂ emissions resulting from the proposed Power Plant is calculated as follows:

$$CO_2 \text{ Emission}(\text{ton} / \text{year}) = 36,610.56(TJ) * 15.3tC / TJ * 0.995 * (44 / 12) = 2,043,583\text{ton} / \text{year}$$

According to the Turkish Statistical Institute, Green House Gases emissions raised to 366.5 Gg (366,500,000 ton) in 2008. 96.586 Gg of green house gas emissions were generated in 2008 from combined heat and energy sector (TSI, 2008). Hence, green house gas emissions to be generated

by the proposed CCGT Power Plant will be approximately 2.12% of total green house gas emissions generated from combined heat and energy sector in Turkey. It can be concluded that proposed Project will not contribute significantly to greenhouse gas emissions on the national base and the contribution of the project will be minor.

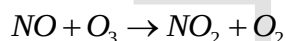
The proposed plant will produce approximately 5,880,000 MWe/y (840MWe * 7000h) which corresponds to 348 gCO₂ /kWh (2,043,583 CO₂ t/y / 5,880,000 MWe/y = 0.348 tCO₂/MWe). Power Plants CO₂ Emissions Performance of New Thermal Power Plants are given in the IFC guidelines for thermal power plants (Table 5-11). The comparison shows that CO₂ emissions from the proposed plant will be below the values given by the IFC Guidelines.

Table 5-11 Power Plants CO₂ Emissions Performance of New Thermal Power Plants

Fuel	Efficiency	CO ₂ (gCO ₂ / kWh – Gross)
Gas	54-58 (CCGT) (Efficiency (% Net, LHV)	348-374 (Net)
Gas	51 (CCGT)	396
Environmental, Health, and Safety Guidelines, Thermal Power Plants		

5.1.2.2 Conversion of Nitric Oxide to Nitrogen Dioxide

The Turkish and IFCWB ambient air quality standards are promulgated in terms of NO₂. However, most of the oxides of nitrogen emitted from combustion sources is nitrogen oxide (NO). With travel time, some of the NO is converted to NO₂ in ambient air. Conversion of NO to NO₂ in the atmosphere occurs through sets of atmospheric reactions. Ambient levels of ozone affect the conversion as the following equation plays a role in NO to NO₂ conversion.



Thus, conversion of NO to NO₂ at the downwind of the stack is mainly determined by atmospheric concentrations of ozone and atmospheric stability. There are sets of equations that take these parameters into account to calculate NO to NO₂ conversion in the atmosphere. Another way of calculation is the use of on-site data by means of measurements. The U.S. EPA's "Guideline on Air Quality Models" (USEPA, 1996) allows use of representative ambient monitoring of NO and NO₂ in order to determine the proper conversion rate of NO_x (NO + NO₂) in the flue gas to NO₂ in the ambient air. Use of ambient measurements to calculate conversion ratio is more accurate as the on-site concentrations and atmospheric conditions are reflected. The model predicted ambient NO_x concentrations are then scaled by this conversion rate to arrive at an ambient NO₂ concentration. Use of representative monitoring data to scale modeled NO_x impacts is called the ambient ratio (AR) method. Since there is no long-term (annual or seasonal) ambient NO and NO₂ concentration measurements in the region, a literature survey is conducted and the common NO₂/NO_x ratio of 0.51 is used in this assessment.

The maximum NO_x impacts predicted from the modeled sources are scaled by 0.51 to arrive at a maximum NO₂ impact. The latter is then added to a monitored background concentration and the total is compared with the Turkish and the IFC/WB ambient standards.

5.1.2.3 Stack Height

Good Engineering Practice (GEP) stack height is defined as the height necessary to insure that emissions from the stack do not result in excessive concentrations of any air pollutant in the immediate vicinity of the source as a result of atmospheric downwash, eddies and wakes that may be created by the source itself, nearby structures or nearby terrain obstacles (U.S. EPA, 1985). The GEP stack height can be calculated using the following formula:

$$H_g = H_b + 1.5(L)$$

where:

H_g = the GEP formula height

H_b = the height of the nearby structure, and

L = the lesser dimension (building height or projected width) of the nearby structure, called the critical dimension).

Both the height and width of a structure are determined from the frontal area of the structure projected onto a plane perpendicular to the direction of the wind. In all instances, the GEP formula for stack height is based on the plane projection of any nearby building that result in the greatest justifiable height. For purposes of determining the maximum GEP formula height, nearby is defined as five structure heights or widths downwind from the trailing edge of the structure.

Prevailing wind directions are from Northeast and East-Northeast of the Project site. It can be seen in the plant layout, shown in Appendix A, that there is no high structure or building located in the northeast or east of the stack location. Thus, it is not possible that the prevailing winds hit first onto a building and results in aerodynamic flow that might create downwash of stacks plume. Although there is no tall building located in the northeast or east of the stack, the GEP stack height is calculated by using the power hall building which is the nearby structure to the stack location. The power hall is 29.8 m above stack base. Building lateral dimensions (length = 60 m; width = 29.4 m) yield a maximum projected width which is greater than the height of the power hall building. Since the maximum projected width is greater than the height, the building is considered a squat structure and the GEP stack height formula equals:

$$H_g = 2.5 H_b$$

because L in equation (1) equals H_b . The GEP formula height is, therefore, 74.5 m (2.5 x 29.8 m).

5.1.2.4 Atmospheric Dispersion Modeling

This section presents the methodology used to quantify ambient impacts from the proposed power project. Pollutant impacts from the Project are estimated using an air quality model approved by the U.S. EPA and recommended by the IFC/WB Guidelines. An air quality model is a set of mathematical equations that relate the release of an air pollutant to the corresponding concentration of the pollutant in ambient air. In this analysis, The American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) was used to calculate concentrations of gases emitted from the HRSG stack.

The suitability of an air quality dispersion model for a particular application is dependent upon several factors. For this study, the following selection criteria have been evaluated:

- stack height relative to nearby structures (i.e., building downwash effect);
- dispersion environment (e.g., urban, rural);
- local terrain (e.g., complex, flat); and
- availability of on-site or representative meteorological data.

The AERMOD model is capable of modeling building downwash by incorporating Building Profile Input Program (BPIP) outputs that performs the GEP calculation for a multi-building complex on a stack-by-stack basis. The AERMOD Model incorporated air dispersion based on planetary boundary layer turbulence structure and scaling concepts, including treatment of both surface and elevated sources, and both simple and complex terrain (AERMOD User's Guide, U.S. EPA, 2004). The hourly meteorological data is available from Kırıkkale Meteorology Station of Turkish State Meteorological Service. Therefore the AERMOD model was selected for this application.

5.1.2.5 Dispersion Model and Inputs

Modeling Scenario

The proposed plant will operate under combined cycle mode by using natural gas as the only fuel. There will be no by-pass stack in the proposed plant, thus the plant will only operate in combined cycle mode. Therefore, AERMOD model is utilized under a scenario in order to simulate the air quality impact during operation in combined cycle mode by using natural gas as the fuel. Both the short-term and long-term air quality impacts during operation are assessed in the AERMOD model runs.

Model Inputs:

The AERMOD model was run for regulatory default option under elevated terrain condition and incorporating building downwash algorithms. The model requires the following inputs for proper application:

- Modeling Options;
- Stack and emissions parameters;
- Building dimensions data;

- Receptor grid;
- Terrain (topography) data; and
- Meteorological data.

In addition to dispersion modeling of ambient air NO_x concentrations, deposition modeling of NO_x emissions is also conducted by using AERMOD.

Deposition Modeling

Although the emissions to be generated from the facility will be kept under control, long term effects of nitrate deposition should be evaluated in order to prevent its negative effects on the environment. Nitrogen deposition is calculated in order to assess its potential acidic effects on soil and vegetation. NO_x is a product generated normally as a result of the combustion of fossil fuels. In the proposed facility, NO_x emissions will be controlled by using a dry low NO_x burner. However, some compounds including nitrogen will reach to the earth surface. Nitrogen is a compound releasing hydronium ions and increasing the ambient acidity. A great amount of nitrogen deposition may result in decrease in pH of sensitive soils so forests and agricultural areas may be destroyed and yield may decrease. On the other hand, a little amount of nitrogen deposition may have positive effects on soil due to its nutritiousness. For these reasons, acid-forming effects of the proposed operation should be evaluated.

Nitrogen deposition occurs in the following steps. First, pollutants released from the stack are dispersed in the atmosphere. A part of these pollutants will reach to the earth surface and remain there. If this situation occurs when it is not raining, this deposition is referred to as “dry deposition”. When pollutants in the stack gas are entrapped in rain drops and deposited during a rain event, the deposition is referred to as “wet deposition”. These two occurrences cannot take place at the same time but both contribute to total deposition of the substances in the exhaust gas in the long term. For this reason, both depositions are assessed as “total deposition”.

Annual dry and wet deposition values of NO_x emissions discharged from the facility are calculated with AERMOD dispersion model. The total deposition value is obtained by summation of dry and wet deposition values. The maximum equivalent acid deposition ratio is calculated from total deposition value and evaluated in the scope of acid buffering capacity of soil. Acid buffering capacity of soil is determined by the analysis of soil samples taken from the project area.

Modeling Options

The options used in AERMOD modeling are given in Table 5-12 below. These values are used according to the recommendations of the U.S EPA. One of the most important options is the dispersion coefficient. The project site and surrounding area can be classified as “rural” according to land use procedure of Auer (1978) described in the U.S. EPA Guideline on Air Quality Models (EPA,2005). Therefore, rural dispersion coefficients are used in the modeling.

Table 5-12 Modeling Options used in AERMOD

Modeling Option	Value
Dispersion Coefficient	Rural
Terrain Options	Elevated
Anemometer Height	10 m
Decay Coefficient	0.0
Stack-tip Downwash	Used

- Stack and Emission Parameters

Stack and emission parameters are required as input into the AERMOD model. Table 5-13 presents the stack and stack gas exit parameters used in AERMOD for the proposed HRSG stacks. For the HRSG stacks, modeling is performed for the maximum load case. The proposed power plant is a base load facility and is expected to operate at lower loads only on rare occasions.

Table 5-13 Stack and Emission Parameters for Modeling

Input Parameters (per stack)	Unit	Value
NO _x Emissions (as NO ₂)	g/s	14.95
Flue Gas Exit Velocity	m/s	18.2
Flue Gas Exit Temperature	°K	355.25
Stack Inside Diameter	M	6.9
Stack height	M	74.5
Stack Base Elevation	meters above sea level	780
Stack1 Location	UTM ED 50 Zone 36, m	538,636E 4,401,144N
Stack2 Location	UTM ED 50 Zone 36, m	538,622E 4,401,112N

- Building Dimensions Data

In order to simulate potential building downwash effect of nearby structures, the GEP calculations are incorporated into AERMOD runs. The direction-specific building dimensions are determined using the U.S. EPA's Building Profile Input Program software (BPIP) using the design values of the stack and building heights. The height, length and width of the buildings used in building downwash calculations in BPIP model are presented in Table 5-14. Figure 5-11 shows on-site structures that could potentially cause downwash from sources.

Table 5-14 Building Dimensions Used in BPIP

Building	Height (m)	Length (m)	Width (m)
Power Hall-1	29.8	60	29.4
Power Hall-2	29.8	66.5	29.4
Power Hall-3	15	66.5	17.6
HRSG-1	40	23	15
HRSG-2	40	23	15

Air-Cooled Condenser	39	118	92.4
Electrical Building	14.4	44.6	16.5
Auxiliary Steam Boiler	19	21	19

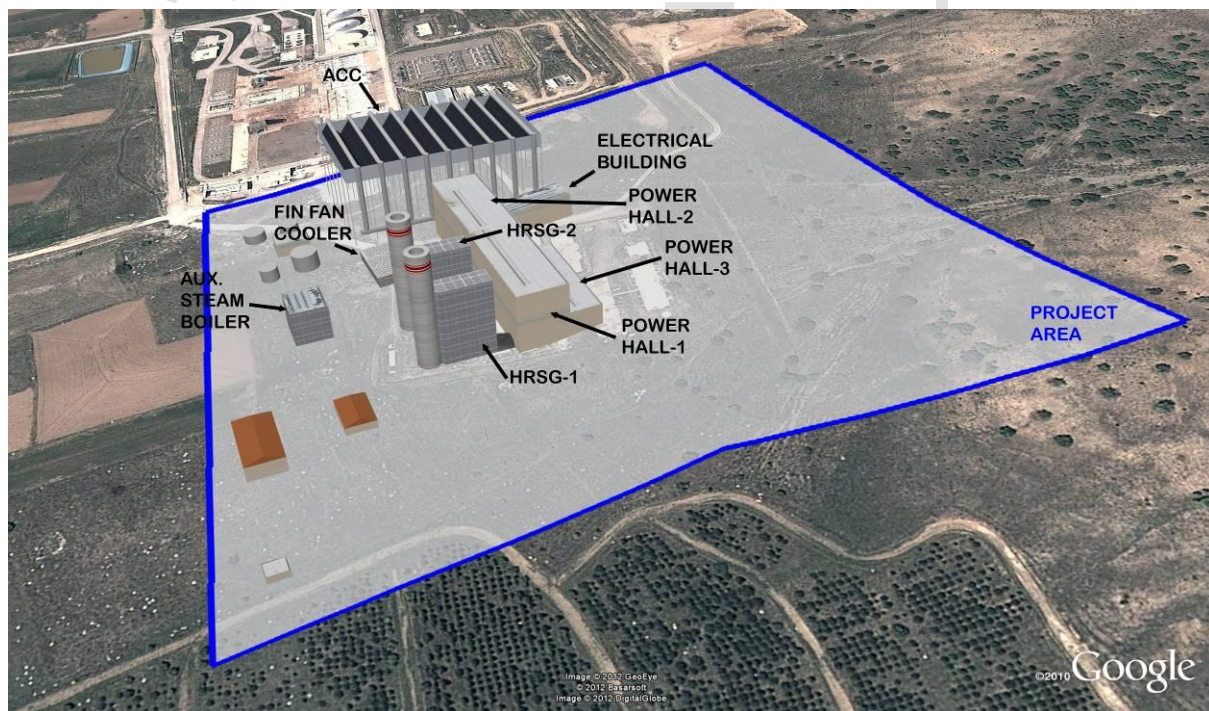


Figure 5-11 3D Representation of Buildings and Structures in the Project Site

- Receptor Grid and Terrain Data

A Cartesian receptor grid extending to 12 km from the project site is used in the AERMOD modeling to assess maximum ground-level pollutant concentrations. The 12-km receptor grid is more than sufficient to resolve the maximum impacts and any potential significant impact in the project area.

The rectangular Cartesian receptors grid consists of the following nested receptor spacing:

- 500-m increments out to 6.3 km;
- 1000-m increments out to 12 km.

The receptor grid is developed and processed with AERMAP that is the terrain pre-processor of the AERMOD model. A total of 392 receptors are used in the modeling. In addition to Cartesian receptors, hilltops and populated places located in 12-km modeling area are also inputted into the model as discrete receptors. Total of 20 discrete receptors are included in the modeling. The names and coordinates of the discrete receptors used in the model are given in Table 5-15.

Table 5-15 Discrete Receptor Coordinates

Receptor Name	Easting (m)	Northing (m)	Elevation (m)
Residential Areas			
Bahşılı	537,578.37	4,405,868.96	797
Hacılar	536,936.75	4,397,812.77	779
Hasandede	543,905.80	4,401,727.75	762
Hilltops			
Ağıldere Hill	532,902.13	4,402,523.32	1,041
Ardıçlı Hillside	533,212.23	4,397,568.83	1,113
Atayağlı Region	535,501.48	4,404,468.65	911
Bozada Hill	532,729.47	4,398,519.97	1,200
Çağlayükseğin Hill	537,513.48	4,396,381.63	814
Çiftekuyular Hillside	535,114.76	4,402,238.67	983
Emiroğlu Hillside	534,557.84	4,400,560.89	1,160
İğnekuyu Hill	532,750.88	4,401,408.40	1,100
İsmailsivrisi Hill	536,196.45	4,401,121.39	1,075
Keçi Hill	533,480.10	4,398,523.29	1,164
Kütürlük Region	537,244.29	4,406,281.55	896
Topaldede Hill	536,818.94	4,402,550.61	1,052
Tuztaşı Hill	537,445.96	4,403,091.68	1,024
Yel Hill	534,701.46	4,404,455.27	959
Unnamed Hill 1	534,221.62	4,400,051.76	1,165
Unnamed Hill 2	533,929.90	4,399,326.20	1,174
Unnamed Hill 3	533,060.89	4,396,498.66	1,040

Elevated terrain option is used in the modeling in order to represent the real-site conditions. Terrain elevations are obtained in the UTM format and converted to the DEM format. The generated DEM data is processed with AERMAP to develop the receptor terrain elevations. The receptor grids together with the 2-dimensional terrain data used in the modeling are shown in Figure 5-12. Figure 5-13 shows a 3-dimensional view of the digital terrain data.

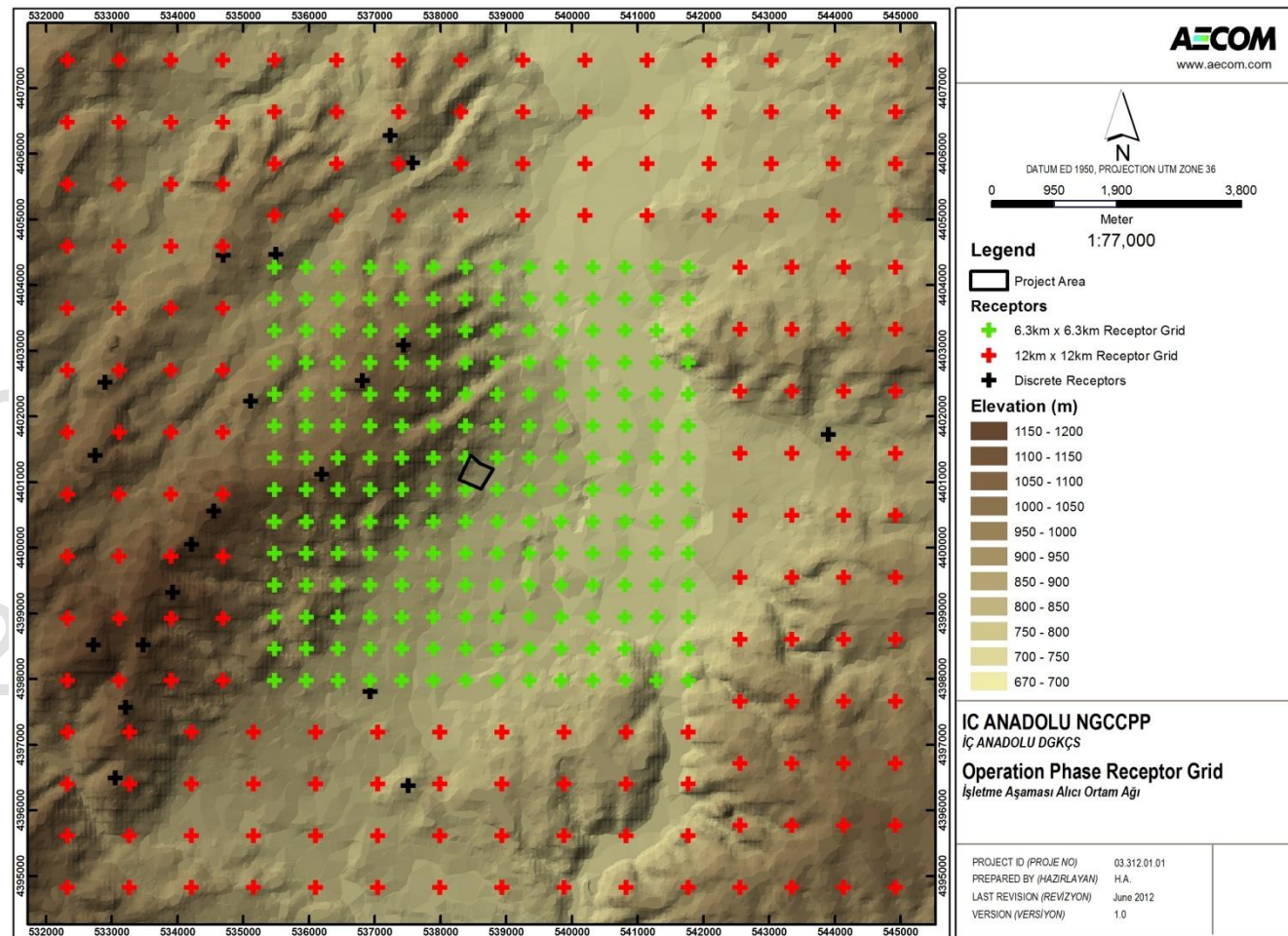


Figure 5-12 Two Dimensional View of Receptor Grid and Terrain Data Used in the AERMOD Modeling

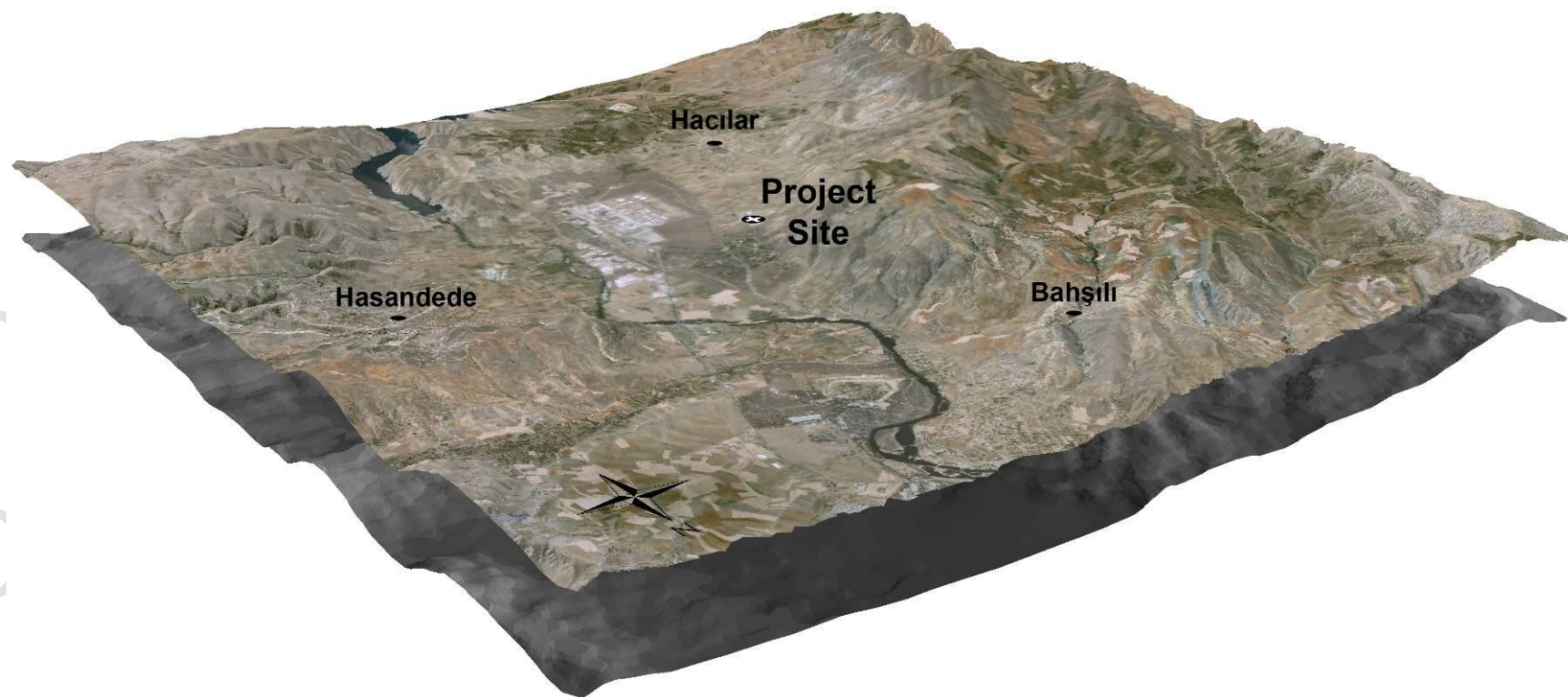


Figure 5-13 Three Dimensional View of Terrain Data Used in the AERMOD Modeling

- Meteorological Data

The meteorological data recorded at Kırıkkale Meteorology Station in 2011 are evaluated for use in the modeling. In the determination of the meteorological data used in the modeling, the wind speed and direction data recorded in the last ten years were evaluated together with Turkish State Meteorological Service. According to official opinion of Turkish State Meteorological Service, it was decided that the data recorded in the year 2011 represents best the long term meteorological conditions. Thus, the hourly wind speed, wind direction, ambient temperature, cloud cover and cloud ceiling height data recorded between January 1, 2011 and December 31, 2011 are used as meteorological input in the modeling in accordance with the official opinion of Turkish State Meteorological Service. The wind rose generated from the wind data recorded at the Kırıkkale Meteorology Station in 2011 is shown in Figure 5-14.

The meteorological data required for input to AERMOD was created with AERMET, the meteorological pre-processor, which utilizes hourly surface observations. AERMET creates two output files for input to AERMOD:

- SURFACE: a file with boundary layer parameters such as sensible heat flux, surface friction velocity, convective velocity scale, vertical potential temperature gradient in the 500-m layer above the planetary boundary layer, and convective and mechanical mixing heights. Also provided are values of Monin-Obukhov length, surface roughness, albedo, Bowen ratio, wind speed, wind direction, temperature, and heights at which measurements were taken.
- PROFILE: a file containing multi-level meteorological data with wind speed, wind direction, temperature, sigma-theta ($\sigma\theta$) and sigma-w (σw) when such data are available.

AERMET requires specification of site characteristics including surface roughness (z_0), albedo (r), and Bowen ratio (Bo). The values of 0.2, 0.28 and 0.75 are used for z_0 , r , and Bo , respectively according to the guidance provided by the U.S. EPA.

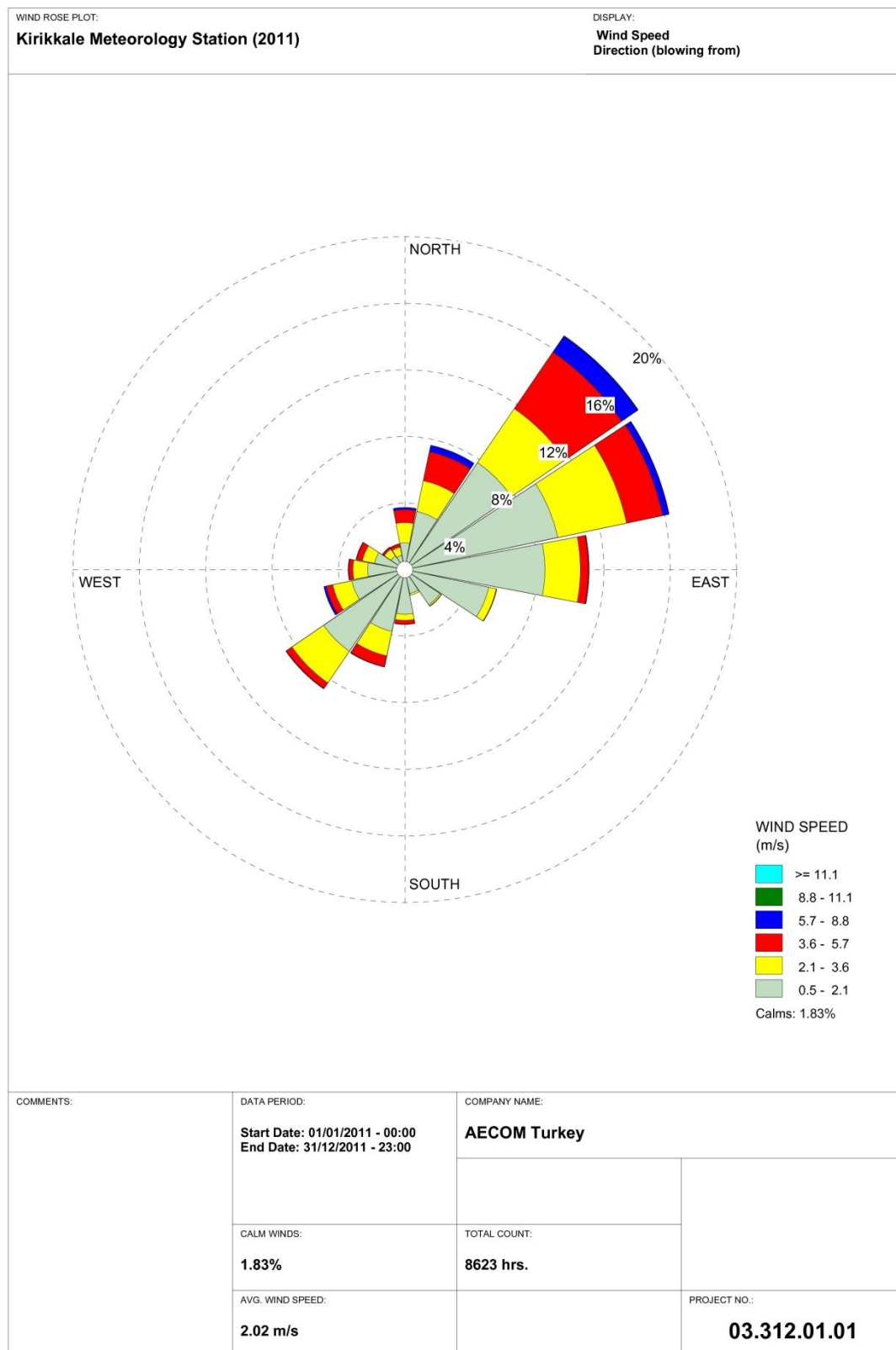


Figure 5-14 Wind Rose for Kirikkale Meteorology Station (2011)

5.1.2.6 Modeling Results

The AERMOD modeling results, focused on the emissions of NO_x (as converted to NO₂), are given as maximum predicted concentrations for 1-hr, 24-hr and annual averaging periods in Table 5-16 below. In addition to the maximum predicted concentrations, 99.79th percentile for 1-hr and maximum concentrations for 24-hr averaging periods are presented in the table. Moreover, the measured background NO₂ concentrations in the study area and cumulative concentrations (i.e., power plant impact plus the background) are given in the table. The calculated cumulative concentration values are also compared with the Turkish and IFC/WB limit values in the table.

The highest annual average NO₂ impact from the proposed power plant is 5.11 µg/m³. This concentration is predicted to occur to the W (270 degrees) of the proposed project at a distance of 1.7 km and an elevation of 1,021 m, mean sea level (msl). The average background NO₂ concentration determined from the monitoring study is 2.85 µg/m³. Thus, cumulative concentration (NO₂ impact plus background value) is calculated as 7.96 µg/m³. This concentration is much lower (only about 13.27 percent of the limit) than the target limit value of 60 µg/m³ for 2013 stated in the Turkish Industrial Air Pollution Control Regulation (IAPCR). In addition to Turkish IAPCR limit value for NO₂, the Turkish Regulation on Assessment and Management of Air Quality (RAMAQ) sets a target limit value for NO₂ for the year 2024 as 40 µg/m³. The calculated cumulative concentration is much below the target limit value stated in both the Turkish RAMAQ and IFC/WB Guideline value of 40 µg/m³. Thus, the long-term (annual) predicted NO₂ impact of the power plant to the ambient air will be negligible.

Figure 5-15 presents the distribution of the predicted NO₂ impacts for the annual averaging period. The orientation of the maximum concentrations is at the W and SW of the proposed power plant. Location of the maximum predicted concentrations is affected by meteorological parameters, topography and emission source parameters (building orientations, stack parameters, etc.). Prevailing winds are blowing from NE and ENE directions in the area. Therefore, Figure 5-15 shows that the annual ground level concentrations are affected mostly by the prevailing wind regime of the region. Relatively close distance of maximum concentrations to the plant site is due to the topography around the power plant. The figure shows that predicted concentrations from the Project are low relative to Turkish Regulations and IFC/WB Guidelines. The figure also shows that the proposed power plant emissions will have a negligible impact at the populated places Hacılar Town, Tüpraş Social Facilities and Tüpraş Orta Anadolu Refinery located in the close vicinity of the plant site.

Table 5-16 Results of the AERMOD Modeling for the Proposed Power Plant

Averaging Period	NO ₂ Modeling Results				Monitored Background Conc. (µg/m ³)	Cumulative Conc. (µg/m ³)	Turkish IAPCR Limits (µg/m ³) ²	Turkish RAMAQ Limits (µg/m ³) ⁴	IFC/WB Guideline (µg/m ³) ¹
	Modeled Max. Average Concentration (µg/m ³)	Easting (m)	Northing (m)	Distance from stack (km)					
1-hr (Max)	160.38	537,417.44	4,401,370.50	1.25	2.88	163.26	-	-	200
1-hr (99.79 th %ile)	130.4	537,417.44	4,401,370.50	1.25	2.88	133.28	-	200	-
24-hr (Max)	29.6	536,932.88	4,400,885.50	1.7	2.34	31.94	300	-	-
Annual	5.11	536,932.88	4,400,885.50	1.7	2.85	7.96	60	40	40
¹ The IFC/WB Guideline values are provided for comparison purposes only although the project will only be required to meet the Turkish limit values as per the IFC/WB guidelines which states that local standards should be met unless they are not available. ² Turkish IAPCR target limit value for 2013. ³ Turkish RAMAQ target limit value for 2024. Notes: - Annual average impacts assume annual average emission rates. - NO ₂ impacts assume 51% conversion of the stack emissions of NO _x to NO ₂ in the ambient air per the U.S. EPA guidance. - Turkish Regulations and IFC/WB Guideline levels apply to this project.									

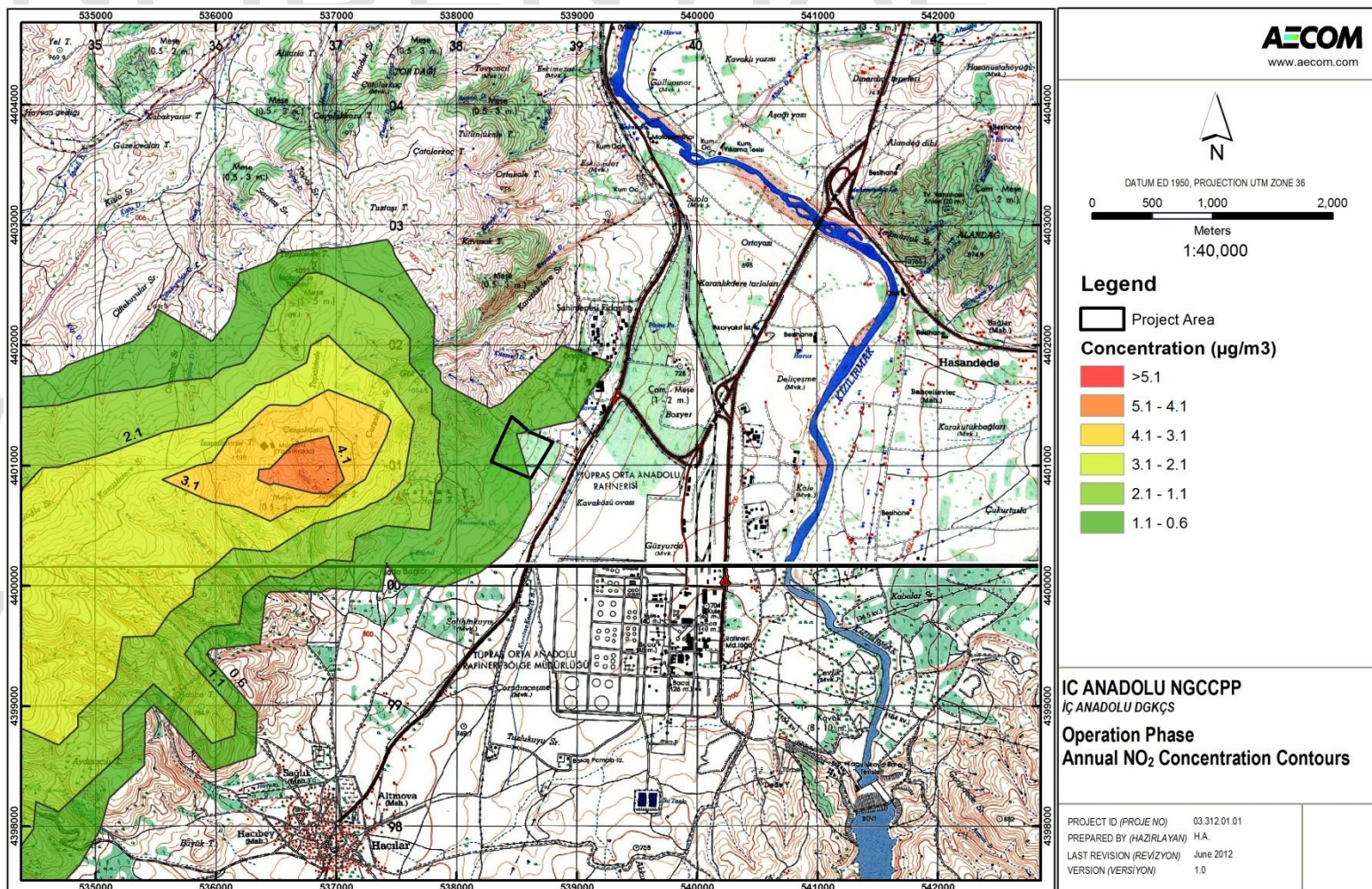


Figure 5-15 Maximum Predicted NO₂ Impact for the Annual Averaging Period

The maximum prediction for 24-hr averaging period is $29.6 \mu\text{g}/\text{m}^3$. This concentration is predicted to occur to the W (270 degrees) of the proposed power plant at a distance of 1.7 km and an elevation of 1,021 m, msl. The closest background NO_2 sampling to the location where maximum 24-hr impact occurred is Sample-1 and the measured NO_2 background at Sample-4 is $2.34 \mu\text{g}/\text{m}^3$. Thus, the cumulative concentration is calculated as $31.94 \mu\text{g}/\text{m}^3$. This concentration is much lower than the target limit value of $300 \mu\text{g}/\text{m}^3$ for 2013 stated in the Turkish IAPCR. There is no value for NO_2 for 24-hr averaging period in both Turkish RAMAQ and IFC/WB Guidelines. The daily predicted NO_2 impact of the power plant to the background air is almost negligible.

Figure 5-16 presents the distribution of the predicted maximum NO_2 impacts for the 24-hr averaging period. The orientation of the maximum concentrations is toward the W of the proposed power plant. Maximum predicted concentrations on the W receptor grids are influenced by both the prevailing winds and elevations located on the west. High elevations are also located on the W of the plant site yielding maximum concentrations.

The 99.79th percentile 1-hr impact from the proposed power plant is $130.4 \mu\text{g}/\text{m}^3$. It is predicted to occur to the W (280 degrees) of the proposed power plant at a distance of 1.25 km and an elevation of about 998 m, msl. Although no measurement study performed to determine hourly background NO_2 concentration around the project site, the results of the passive sampling study carried out for two months were used since there is no activity causing NO_2 emission. Therefore, it is assumed that hourly NO_2 concentrations around the project site do not show high variations and the average NO_2 concentrations determined from the passive sampling study can represent the hourly NO_2 concentrations. The closest background NO_2 sampling location to the 99.79th percentile of 1-hour impact location is Sample-1 and the measured NO_2 background at Sample-1 is $2.88 \mu\text{g}/\text{m}^3$. Thus, the cumulative concentration is calculated as $133.28 \mu\text{g}/\text{m}^3$. This concentration is below the Turkish RAMAQ target limit values for 2024. In addition to the 99.79th percentile 1-hr impact from the proposed power plant, maximum NO_2 concentrations for 1-hr averaging period was also predicted. The maximum 1-hr impact from the proposed power plant is calculated as $160.38 \mu\text{g}/\text{m}^3$. It is predicted to occur at the same location as the 99.79th percentile 1-hr impact occurred. The cumulative concentration is calculated as $163.26 \mu\text{g}/\text{m}^3$. Figure 5-17 presents the distribution of the predicted maximum NO_2 impacts for the 1-hr averaging period. Maximum concentrations occur at W of the plant site where the high elevations exist.

In summary, the cumulative concentrations calculated from the summation of predicted long-term and short-term NO_2 impacts from the Project and the monitored background NO_2 concentrations are below the limit values given in both Turkish Regulations and IFC/WB Guidelines. In addition, the populated places, Hacılar Town, Bahşılı Town, Tüpraş Social Facilities and Tüpraş Orta Anadolu Refinery, located around the project site will not be affected by the emissions associated with the proposed power plant operations.

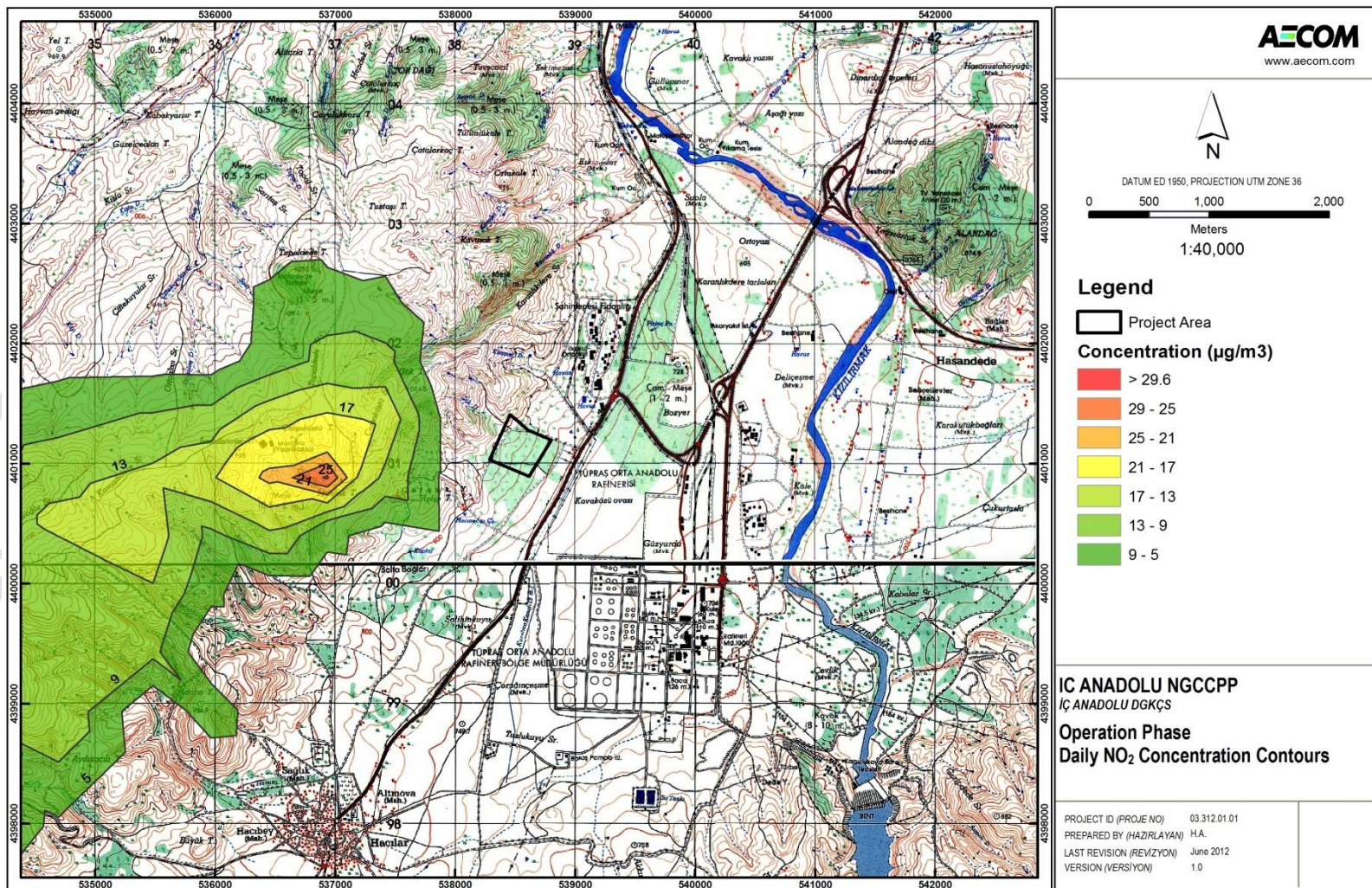


Figure 5-16 Predicted Maximum NO_2 Impact for the 24-hour Averaging Period

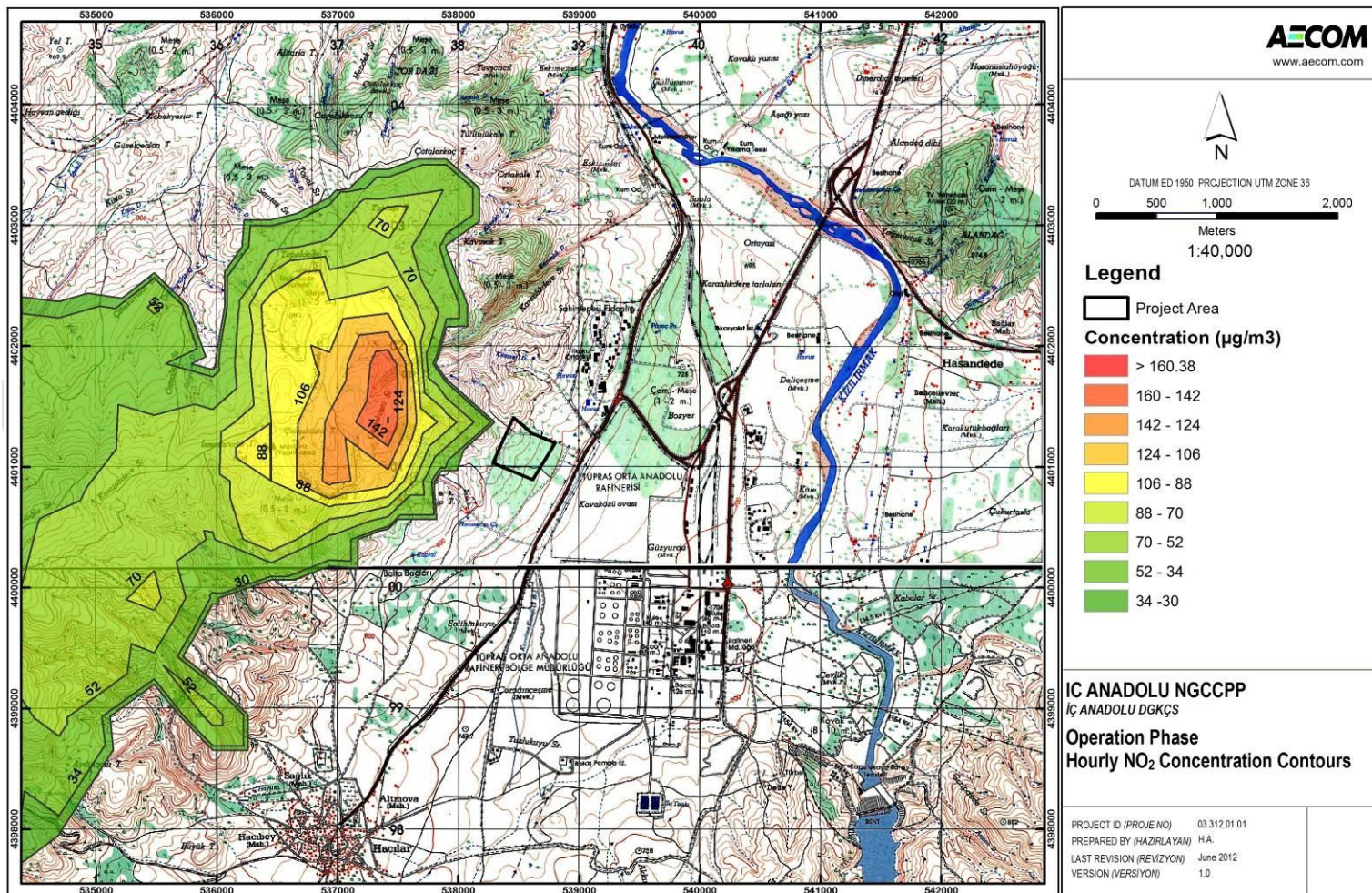


Figure 5-17 Predicted 99.79th Percentile NO₂ Impact for the 1-hour Averaging Period

5.1.2.7 Cumulative Air Quality Impacts

Tüpraş Orta Anadolu Refinery is located in close proximity to the proposed Project location. The background pollutant concentrations caused by Tüpraş Orta Anadolu Refinery together with the other pollution sources were captured during the passive sampling study. The cumulative air quality impact of the proposed Project and the refinery is calculated by adding the modeling results to the existing background concentrations which are mostly associated with the refinery operations. The cumulative impact is in compliance with relevant Turkish Regulations and IFC/WB Guidelines.

In the evaluation of cumulative air quality impact of the proposed Project, in addition to the existing background concentrations, the impacts of the potential future developments in the region are taken also into consideration. Therefore, “Kırıkkale Natural Gas Combined Cycle Power Plant” (Kırıkkale CCPP) that is planned to be built in Yahşihan District of Kırıkkale Province was also assessed during this study.

The ESIA report that was prepared for the proposed Kırıkkale CCPP is evaluated for the purpose of potential cumulative impacts. The project location for the proposed Kırıkkale CCPP is given as 800 m east of Mahmutlar Village located in Yahşihan District of Kırıkkale Province. This area is located at approximately 18.5 km north of the İç Anadolu CCPP location. High hills and Kırıkkale City Center exist between the project locations. Since the prevailing wind directions in the region are in ENE and NE directions and the topographic conditions between both project locations include high hills, it is expected that maximum NO₂ concentrations associated with both projects will occur at different locations. Thus, it can be stated that the cumulative air quality impact of the proposed İç Anadolu CCPP and Kırıkkale CCPP will be negligible.

5.1.2.8 Conclusion

The modeling analysis has demonstrated that ambient pollutant concentrations in the Project area will be in compliance with the Turkish Regulations and the IFC/WB Guideline limits. The predicted ambient concentrations are much lower than the limits. Therefore, emissions from the proposed project will provide insignificant contribution to the existing ambient air quality.

It is anticipated that the impact significance of emissions that will be generated during operation period will be moderate. However, as necessary preventive measures are taken the residual impact significance will reduce to negligible.

5.1.2.9 Impacts on Agricultural Products and Soil Acidification

The most important impact of the proposed project on agricultural crops will be NO_x emissions during operation phase. Calculated ambient NO_x concentrations are given in the previous section and it is shown that air emissions during operation phase are well below the limit values given in the relevant regulation. Therefore, it is expected that the proposed project will not have any adverse impacts on flora and fauna in 12 x 12 km modeling area.

Wheat and barley are the most important agricultural products of Kırıkkale Province. 92.4% of total croplands in Kırıkkale Province are used to produce grain products (wheat, barley etc.). In addition

to wheat and barley, grape is another important product of Kırıkkale Province. 80.9% of total gardens in Kırıkkale Province are used to produce grape products. “Hasandede karası” and “Hasandede beyazı” are unique grapes produced in the region (Kırıkkale Valiliği, 2010).

Nitrogen oxides are less toxic than other photochemical oxidant compounds for plants. The most important effect of nitrogen oxides on plants is the damage on the leaves of the plant. Plants take atmospheric NO_x by means of stomata and the pollutant passes to liquid phase from gas phase. Liquid phase contaminants can change the pH of solution in the cell or they can bring the reactants into a form that can affect the plant metabolism and can react one or more components of the plant. The impacts of nitrogen oxides on plants depend on both internal and external conditions. Environmental conditions, other pollutants present in the atmosphere and the current status of the plant can change the reaction of the plant against NO_x . The classification of plants according to their response against NO_x shows the importance of genetic factors. The response of plants against NO_x shows variations for each plant species. In addition, the age and developmental stage of the plant are other important biological factors. There are many studies investigating the effects of nitrogen oxides on plants. Since the plants are more sensitive to NO_2 than NO , all these studies are focused on NO_2 (NRC, 1977). Generally 50 mg/m^3 ($50,000 \text{ }\mu\text{g/m}^3$) and higher NO_2 concentrations are harmful to plants (Akman et al, 1996).

The studies evaluating the response of plants against NO_x result in a threshold curves given in Figure 5-18 (NRC, 1977). These curves were prepared based on reactions of plants against acute and chronic NO_2 doses in various studies. The threshold curve of “death” is relatively short since there is not enough data. NO_2 doses approaching to threshold curves leads to loss of all leaves, however it is not lethal. Leaf damage threshold curve is obtained from various observations made on the basis of several different doses of NO_2 . Along this curve, leaf damage change usually occurs from necrosis to chlorosis in 10 and 100 hours. Since there is no measurable impact specified below the curve located at the bottom, this curve can be assumed as the threshold curve for the effects on metabolism and development. NO_2 doses that are between leaf damage threshold curve and metabolism and development threshold curve do not cause leaf damage, however they prevent the development or photosynthesis and other functions of the plant.

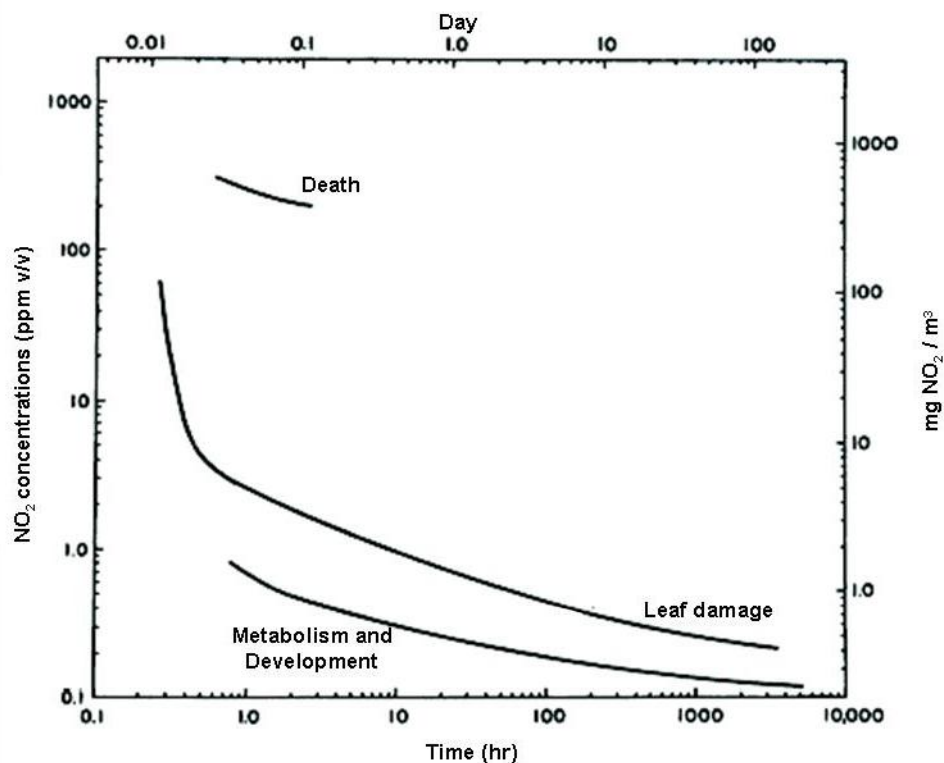


Figure 5-18 Impacts of NO_x on Plants
(Source: NRC, 1977)

According to studies in literature, it is concluded that grape as one of the most important agricultural product in the region is not sensitive to NO_x and the response of the grape to NO_x can be classified as “Medium Level” (NRC, 1977). In addition, when ambient air NO_x concentrations are compared to NO_x concentration of 50,000 µg/m³ which is accepted concentration lead to damages on plants, it is concluded that NO_x concentrations in ambient air will not cause any adverse impacts on plants.

Soil Acidification

Deposition of nitrogen oxides is one of the main factors cause soil acidification. Residence time of NO₂ in the atmosphere is approximately 2-3 days. Firstly, NO₂ reacts with water and forms nitric acid, then nitric acid reacts with ammonia and forms nitrate (NH₄NO₃). Ammonium nitrate is generally included by aerosol particulates and it precipitates on soil generally with snowfall. So nitrate required for the growth of plants precipitates on soil through snow. For that reason, NO₂ in the atmosphere may be significant for nitrate requirement of the soil (Akman et al., 1996).

Cation Exchange in Soil

Since soil colloids have negative charge, they hold some cations in the soil. These cations may be exchanged with other cations without any dissolution in soil colloids. Most abundant cations in the soil are Ca²⁺, Mg²⁺, K⁺, Na⁺, Al³⁺ and H⁺. Cation exchange means displacement of exchangeable cations with cations included by the soil. Rate of cations retention by soil colloids depends on the

number of cations in the environment or the relative amount, electric charge, activity of the cations in the environment and their movement speeds. Continuous absorption of hydrogen ions, by colloid surfaces, instead of the other bases causes clays to win acidic feature. In parallel with increase in H^+ ions adsorbed, H^+ ions in the soil solution increase. Thus, the pH decreases. In order to balance pH in humid regions, specific amount of lime is added to the soil. When lime is added to acid reacted soil, calcium ions formed from the lime replace with hydrogen and some other bases. Thus, clay enriches in calcium, but loses hydrogen. When exchangeable hydrogen decreases, pH reaches to a normal level. Cation exchange capacity (CEC) is the capacity of a soil for ion exchange of cations between the soil and the soil solution and expressed as equivalent or milliequivalent/100 g soil (Boşgelmez, A et al., 2001).

In order to evaluate the effects of NO_2 on change (due to acid deposition) in pH of agricultural and horticultural soils located in the vicinity of the project area, soil samples were taken from the hill and vineyard (NO_2 concentrations are maximum here). The samples were sent to Ankara University Faculty of Agriculture, Soil Science Laboratory for the analysis. Results of the analysis of the soil samples are provided in Table 5-17.

Table 5-17 Results of Soil Analysis

Parameter	Sample 1 (Hill)	Sample 2 (Vineyard)	Average
pH	7.43	7.34	7.39
Organic Substance (%)	1.16	1.75	1.46
CEC (me/100gr)	23	14	18.5

Cation Exchange Capacity (CEC) was calculated by taking the average of results of analysis of both soil samples. Soil depth which can be affected by acid deposition was considered as 10 cm (based on depth of typical alluvial soil in agricultural areas). According to the literature, specific gravity of clay and clay-loam soil changes between 1.20 g/cm^3 and 1.80 g/cm^3 (Boşgelmez, A et al., 2001). In the direction of this information, specific gravity was accepted as 1.40 g/cm^3 and amount of the soil corresponding to one square meter surface area was calculated as 140 kg. When average CEC value, 18.5 me/100 g, is taken in to the account, buffer capacity of the soil was calculated as 25.9 eq/m^2 .

AERMOD model calculated the annual average nitrogen deposition value to be generated from the plant as $0.13735 \text{ g/m}^2 \cdot \text{year}$. This value is equal to $0.005972 \text{ eq/m}^2 \cdot \text{year}$. According to this, dry and wet deposition of NO_2 pollutants will consume approximately 1.13% of buffer capacity of the soil during the 49-year operation of the plant. In other words, 4,336 year will be required in order to consume whole buffer capacity of the soil.

In conclusion, acid deposition generated from the plant will not have any significant negative effect on soil in the domain of wind direction. The acid deposition impact can be regarded as negligible.

Effects of Deposition of Acid-formers on Vegetation

In terms of biological effects, wet deposition means direct contact of plants with acid rain, dew or fog. Acid rain having pH lower than 5.6 is accepted as phytotoxic, and it may be harmful according to the pH of the rain. Dry deposition generally means absorption and/or adsorption of pollutants by vegetation and/or soil.

Direct formation of deposition on vegetation may affect the soil and it may have indirect effects through changes in soil properties. pH of the soil may decrease significantly due to deposition and vegetation is affected negatively. Damage to surface structures such as the protective cuticle, damage to the normal functions of protective cells, intoxication of plant cells with diffusion from the cuticle and contagion of normal metabolism and development processes in the plant cell without creating necrosis can be regarded as direct effects of acid deposition. The most common response symptoms of plants are observed as visible damages on leaves and yield loss. On the other hand, indirect effects can be summarized as changes in significant properties of the soil, acceleration in filtration of substances through the leaf, increase of sensitivity in the symbiotic relationships, drought and other environmental stress factors (Tom et al., 1987; Treshow, 1984; Varshney and Garg, 1979; WHO, 2000).

In acid rain simulated studies, when visible effects of pH concentration on leafy plants considered, their acidic deposition sensitivity grades are ranked from high to low; herbaceous dicotyledons, arboreous dicotyledons, monocotyledons and coniferae. As a result of studies, it was seen that the visible leaf damage is proportional to acid concentration in the solution (Evans, 1982; Lee et al., 1980). Minimum pH values and optimum pH ranges for some plants are provided in Table 5-18.

Table 5-18 Minimum pH value and Optimum pH Range for Some Plants

Plant Name	Minimum pH	Optimum pH
Pear	-	6.0-7.5
Barley	5.4	6.5-7.8
Pea	5.5	6.0-7.5
Rye	4.5	5.0-7.0
Wheat	5.0	5.5-7.5
Bean	5.0	6.0-7.5
Spinach	5.5	6.0-7.5
Lentil	-	5.5-7.0
Corn	5.5	6.0-7.5
Potato	-	4.8-6.5
Onion	5.0	5.8-7.0
Grape	-	5.5-6.5
Cherry	-	6.0-7.0
Oat	4.5	5.0-7.5

Source: Boşgelmez, A et al., 2001

In studies conducted for the literature, soil acidity sensitivity rates of plants including wheat and barley which are most important crops in the region were determined. According to these studies,

plants were divided into four; resistant, moderately resistant, sensitive and very sensitive. Wheat and barley are moderately resistant and sensitive plants, respectively (Boşgelmez, A et al., 2001). According to another literature study (National Academy of Science, 1977), nitrogen oxides sensitivity of plants is divided into three; resistant, moderately resistant and sensitive. According to this ranking, grape is included by moderately resistance class.

As indicated before, acidic deposition originated from the proposed plant will not affect pH of the soil significantly. For that reason, plants in the region will not be affected by the acid deposition originated from the project and thus the potential impact will be negligible.

5.2 Noise

5.2.1 Construction

Construction activity inevitably creates some degree of noise emissions at locations in close vicinity of the construction site. It is, however, a temporary source of noise. The noise levels generated by construction works will have potential impact on noise sensitive receptors. Noise levels at a receptor depends on several factors such as number and type of equipment and machinery used, the distance between noise sensitive receptor and the construction site and level of attenuation likely due to ground absorption, air absorption and barrier effects.

Noise Modeling Method and Inputs

In order to predict the noise levels generated during the construction period, noise modeling of construction activities is performed. In the noise modeling, ISO 9613-2 noise prediction method is used in the SoundPLAN noise modeling software.

The SoundPLAN noise modeling software uses the following information to predict noise levels at noise sensitive receptors:

- Three-dimensional digital terrain map of site and surrounding area;
- Sound power level noise data for plant and equipment operating at the site;
- Intervening ground cover;
- Shielding by barriers, intervening buildings or topography; and
- Atmospheric conditions.

During the course of construction many of the activities will occur simultaneously and at varying levels of intensity. It is difficult, therefore, to accurately predict construction noise emissions throughout the entire construction period. In order to facilitate the noise assessment, a 'worst case' scenario has been developed. In this regard, it is assumed that all equipment will operate simultaneously and at full load at the same location. In this scenario the location is selected as the Reduction and Measuring Station (RMS) which is closest to the noise sensitive receptor 1 (NSR-1) located in the east of the project area. Regarding the intervening ground cover, it is assumed that ground absorption value of 0.5 as a rational value since the project area is mostly surrounded by croplands. For air absorption, atmospheric conditions of humidity value of 70%, temperature value

of 10 °C and air pressure of 1,013.25 mbar are used as default values for the ISO 9613-2 noise prediction method.

Construction activities at the project area will be carried out in three stages; site preparation, civil works and construction of plant facilities. In the noise modeling, each stage was assessed separately since the type and number of equipments used in each phase will be different.

Site Preparation Stage

Site preparation stage will include several noise emitting activities such as vegetation clearance, topsoil removal using bulldozers, excavation, refilling using excavators, loaders, dumper trucks, etc.

Type and number of equipment and machines that will be used during site preparation stage and their equivalent sound power levels are listed in Table 5-20.

Table 5-19 Equipment List for Site Preparation Stage

Equipment	Number of Items	Lw (dBA)
Roller	2	99.5
Excavator	3	104.5
Dumper Truck	12	103.5
Loader	3	99.5
Grader	1	99.5
Bulldozer	2	104.5
TOTAL		117.4

Civil Works Stage

Civil works will typically include installation of foundation of structures and paved areas using rollers, concrete pumps and vibrators, concrete mixer trucks, dumper trucks, etc.

Type and number of equipments that will be used during civil works stage and their equivalent sound power levels are listed in Table 5-21.

Table 5-20 Equipment List for Civil Works Stage

Equipment	Number of Items	Lw (dBA)
Roller	1	99.5
Excavator	2	104.5
Dumper Truck	2	103.5
Loader	1	99.5
Concrete Pump and Vibrator	1	98.5
Concrete Mixer Truck	2	104.5
Pile Driver	2	117.5
TOTAL		120.9

Construction of Plant Facilities Stage

Construction of plant facilities include noise producing activities such as; loading, unloading, transportation, erection and assembly of plant items using cranes, trucks and other necessary equipments.

Type and number of equipments that will be used during construction of plant facilities and their equivalent sound power levels are listed in Table 5-22.

Table 5-21 Equipment List for Construction of Plant Facilities

Equipment	Number of Items	Lw (dBA)
Mobile Crane (50t)	6	100.6
Mobile Crane (100t)	1	100.6
Mobile Crane (150t)	1	100.6
Mobile Crane (250t)	1	100.6
Mobile Crane (500t)	1	100.6
Dumper Truck	4	103.5
Excavator	2	104.5
Loader	2	99.5
TOTAL		114.5

Noise Modeling Results

Construction noise levels have been predicted for each stage. The predicted L_{eq} noise levels at each NSR for three stages are calculated assuming maximum activity with all equipment operating at the same point. The predicted noise levels for each stage with the construction period noise limits stated in relevant Turkish regulation are given in Table 5-23 below.

Table 5-22 Predicted Construction Noise Levels

Noise Sensitive Receptor	Site Preparation Stage (dBA)	Civil Works Stage (dBA)	Construction of Plant Facilities Stage (dBA)	Noise Limit (dBA) ¹
NSR-1	64.3	64.6	63.6	70
NSR-2	48.1	48.1	47.1	70
NSR-3	44.7	44.7	43.7	70

¹ Construction noise limit in Turkish Regulation on Assessment and Management of Environmental Noise (RAMEN)

As can be seen in Table 5-23, the maximum noise levels generated from construction activities occur at NSR-1 which is located closer to the project area than other two noise sensitive receptors. The predicted noise levels at NSR-1 during the Site Preparation Stage, Civil Works Stage and Construction of Plant Facilities Stage are 64.3 dBA, 64.6 dBA and 63.6 dBA, respectively. The noise levels calculated at other two receptors are much lower than the levels predicted at NSR-1.

In Turkish Regulation on Assessment and Management of Environmental Noise (RAMEN), construction site noise level limits are stated in Table 2-6 of Section 2.2.4. According to this table,

the Project site is classified as “Other Resources” and the noise level limit in this class of areas is set to 70 dBA. As a result, the predicted construction noise levels at noise sensitive receptors comply with the Turkish RAMEN noise limits. It is anticipated that the impact significance of the noise generated during construction will be moderate and the residual impact will be negligible after taking all necessary mitigation measures.

During the construction period, total of about 30 construction vehicles will be employed at site at maximum during construction period. Most of these vehicles will stay on site until their work finishes and will not generate traffic continuously. According the records of State Highways, the daily heavy vehicle traffic load on Kırıkkale-Konya Road is 116 in 2009. Hence, the increase in the daily traffic load on the Kırıkkale-Konya Road due to project construction will be negligible. As a result, since the increase in the traffic load due to project construction will be negligible, the increase in the background noise levels caused by the traffic of construction vehicles will be negligible.

5.2.2 Operation

Power plant operations comprise a large number of processes, activities and equipment that create some degree of noise emission. The proposed plant will operate continuously and produce a steady sound 24 hours per day and 7 days a week. In order to predict the noise levels produced during operation of the proposed plant, a noise modeling study is carried out. The details of the noise modeling are given in the following sections.

Noise Modeling Method

In order to determine the noise levels produced during the operation of the proposed plant, a three-dimensional computer noise model is used with SoundPLAN software. SoundPLAN is a noise modeling software that is accepted and endorsed by numerous agencies worldwide. The software can account for the following site conditions:

- Ground topography and the extent of ground absorption from different surfaces;
- Prevailing meteorological conditions, including the presence of temperature inversions and adverse winds;
- Noise emission of each source as well as its location, elevation, orientation, shape and size;
- Location and elevation above local ground level of all sensitive receptors;
- Screening from any enclosures, barriers, buildings or hills;
- Attenuation due to distance and atmospheric absorption; and
- Increase in noise level due to reflections from nearby facades and reflective objects.

SoundPLAN includes a great number of standards for noise modeling from roads, railways, industries etc. Some of these standards that are used in determination of noise emissions from industrial activities are Nord 2000, Concawe, VDI 2714/2720 and ISO 9613-2. In the noise modeling performed for the proposed plant, ISO 9613-2: Acoustics - Attenuation of Sound Outdoors

Part 2: General Method of Calculation is used as recommended method for industrial noise by the EU Directive 2002/49/EC and Turkish RAMEN.

The ISO 9613 method is applicable in practice to a great variety of noise sources and environments. It is applicable, directly or indirectly, to most situations concerning road or rail traffic, commercial and industrial noise sources, construction activities, and many other ground-based noise sources. The method predicts the sound pressure level under meteorological conditions favorable to propagation from source to the receiver. These conditions are for downwind propagation or propagation under a well-developed moderate ground-based temperature inversion, such can occur at night.

In order to simulate worst-case conditions, downwind propagation is considered which assumes wind always blows from the source to the receiver. In addition, as parameters in determination of attenuation due to air absorption, humidity, temperature and air pressure values are taken as 70%, 10°C, 1013.25 mbar, respectively, which are default values of ISO 9613-2. Regarding the attenuation due to ground absorption, the area surrounding the project area is semi-hard ground since it is mostly composed of croplands. Thus, the ground absorption value of 0.5 is used.

Noise Modeling Inputs

SoundPLAN noise modeling software is able to create three-dimensional digital elevation from elevation contour lines to be used in the ISO 9613 method. Ground elevations generated from 10 m interval elevation contours are used in the model. All buildings and structures of the plant shown in plant layout (Appendix A) are digitized and inserted into the model and taken into consideration as barrier for screening effect. In addition to plant structures, residences and buildings in the close vicinity of the project area such as NSR's and Tüpraş Social Facilities are also inputted into the model. An example of three-dimensional representation of the structures and topography is given in Figure 5-17 below.

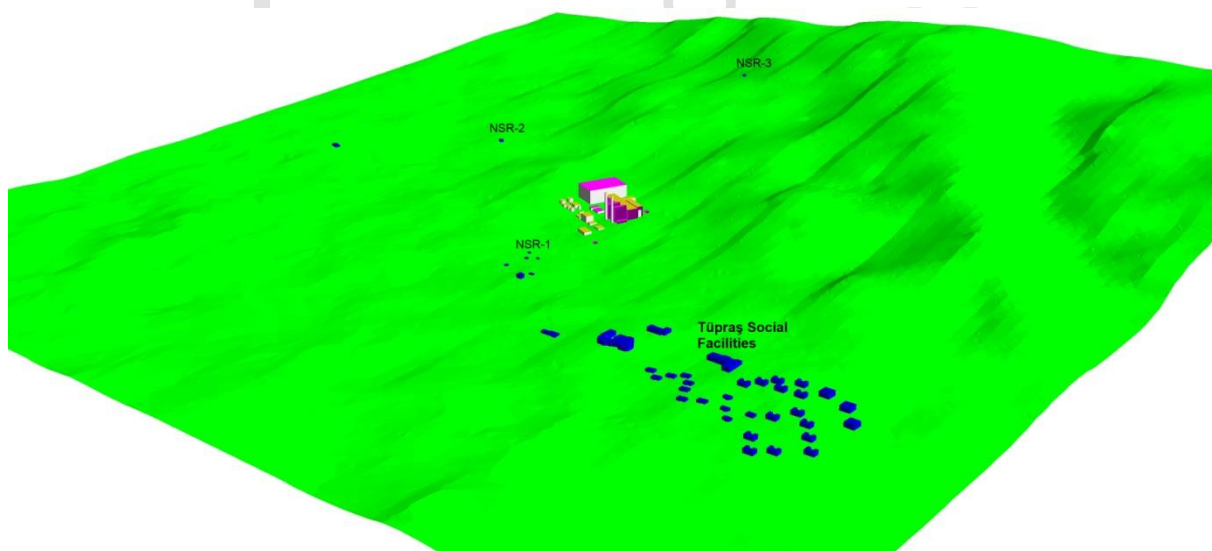


Figure 5-19 Three-Dimensional View of Plant Structures and Buildings Used in Noise Modeling

Noise will be generated by the operations of several plant equipment such as equipments in turbine compartment, generators, ventilation fans, HRSG, ACC, transformers etc. The noise sources information, obtained from the project owner, including sound power levels, indoor/outdoor location is presented in Table 5-24 together with enclosure information. Moreover, plant equipment sound power levels at each octave band frequency between 31 Hz to 8,000 Hz are given in Appendix C.

Table 5-23 Sound Power Levels

Noise Source	Sound Power Level, L_w (dBA)	Indoor / Outdoor ¹	Enclosure
Inlet Ducting	105.0	I	No
Inlet Filter Face (with hoods)	91.0	O	Yes
Gas Turbine Inlet Plenum	101-6.0	I	Yes
GT Compartment	105.0	I	Yes
Lube Oil / Gas Module	98.0	I	Yes
GT Exhaust Diffuser	103.0	O	Yes
ST HP/IP Turbine Compartment	104.0	I	Yes
ST LP Turbine Compartment	104.0	I	Yes
HP/IP/LP Steam Valves	99.0	I	No
ST Generator	104.0	I	Yes
GT Generator	104.0	I	Yes
Generator Excitation Cooling System Inlet	100.0	I	No
Generator Excitation Cooling System Outlet	100.0	I	No
Turbine Compartment Vent Fans	98.0	I	No
Exhaust Compartment Vent Fan	80.0	O	No
Gas Module Vent Fan	83.0	O	No
Lube Oil Module Vent Fan	96.0	I	No
Lube Oile Module Vent Fan	85.0	O	No
Roof Exhaust Fans	85.0	O	No
Steam Gland Condenser Vent	98.0	O	No
HRSG Body + Piping, Valves, Cont Vents	105.8	O	Yes
HRSG Stack Exit	100.0	O	No
Boiler Feedwater Pump Sets	100.0	I	No
Condensate Forwarding Pump set	99.0	I	No
Finfan Coolers for GTG 1	100.0	O	No

Finfan Coolers for GTG 2	100.0	O	No
Finfan Coolers for STG and BOP	100.0	O	No
ACC- Air Cooled Condenser	115.0	O	No
ACC Main Steam Duct	108.0	O	No
RMS	83.0	I	No
Transformer for GT 1	105.0	O	No
Transformer for GT 2	105.0	O	No
Transformer for ST + BOP	105.0	O	No
Piperack	97.0	O	No

I: Indoor, O: Outdoor

As can be seen from the table above, primary noise sources in the proposed plant are transformers, roof exhaust fans, turbine compartment vent fans and exhaust compartment vent fans as outdoor sources. In the noise modeling study, sound power levels obtained from the project owner are converted to unweighted octave band sound power levels for each octave band from 31.5 Hz to 8 kHz by using adjustment values (Bruce et. al, 2007). Since there is no information, at present, on enclosures that are going to be installed in the proposed plant, enclosures and facades of the plant buildings and structures are assumed as “1 mm trapeze profile corrugated steel sheet” material that has octave band sound reduction values given in Table 5-25. In order to simulate the worst-case conditions, equipments that are located indoor and have enclosure are inputted into the model without enclosures. The plant equipments like ACC, finfan coolers, turbine compartment vent fans, exhaust compartment vent fan, roof exhaust fans and stack exits are modeled with the vertical directivity correction function.

Table 5-24 Sound Reduction Values of Enclosure Used in Modeling

Enclosure Material	Octave Band Frequency (Hz)									
	31	63	125	250	500	1,000	2,000	4,000	8,000	Rw, dB
1 mm Corrugated Steel Sheet	10	10	14	16	20	25	29	23	20	25

In the noise modeling, all indoor noise sources are modeled as point source. Facades of plant buildings having point source inside are used as area source. Stack exits, turbine compartment vent fans, exhaust compartment vent fans and roof exhaust fans are modeled as point sources. The ACC is modeled as the roof of the ACC is area source at 39 m above the ground. The roof of finfan coolers are also modeled as an area source.

In the noise modeling, single point receivers are used at the locations of noise sensitive receptors. Receivers are situated at 1.5 m above the ground and 3 m away from the closest facade.

Noise Modeling Results

Sound pressure levels are predicted for each noise sensitive receptors, using the SoundPLAN noise modeling software. The plant equipment sound pressure levels at each octave band frequency from 31 Hz to 8 kHz are presented in Appendix C together with the map of noise level contours from operation of the proposed plant. Figure 5-20 shows the noise map of the proposed project during operation.

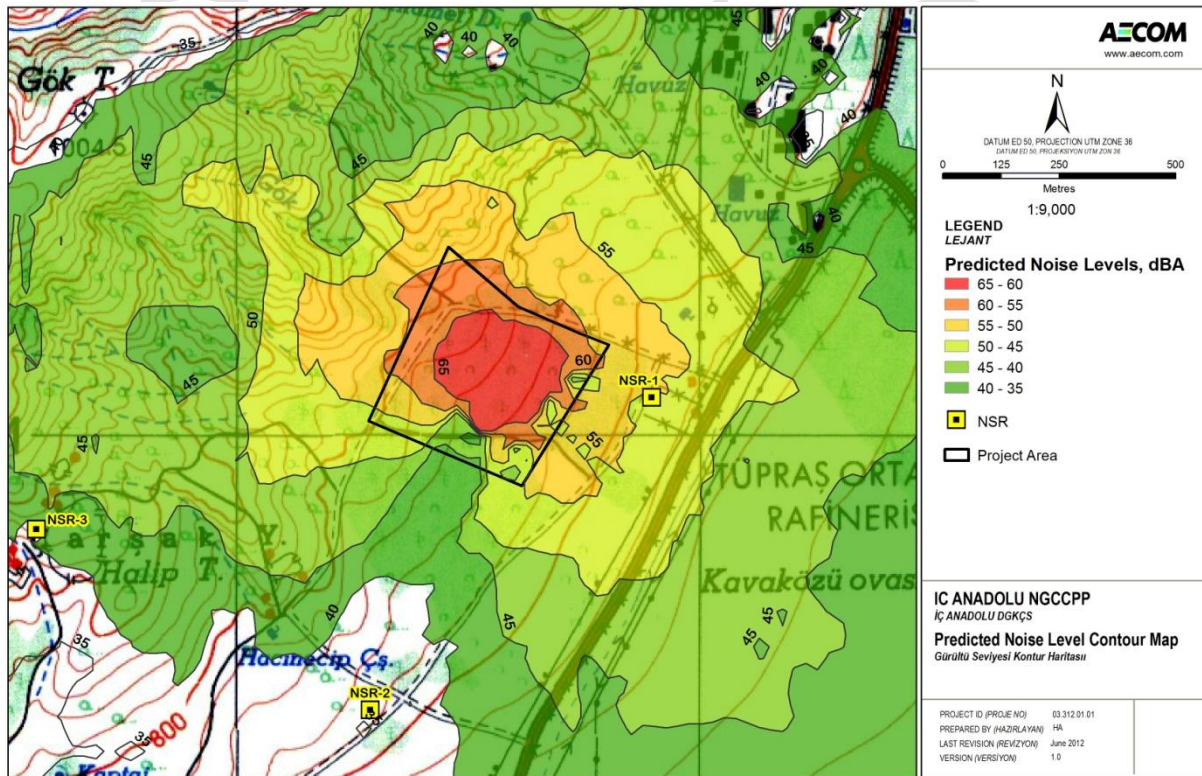


Figure 5-20 Noise Map of Proposed Project During Operations

In addition to sound pressure level of each equipment, predicted noise levels from the operation of the proposed plant are calculated. The predicted noise level at each NSR is logarithmically added to the measured background levels in order to calculate the cumulative noise impact. As mentioned earlier, background noise levels are measured at NSR-1 and it is reasonable to expect similar background noise levels at NSR-2 and NSR-3 since there is no noise emitting activity in the close vicinity of the project area and NSRs. Thus, the background noise levels at NSR-2 and NSR-3 are assumed to be the same as at NSR-1. Predicted noise levels, daytime and nighttime background noise levels and cumulative noise levels are presented in Table 5-26 below. Table also provides difference between background noise levels and cumulative noise levels. This difference represents the additional noise load to the existing background generated by the Project.

Table 5-25 Daytime and Nighttime Cumulative Noise Levels at each NSR

		NSR-1	NSR-2	NSR-3
Predicted Noise Levels, dBA		55.0	39.8	41.9
Daytime Period (07:00 – 22:00)	Background Noise Levels, dBA	44.7	44.7	44.7
	Cumulative Noise Levels, dBA	55.4	45.9	46.5
	Difference, dBA	10.7	1.2	1.8
Nighttime Period (22:00 – 07:00)	Background Noise Levels, dBA	44.0	44.0	44.0
	Cumulative Noise Levels, dBA	55.3	45.4	46.1
	Difference, dBA	11.3	1.4	2.1

Noise Criteria

The noise limit and guideline values applicable to this project were discussed in Section 2 of this report and summarized in Table 5-27 below. Note that noise limits and guidelines provided in Table 5-27 are L_{eq} noise levels.

Table 5-26 Noise Limits and Guidelines Applicable to the Project

Turkish RAMEN				
	Definition	L_{day} (dBA) (7:00-19:00)	$L_{evening}$ (dBA) (19:00-23:00)	L_{night} (dBA) (23:00-7:00)
Limit Value	Areas with both noise sensitive areas and industrial activities (predominantly industrial)	68	63	58
IFC/WB Guideline				
	Definition	L_{day} (dBA) (7:00-22:00)	L_{night} (dBA) (22:00-7:00)	
Guideline value	Residential; Institutional; Educational	55	45	
Maximum allowable increase in background	If the limit values are not satisfied, the maximum allowable increase in the background level(at the nearest receptor off-site)	3	3	

As it can be seen from Table 5-27, cumulative noise levels calculated during daytime and nighttime periods are well below the values given in Turkish RAMEN. The highest daytime cumulative noise level is calculated at NSR-1 as 55.4 dBA whereas at NSR-2 and NSR-3 the values are 45.9 dBA and 46.5 dBA, respectively. Thus, daytime and nighttime cumulative noise levels comply with the Turkish RAMEN limits (both daytime and evening time) at all NSRs (i.e., NSR-1, NSR-2, NSR-3).

Regarding the IFC/WB Guideline noise limits, the daytime cumulative noise levels at NSR-2 and NSR-3 are below the daytime noise limit of 55 dBA. Although the nighttime cumulative noise levels at NSR-2 and NSR-3 are above the nighttime noise limit of 45 dBA, since the difference between the cumulative noise levels and background noise levels are below 3 dB (the allowable increase in the background noise levels) at both NSRs (NSR-2 and NSR-3), the IFC/WB nighttime noise limits are complied at NSR-2 and NSR-3. However, the cumulative daytime and nighttime noise levels calculated at NSR-1 are both above the IFC/WB daytime and nighttime noise limits, which are 55 dBA and 45 dBA, respectively.

As the conclusion of the noise assessment study, the proposed Project will comply with the relevant noise limits given by the Turkish RAMEN at all NSRs. The IFC/WB Guideline daytime noise limits will be achieved at NSR-2 and NSR-3 under normal operational conditions. However, the predicted daytime and nighttime cumulative noise levels at NSR-1 exceed the IFC/WB Guideline noise limits. Thus, the potential noise impact associated with the proposed Project will be major at NSR-1 and minor at NSR-2 and NSR-3.

5.2.3 Decommissioning

The noise levels associated with the decommissioning activities will be similar to the construction phase activities. Thus, the noise compliance can be achieved if the location of the current noise sensitive receptors remains the same. However, in future, there might be more noise sensitive receptors that are closer to the project site. This might cause potential exceedances at these receptors. However, the noise generation will be temporary and it will disappear after the decommissioning. In order to minimize adverse impacts during the decommissioning, the activities can be limited to the weekdays and daytime hours.

5.3 Water Supply and Wastewater

5.3.1 Construction

The water will be required by the proposed project during construction for the following activities: potable water for the workers/employees, concrete curing water and water sprays to prevent dust formation.

The potable water requirement will be supplied from the existing pipeline supplying water to Hacilar Town. Hacilar Municipality approved water use from the existing pipeline for the proposed project. This water pipeline is located at approximately 500 m to the south of the Site. The drinking water for the employees, bottled water will be provided.

Total water amount that will be used for concrete curing, spraying the dust generating areas, and washing of construction equipments will be approximately 600 m³/day. Considering that the daily water use per employee is 150 l/person-day (Benefield, L., Randall, C., 1980), the water requirement of 900 employees that will work during construction is calculated as follows:

$$0.15 \text{ m}^3/\text{person-day} \times 900 \text{ persons} = 135 \text{ m}^3/\text{day}$$

Domestic wastewater generated during construction will be discharged to the Hacilar Municipality sewerage network after it is treated at the package treatment plant. A protocol will be signed with

the Municipality regarding this issue and the connection permit will be secured. In case the municipal sewerage network is not completed prior to the construction period, wastewater generated during construction will be collected in leakproof tanks and will be transferred by vacuum trucks of Municipality to the closest wastewater treatment plant in Kırıkkale.

Project activities involving wastewater discharges, water extraction, diversion or impoundment will prevent adverse impacts to the quality and availability of groundwater and surface water resources. The project will comply with the Turkish Water Pollution Control Regulation and the IFCMB Guidelines.

It is anticipated that the impact significance of the wastewater generated during construction will be minor to moderate and the residual impact will be negligible after mitigation measures.

5.3.2 Operation

Since the proposed Project will have an air cooled condenser (ACC) system the water requirement for process will be at minimum level. The water use will be limited to: regeneration of HRSG blowdowns and demineralization system, turbine washing and the domestic water use by employees. The daily amount of the water used by the employees will be approximately 9.6 m³. On the other hand, it is foreseen that the water requirement of the operation carried out at the Plant will be approximately 35.5 m³/hr. The water amounts entering units and systems of the Plant is given in Table 5-28 below.

Table 5-27 Water Amounts Entering the Units

Unit	Water Amount
Demineralization System	22.5 m ³ /hr
Water Steam Cycle	16.4 m ³ /hr
HRSG Blowdown Tank	17.6 m ³ /hr
Compressor Cleaning	0.3 m ³ /hr
Service Water	4.0 m ³ /hr
Irrigation Water	0.3 m ³ /hr
Output Water Treatment Plant	26.6 m ³ /hr
Chemical Treatment Plant	2.7 m ³ /hr

Required water will be supplied via the water supply pipeline of the Hacilar Town. Hacilar Municipality approved water use from the existing pipeline for the proposed project. Drinking water will be supplied as bottled water.

Wastewater generated during operation will be discharged to the Hacilar Municipality sewerage network after it is treated. A protocol will be signed with the Municipality regarding this issue and the connection permit will be secured. In case the sewerage network will not be completed, wastewater generated during operation will be collected in leakproof septic tank and will be transferred by vacuum trucks of Municipality.

The wastewater treatment plant will consist of three wastewater treatment systems. The systems will treat chemically contaminated water, TSS, TDS and domestic wastewater. The treated water will be combined and discharged to the Hacilar Municipality sewerage network or septic tank. The sludge from the WWTP will also be treated. The treatment plant will treat wastewater from the Plant and discharged wastewater will comply with the limits. For domestic wastewater the discharge limits determined at Table 25 of WPCR and for industrial wastewater discharge limits determined at Table 20.7 of WPCR will not be exceeded.

The project approval of the treatment system will be done in the context of Project Approval Circular numbered 2005/5. The proposed project will comply with the Turkish Water Pollution Control Regulation and the IFC/WB Guidelines and will not have any negative impact on the local environment.

It is anticipated that the impact significance of the wastewater generated during operation will be moderate and the residual impact will be negligible after the mitigation measures.

5.3.3 Decommissioning

During decommissioning phase, potential impacts of water supply and wastewater are likely to be similar in scale to those associated with construction and an adverse impact is not expected.

5.4 Hazardous Waste

5.4.1 Construction

Water and chemical based paints, construction chemicals, and solvents will be used during construction period of the project. These materials will be stored in their original boxes, barrels or containers placed on concrete floors with proper shade so as not to be exposed to adverse weather conditions. Empty boxes, barrels and containers will be collected properly and stored in a way that they do not cause any soil contamination and disposed of periodically. If any wastes are characterized as hazardous waste, they will be transported and disposed of by licensed companies according to Hazardous Waste Control Regulation.

Waste Oil

Waste oil to be generated during construction activities are limited with engine and lube oil that can be generated from equipment and construction vehicles. Maintenance and repair of equipment will be performed on proper area with sufficient infrastructure so waste oil generation will be minimized. Waste oil will be collected in the red containers labeled as "Waste Oil" which will be located on impermeable surface and they will be protected from rain and snow. Closed areas and/or storage tanks will be provided. Waste oils will be transported by licensed transporters to the licensed processing and disposal facilities. All waste oil generated during construction period will be collected, stored temporarily, transported and disposed of in accordance with the Waste Oil Control Regulation.

Waste Batteries and Accumulators

Waste batteries and accumulators will be generated during construction. These wastes will be collected separately from household wastes and will be delivered to the collection points to be established by enterprises engaged in the distribution and sales of battery products, or by municipalities within six months after they are generated. Waste batteries and accumulators will be disposed of according to the Waste Batteries and Accumulators Control Regulation.

Medical Wastes

It is not planned to construct an infirmary at the proposed project site within the scope of the project. Hence, no medical waste will be generated at the project site during the construction and operation phase.

5.4.2 Operation

During the operation period of the project; waste oil, oily water, organic solvent wastes, hydrocarbon/water mixtures, solutions, emulsions (clothes, rags, soil, adsorbents etc.), contaminated tin, package and aerosol, IBC tanks and drums, paints (water and solvent based points, dry paints, paint solutions), paint varnish remover, waxes and polishers, industrial treatment wastes (resin), materials containing mercury (accumulator, batteries and fluorescent tubes), contaminated adsorbents, clothes, personal protective equipment and clothes, isolation wool, laboratory chemicals, waste cable, and little amount of medical waste will be generated. The hazardous wastes generated at the facility will be disposed by the MOEU certified disposal sites and companies. The Facility will fill out national hazardous waste transportation forms as required in Annex 9A of Hazardous Waste Control Regulation (HWCR). According to the HWCR, the hazardous waste producer will put "hazardous waste" label on to the containers and indicate the amount of stored waste as well as the storage time on the label. The containers will be kept closed at all times. The Facility will have designated storage areas, fire prevention systems for storage facilities and take precautions to prevent contamination of soil and groundwater.

According to the Hazardous Waste Control Regulation, a temporary storage permit is not required if the facility does not produce more than 1,000 kg of hazardous waste every month and if the stored amount does not exceed 6,000 kg. Under these conditions, the facility could store its hazardous waste without a permit for up to 180 days. So, collected hazardous waste will be sent to the licensed disposal facilities before exceeding 6,000 tons in amount and 180 days storage duration. Hazardous wastes to be generated in the facility will be transported and disposed of by companies licensed by Ministry of Environment and Urbanization before exceeding 6,000 tons in amount and 180 days storage duration. Otherwise, the facility will secure temporary storage permit for hazardous waste.

According to the Hazardous Waste Control Regulation, the facility will submit a waste management plan in every three years. In addition, if the facility generates hazardous wastes that are not mentioned in three-year waste management plan, they will revise the waste management plan with new waste and inform Provincial Directorate of Environment and Urbanization.

In accordance with the Hazardous Waste Control Regulation, the facility will submit waste declaration form to the Governorate annually before the end March.

Waste Oil

It is expected that large amount of waste oil including transformer oil will be generated during operation and periodic maintenance of the facility. It is estimated that 1-2 tons of waste oil will be formed in a year. Waste oil generated by the facility will be analyzed by an accredited laboratory according to the specifications and parameters given in the Waste Oil Control Regulation (WOCR). Waste oils will be collected in red leak-proof containers placed on impervious layer and labeled as "Waste Oil". Proper and practical leak-proof storage tanks will be provided for waste oil storage. These containers will be protected from rain and snow. Waste oil will be managed according to Waste Oil Control Regulation. In addition, the facility will submit waste oil declaration form annually to the Governorate before the end of February according to the WOCR. If waste oil is determined as hazardous waste, it will be transported and disposed of by licensed companies according to the Hazardous Waste Management Regulation. National Waste Transportation Forms will be used when the waste oils are transported out of the facility boundaries, as required by the Regulation and the facility will keep all the documents related to oil wastes for at least 5 years. In conclusion, the Facility will be in compliance with the Turkish WOCR.

Waste Batteries and Accumulators

Waste batteries and accumulators will be collected, temporarily stored, transported and disposed in accordance with the Waste Batteries and Accumulators Control Regulation.

Medical Wastes

There will be a first-aid room in the facility. Serious medical interventions will not be practiced in this room. It is estimated that negligible amount of medical waste will be generated annually. These wastes will be managed in accordance with the Medical Waste Control Regulation.

Treatment Sludge

Sludge will be generated from the industrial wastewater treatment plant during operation phase. The sludge will be analyzed in accordance with Hazardous Wastes Control Regulation in order to determine whether it is hazardous or not. Depending on the analyses results, the sludge will be disposed in accordance with the Hazardous Wastes Control Regulation.

5.4.3 Decommissioning

During decommissioning, transformer oil and lubricating oil will be collected and stored on site as required by the Waste Oil Control Regulation prior sending them to a licensed company with licensed vehicles. Any hazardous waste generated during decommissioning will be stored on site temporarily until they are sent to the licensed treatment and disposal facilities. None of the hazardous waste will be left on site permanently.

In conclusion, the proposed project will not create any adverse impact on the local environment due to the handling, storage, transport and disposal of the hazardous waste generated during the construction, operation and decommissioning phases and will comply with the requirements of the Turkish Regulations and the IFC/WB Guidelines. It is anticipated that the impact significance of

hazardous wastes that will be generated during construction and operation will be minor. The residual impact after taken all necessary measures can be defined as negligible.

5.5 Non-Hazardous Solid Waste

5.5.1 Construction

The following non-hazardous solid waste is expected to be generated during the construction period:

- Waste steel metal and metal pieces;
- Packaging materials and cardboard boxes;
- Wood and timber scraps;
- Recyclable solid waste (e.g. paper, glass, plastics, etc.);
- Organic solid wastes generated due to catering services provided for the employees;
- Excavation waste; and
- Empty drums, cans, containers, etc. (according to the Turkish regulations, if they are used to contain hazardous chemicals, then the containers are considered as hazardous waste).

The domestic non-hazardous solid wastes in the facility are generated from the cafeteria, washrooms and offices. Generated waste will be characterized according to composition, source, types of wastes produced, and generation rates. Wastes will be collected separately at source in accordance with the Regulation on General Principles of Waste Management. Recyclable wastes like cement bags, metal scraps and wooden crates, etc. will be collected separately and recycled. A sound, impermeable, rain-proofed, labeled storage area will be designated for recyclables keeping them segregated from other wastes. Assuming that daily waste generation per personnel is 1.47 kg/person-day (Turkish Statistical Institute, 2010 data for Kırklareli Province), waste generated by 900 personnel will be 1323 m³/day. Domestic waste will be collected in closed bags and will be carried to the area determined by the Governorate or the Municipality. If necessary, the protocol in this regard will be signed by the Governorate and Municipality.

Packaging wastes to be generated during construction period will be collected and treated separately according to the Packaging Wastes Control Regulation.

Excavated soil will be collected, stored temporarily, transported, recycled and disposed of ultimately according to the Regulation on Control of Excavation, Construction and Demolition Wastes. It is planned that excavated soil generated during construction period will be re-used for landscaping purposes primarily. Remaining soil, excavation waste will be transported to the sites approved by Hacılar Municipality. Necessary permits will be obtained during this process.

On-site and off-site transportation of waste will be conducted so as to prevent or minimize spills, releases, and exposures to employees and the public.

All solid non-hazardous wastes will be treated according to the Solid Waste Control Regulation, Communiqué on Recovery of Some Non-Hazardous Wastes and the IFC/WB guidelines.

5.5.2 Operation

It is expected that domestic and industrial non-hazardous waste will be generated during operation period of this project. Generated waste will be characterized according to composition, source, types of wastes produced, and generation rates. Wastes will be collected separately at source in accordance with the Regulation on General Principles of Waste Management.

Domestic waste will be generated by 60 personnel working during operation period. According to Turkish Statistical Institute Regional Statistics (2010), waste generation rate per person in Kırıkkale Province is 1.47 kg/day/person. Thus, for 60 employees, daily total solid waste generation is estimated to be about 88.2 kg/day. This waste will be collected and transported to an area which Governorate or Municipality will determine properly by the project owner. The official letter of Hacilar Municipality related to collection and transportation to the waste storage facility of this solid waste is already secured. Management of solid waste to be generated during operation period of the project will be carried out according to the Solid Waste Control Regulation, and the IFC/WB guidelines.

Industrial solid wastes to be generated during operation period are non-contaminated filters, used moisture retaining substances, workshop wastes and empty drums. These non-contaminated solid wastes will be disposed of periodically.

Recyclable wastes like paper, cardboard, metal and glass will be collected, separately and recycled. These wastes will be collected, stored and disposed of according to the Packaging Wastes Control Regulation, Solid Waste Control Regulation, Communiqué on Recovery of Some Non-Hazardous Wastes and the IFC/WB guidelines.

In conclusion, impacts of all domestic and non-hazardous wastes will be negligible with implementation of requirements of related regulations and guidelines.

5.5.3 Decommissioning

During the decommissioning, non-hazardous waste will be segregated and non-recyclable waste will be taken to the local municipal land fill. The recyclable waste will be sent to the licensed and authorized recycling companies. Adverse environmental impact is not expected during decommissioning. It is anticipated that the impact significance of non-hazardous wastes that will be generated during construction and operation will be minor to moderate. The residual impact after taken all necessary measures can be defined as negligible.

5.6 Soil and Groundwater

5.6.1 Construction

Construction activities may pose a potential for release of petroleum based products, such as lubricants, hydraulic fluids, or fuels during their storage, transfer, or use in equipment. All

chemical storage containers, including diesel fuel, and hazardous liquid waste drums/containers will be placed so as to minimize the risk of soil and groundwater contamination and water pollution. Such chemicals and fuel will be stored in concrete areas with proper secondary containments and drip trays during construction. When necessary, spill kits, absorbent pads or materials and absorbent sands will be provided near the chemical storage areas at all times.

There is also a potential for spills/leakage of oil associated with the construction machinery and vehicles. Construction machinery will be checked regularly. Any maintenance required will occur over hardstanding or on a suitable impermeable ground cover. Refueling will be limited to a designated area. Spill kits, absorbent pads and absorbent sands will be available on site at all times. Parking of staff vehicles will only be permitted in designated areas. Any spills will be cleaned up as soon as possible with any contaminated sands bagged up and disposed of correctly.

All mitigation measures during handling, storage and transfer of chemicals and hazardous materials will be in compliance with the Statute on the Measures to be Taken at Work Sites and Works Utilizing Explosive, Flammable, Hazardous and Detrimental Materials and Regulation on Soil Pollution Control and Contaminated Sites by Point Sources.

With such proper precautions to prevent potential releases to reach environment, an adverse impact to soil or groundwater is not expected during the construction.

5.6.2 Operation

Various types of chemicals and oil will be used during operations. All storage tanks and drums, including those containing oil will be placed in concrete areas with proper secondary containments.

Oil storage tanks and chemical storage tanks, such as the acid and caustic storage tanks, will have secondary containment structures that will hold more than the contents of the storage tanks and have drainage valves that are normally closed. Areas for unloading hazardous chemicals will be isolated by curbs and provided with a sump equipped with a manually. The maintenance and repair of the equipments will be done on the area with appropriate infrastructure, thus the generation of the waste oil will be minimized.

An Emergency Response Plan and Oil Spill Contingency Plan will be prepared and implemented.

Transformers will be sealed units with negligible leakages. The transformer oils will not contain polychlorinated biphenyls (PCB). Transformers will be provided with pits to retain 110% of the coolant capacity of the transformers.

With these precautions to prevent potential releases from reaching the environment, an adverse impact to soil or groundwater is not expected during the operations phase.

5.7 Flora-Fauna

When the data of previous field studies and observations conducted in the project site and its close vicinity are evaluated, the project site is observed not to be a breeding, nesting, sheltering, resting or reproduction area for wild- especially bird species.

Turkey has signed The Convention on the Conservation of European Wildlife and Natural Habitats known as the Bern Convention in 1984. The Bern Convention is a binding international legal instrument in the field of nature conservation, which covers the whole of the natural heritage of the European continent and extends to some states of Africa. Its aims are to conserve wild flora and fauna and their natural habitats and to promote European co-operation in that field. Accordingly, each party signed the convention will specially guarantee the preservation of the wild flora and fauna species listed in the Appendix I by making necessary legal and regulatory arrangements. The tearing off of these plants on purpose, picking up of them, cutting down or collection of the roots will be prohibited strictly. Each party will prohibit the existence of these species in the stocks of bodies and trading. The flora species in the project area were evaluated for the Bern Convention and no species were determined that are protected by Bern Convention.

The endemic plant species recorded in the project site: *Stachys cretica anatolica* Rech. Fil. and *Centaurea urvillei* DC. subsp. *stepposa* Wagenitz have broad distribution and have Least Concern category according to IUCN conservation categories. For this reason, during construction no conservation measure is necessary in the project area.

It has been emphasized in Annex II of the Bern Convention that all countries party to the convention must place special care to areas that are important for migrating species included in Annex-II and Annex-III. The project site is evaluated by means of this, and it has been determined that the area has not been used by migrating species regularly for feeding, resting, etc. purposes.

According to Article 6 of the Convention, the following are expressly prohibited:

- all forms of deliberate capture and keeping and deliberate killing;
- the deliberate damage to or destruction of breeding or resting sites;
- the deliberate disturbance of wild fauna, particularly during the period of breeding, rearing and hibernation, insofar as disturbance would be significant in relation to the objectives of this Convention;
- the deliberate destruction or taking of eggs from the wild or keeping these eggs even if empty.

During all kinds of activities to be carried out in the project area, the above-mentioned precautions will be followed, particularly for wild animal species included in Bern Convention Annex-II and Annex-III.

Provisions for wild fauna species covered in Annex-III are specified in Article 7. Accordingly, all countries party to the convention must take all necessary legal and administrative measures for wild

fauna species covered in Annex-III. These measures will be arranged in such a manner of that none of the operational activities in the area not to endanger populations of wild animal species.

For species in protection lists prepared by Central Hunting Commission of the General Directorate of Nature Conservation and National Parks, protection measures must be implemented in accordance with the provisions of that commission's decisions. Wild animals listed in Annex-I have been taken under preservation following the Article 4 Paragraph 1 of the Hunting Law #4915 enacted by the Ministry of Environment and Forestry. It is forbidden to hunt, carry dead or alive, or transport the wild animals in this list.

For species in protection lists for 2011-2012 Hunting Season prepared by Central Hunting Commission of the General Directorate of Nature Conservation and National Parks, protection measures will be implemented in accordance with the provisions of that commission's decisions.

The species in the license area and vicinity having the "VU" designation are also defined as "species exposed to the threat of extinction in the medium term." Therefore, activities that may directly or indirectly impact these species will be avoided.

The effects on amphibians: During the construction period, the old water tank, which is the only observation point of amphibian species, will be destructed. In order to keep the amphibians away from the negative effect of this, *Bufo viridis* individuals will be caught by special instruments (dipper, dip net, etc.) and will be released to Kızılırmak River. Since Kızılırmak is far away from the project site, it will not be affected from the operations.

The effects on reptiles: As known, the bushes and trees are used for many purposes by the reptiles. For example, while some snakes and lizards use these habitats when the sun light reaches peak point in summer; they spent the winter in cracks and hallows of trees.

Among the reptilian species present in the project area, there are ones in the Bern Convention annexes, Annex II and Annex III. Bern Convention makes condition that wild forms and habitats of species listed in Annex II be prevented from damage. One reptilian species in the project area is *Testudo graeca*. It is in species under conservation according to Bern Convention, but is in objection-record list in Turkey. This tortoise, spent winter in the hollows, it opens in the ground. Before construction period, a basic surface check will be sufficient to identify the species. The individuals identified by this method, will be carried to the surrounding environments that will not be affected from the construction and operation.

The effects on birds: The field is quite poor in terms of perennial plant species and trees. Only few ash and pear trees are detected. Bird nests are observed in some of these trees (Figure 5-19). Moreover, in agricultural regions grapevine trees are observed. In the construction period, these trees will be cut. The species using them will not be able to use anymore: birds for example will not be able to use these trees for nesting. When it is necessary to cut these trees, the time will be arranged according to time. By this, the species which will lose their habitat will be prevented from damage. These birds will have to use the alternative habitats for nesting and feeding purposes.

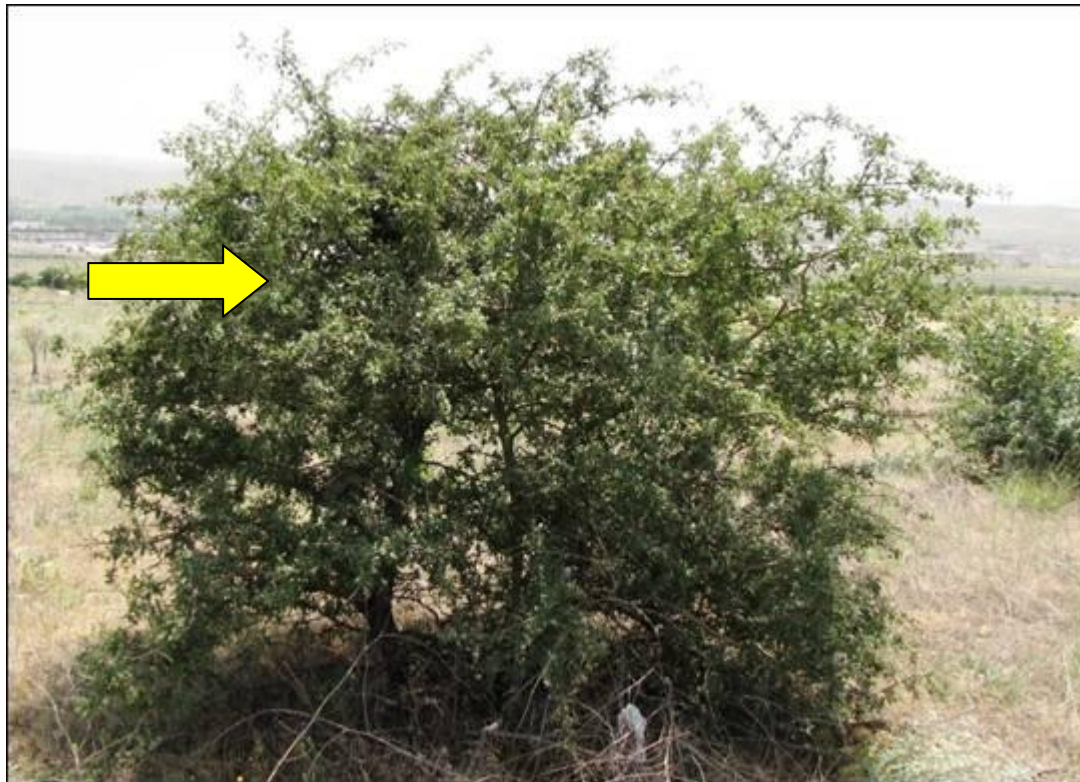


Figure 5-21 Bird Nest in a Tree in the Project Site

The few number of birds recorded while passing above the project area use the area for feeding and resting purposes. Some of them just pass over the area and go to adjacent regions. These species are classified as transit birds and they are not closely related to project area. Therefore, they will not be directly affected from the operations. In natural environments the most important risk of the operations to wildlife fauna is the negative effect on breeding.

The effects on mammals: Entries of nest-holes and mounds on the soil are determined some parts in the project area. These spots are the habitats used by reptilians and rodents. Indeed these habitats are mostly used *Microtus* sp. and *Nannospalax* sp. (Rodentia). These species will be negatively affected from the transformation of land. Before starting construction works especially the land where the transformation happens, there will be habitat controls. With these controls the places of the mole species will be determined. Similarly, in the soil near the upper surface the herpatofauna components as frogs, lizards and snakes are present. Therefore, care will be spent working on these parts. Not to harm any of these components either one will let them leave the place by themselves or additional transfers will be applied.

If there are animals inhabiting under the soil near to the surface, they may come out to the surface because of the excavation. They will be removed from the project site by appropriate means of methods or make them leave the site.

It is not possible for the animals nesting on the plants or soil in the project site to inhabit these areas again after the stripping. The individuals leaving their habitats will have to find similar habitats

around. In this period, since these animals will be under stress and in an adaptation process, anyone will not approach; try to capture or any other attempt which increases their stress.

Moreover, most animal species are affected negatively from lower decibel sound rather than humans. From this consequence the animal can either move from the area or stop the activities as reproduction, feeding, resting, and breeding. For this reason, the precautions will be taken during the construction that the noise will decrease to minimum level, especially in the period of reproduction and nesting. Some local fauna components will be affected from the working devices during the construction and from different kind of noise during operation. Because of the disturbance, some species will leave the area either temporarily or permanently. There can be species that already begin nesting or later on will begin nesting after the operation. If the produced level of noise is high, there is risk of those species to quit nesting and looking after the offspring. With suitable conservation measures, it can be possible to keep that level to avoid migration of the species inhabiting the region. In the vicinity of project area there are similar kinds of habitats that those species can move.

It is anticipated that the impact significance to flora-fauna due to construction and operation activities will be minor. The residual impact after taken all necessary measures is determined as negligible.

5.8 Visual Impacts

Visual or aesthetic resources refer to those natural and cultural features of an environmental setting that are of visual interest to people. The project site is not located in a protected area or a tourist/resort area; it is located on an area which is classified as industrial zone near a large oil refinery and not considered as an aesthetically significant place. Thus, a visual impact is not considered as significant. However, the visual impact associated with the proposed project will be permanent for those residing at the closest settlements.

The potential visual impact of the proposed project will primarily result from changes to the visual character of the area within the view catchment. The nature of these changes will depend on the level of the visual contrast between plant structures and the existing landscape within which they would be viewed. The degree of contrast between the structures and the surrounding landscape will result from one or more of the visual characteristics such as; color, shape or scale, texture and reflectivity.

In order to demonstrate the visual impact, views of the Project site from four different locations have been prepared. Three dimensional models were used in order to represent plant structures and these models were located on satellite image of the Project site. The dimensions of the models were same as the project dimensions.

- The first view, which is given in Figure 5-20, is looking to the Project site from D753 Kırıkkale-Konya Road in west direction, about 300 m away from the Project site at 738 m altitude.

- The second view in Figure 5-21 shows the Project site from Tüpraş Social Facilities situated in the northeast of the Project site. The view is looking in southwest direction, about 400 m away from the Project site at 760 m altitude.
- The third view, shown in Figure 5-22 is looking to the Project site from the residence situated in the west-southwest of the Project Site looking in east-northeast direction, about 800 m away from the Project site at the altitude of 870 m.
- The last view in Figure 5-23 shows the Project site from the north of Hacılar Town located in the south of the Project site. The view is looking in north direction, about 2.1 km away from the Project site at 767 m altitude.

**Viewpoint Information**

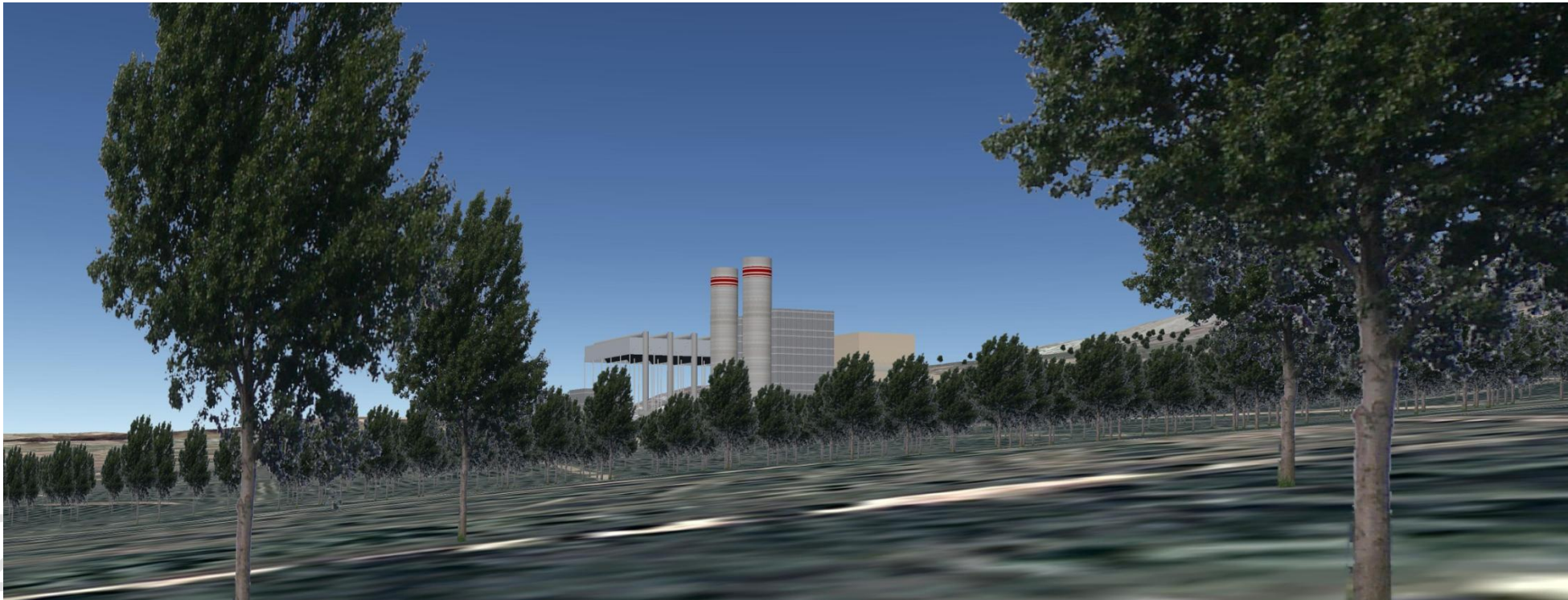
Viewpoint Coordinates : 539061E 4401094N
View Direction : West
Viewpoint Elevation : 738 m
Distance to Nearest Turbine : 300 m

IC ANADOLU CCPP

Viewpoint 1 (D753 Kırıkkale-Konya Road)

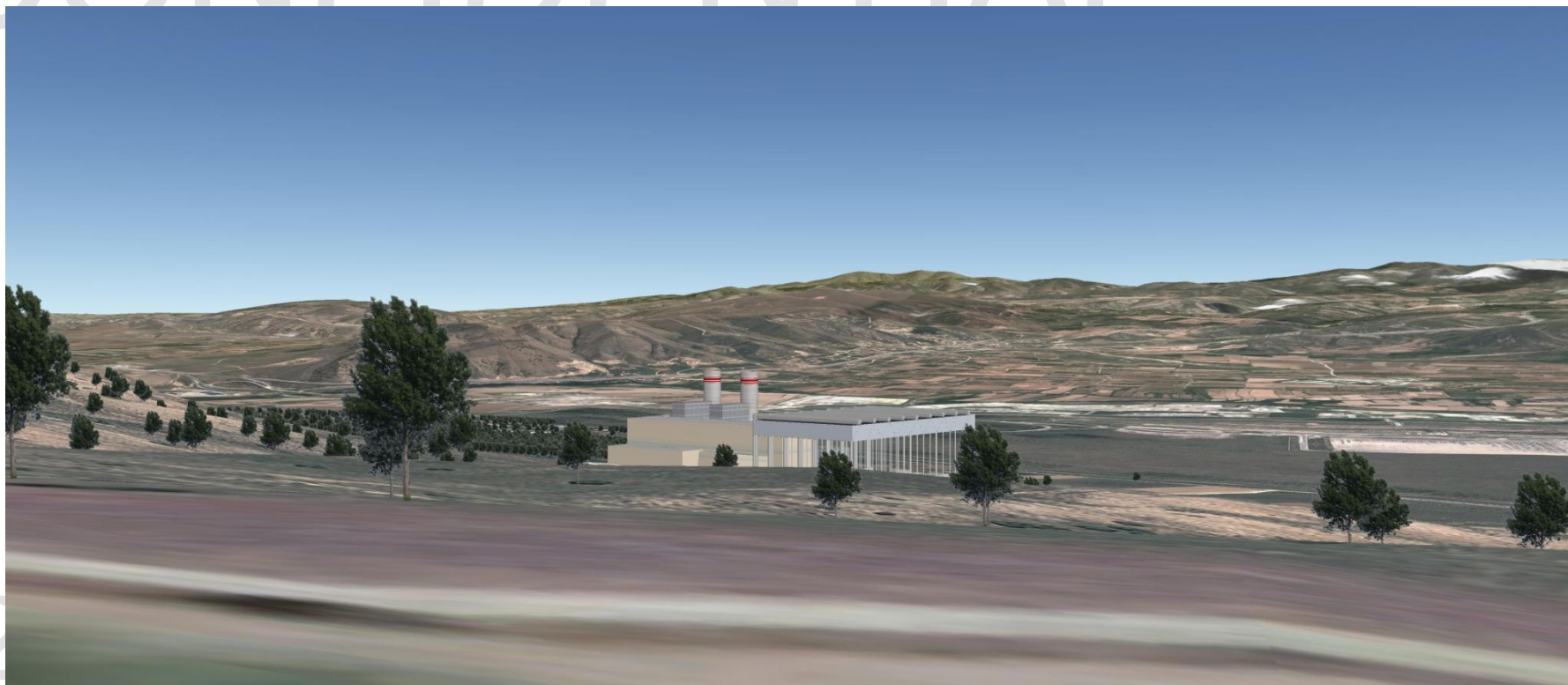
AECOM

Figure 5-22 View of the Project Site from D753 Kırıkkale-Konya Road



Viewpoint Information Viewpoint Coordinates : 539052E 4401492N View Direction : Southwest Viewpoint Elevation : 760 m Distance to Nearest Turbine : 400 m	IC ANADOLU CCPP Viewpoint 2 (Tüpraş Social Facilities)

Figure 5-23 View of the Project Site from Tüpraş Social Facilities

**Viewpoint Information**

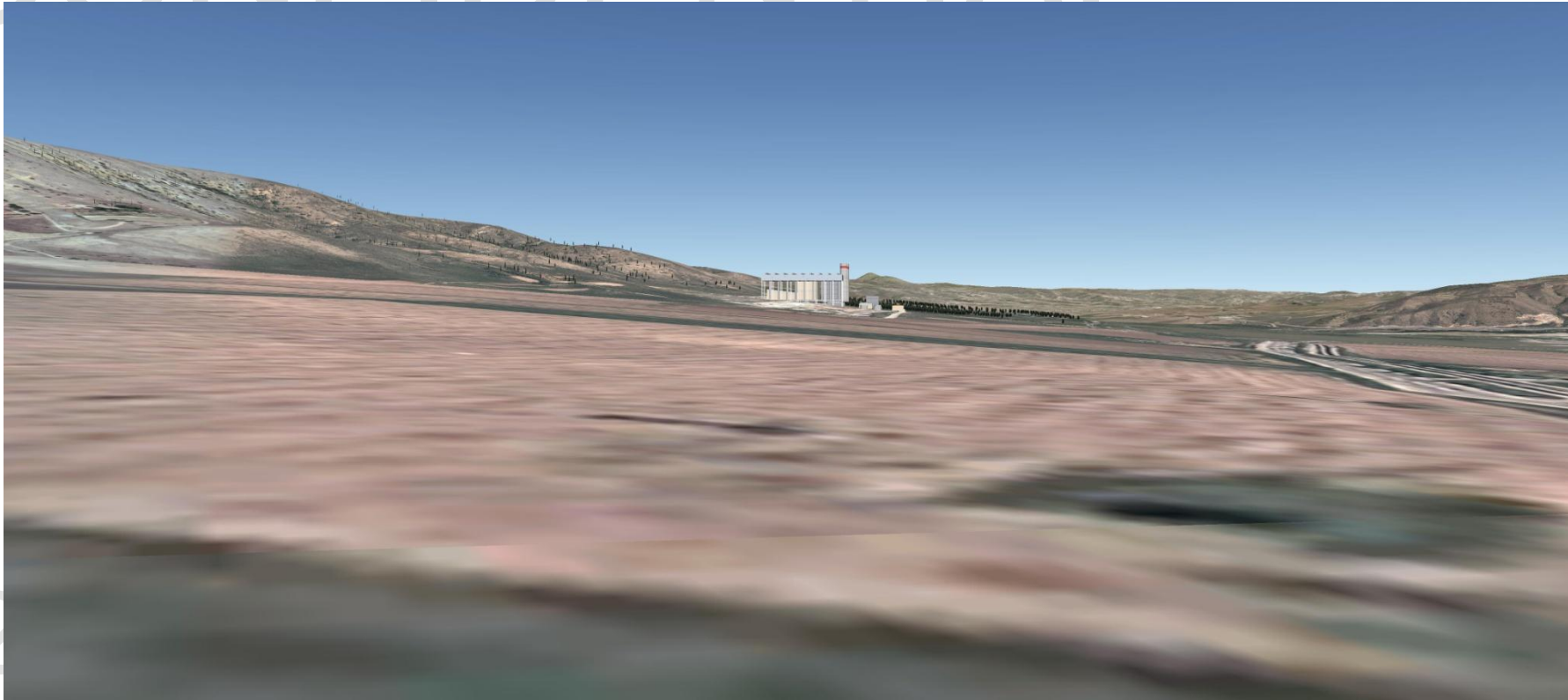
Viewpoint Coordinates : 537681E 4400811N
View Direction : East-Northeast
Viewpoint Elevation : 870 m
Distance to Nearest Turbine : 800 m

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Viewpoint 3 (Dwelling Located in West-Southwest)

AECOM

Figure 5-24 View of the Project Site from the Dwelling Located in West-Southwest

**Viewpoint Information**

Viewpoint Coordinates : 537730E 4398971N
View Direction : North
Viewpoint Elevation : 767 m
Distance to Nearest Turbine : 2.1 km

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Viewpoint 4 (Hacılar Town)

AECOM

Figure 5-25 View of the Project Site from Hacılar Town

As can be seen from Figure 5-20, all structures of the proposed plant will be in the view shed of the drivers navigating on D753 Kırıkkale-Konya Road passing from the east of the Project site. As shown in Figure 5-21, there is a plantation area having mature trees (mostly pine) between the Project site and Tüpraş Social Facilities. Thus, the proposed plant buildings will not be seen from Tüpraş Social Facilities where the point of view2 is located. The HRSG, ACC and stack structures will be partially visible from the point of view2. Since the dwelling located in the west-southwest of the Project site is situated at higher elevations, most of the structures of the proposed power plant will be visible from the point of view3. The high structures such as HRSG, ACC, Power Hall and Stack will be seen as shown in Figure 5-22 whereas other low-height buildings such as RMS, Workshop & Stores, Water Treatment Plant and Water Tanks will not be visible to the point of view3. In the last view (Figure 5-23) from the north of Hacılar Town situated in the south of the Project Site, all structures will be visible to the residents.

Visual impact is a subjective issue. There is no known public opposition on power plants in terms of potential visual effects. Since the Project site is classified as industrial area and there is Tüpraş Orta Anadolu Refinery in the close vicinity of the Project site, the residents of the closest settlements are familiar with industrial plant structures. Moreover, after the conversations with local people, it was understood that they do not have any negative attitude about the visual impact of power plants. Thus, it is expected that public and NGOs will view this development favorably and visual impacts will be considered as minor.

5.9 Cultural and Historical Resources

As indicated in Section 4.11, there are no archaeological, historical and cultural resources within the proposed Project site. The closest historical resource is the archaeological site located at Hacılar - Cumaovası. This place is located at the Hacılar Town. This area was declared as the 1st degree archeological site on December 4, 1990. There is Roman Necropolis at the vicinity of Tüpraş refinery which was also declared as the 1st degree archeological site on January 30, 2004. In addition to these, there are also Aşara and Çatalsöğüt mounds in the Hacılar Town. None of these resources are located in the vicinity of the Project site thus proposed project will not have any adverse impacts on cultural and historical resources during construction and operation.

5.10 Socio-Economic Impacts

Probable Income Growth

Total investment cost of proposed İç Anadolu CCPP is approximately 900 million USD. Construction period of the project will last 34 months. It is estimated that nearly 900 personnel will be required for construction and most personnel will be employed from local work force. Service buses and minibuses will be provided in the mornings and evenings for workers living in towns and cities around the facility. It is planned that necessary material and service (expenses to paid for preparation of the project site and construction period, work force, equipment rental , fuel etc.) will be delivered using existing local resources. These expenses will contribute to local economy positively.

Since 60 personnel will work during operation period, contribution of the project (salaries of employees, accommodation, consumption for food and clothing etc.) to the regional economy will be limited. So, probable income growth arising from employees working for the plant during operation period will be negligible.

Employment

It is aimed that 900 personnel will be employed during construction period and 60 personnel will be employed during operation period of İç Anadolu CCPP. Employees will be employed from local towns and cities as much as possible. So, temporary and permanent business opportunities will be provided during construction and operation period of this project. It is expected that these business opportunities will affect local economy in positive manner.

Population Movements and Migration

Since workers during construction period will be employed mostly from locals and 60 employees will work during operation period of the plant, there will not be an important population movement or migration.

Education and Culture

Children of employees will form a part of population resettling there. But since number of employees will not be very high, number of children will not affect schools in that region negatively. In a similar way, it is not expected that personnel working for the plant will affect educational and cultural structure of the region negatively.

Other Social and Technical Infrastructure Services

It is not expected that social and technical infrastructure of the region will be affected by implementation of the İç Anadolu CCPP. However, it is expected that the number of trips of Hacılar public buses will increase during the construction period of the project. Personnel working during construction period of the project will meet their food and other requirements using local stores. So it is anticipated that number or production of shops, markets and bakeries may increase in the area.

Traffic

It is not expected that the change in the traffic load due to the project will adversely affect the traffic load of the roads in the vicinity of the project site. The annual average daily traffic load of Kırıkkale-Konya road which is the main access road of the project site is presented in Table 5-29 below. This data belongs to the General Directorate of Highways-Department of Strategy Development- Transportation and Cost Analysis Division. According this data the road is frequently used by people.

Table 5-28 Traffic Load of Kırıkkale-Konya Road (2010)

Vehicle Type	Number of Vehicles/day
Car	634
Medium Gross Vehicle	63
Bus	0
Truck	71
Articulated Truck	45
Total	813

The numbers of construction vehicles are presented in Table 5-29. Total of about 40 construction vehicles will be employed at site at maximum during construction period. According the records of General Directorate of Highways, the daily heavy vehicle traffic load on Kırıkkale-Konya Road was 177 in 2011. Hence, the increase in the daily traffic load on the Kırıkkale-Konya Road due to project will be negligible. Most of these vehicles will stay on site until their work finishes and will not generate traffic continuously. Besides, the workers will stay in the vicinity of the project site. Thus, traffic due to transportation of workers will be negligible. Construction will continue for 34 months and the traffic load will be extended through this period. Necessary permissions will be taken from General Directorate of Highways when heavy and wide loads will be transferred in accordance with the Highway Traffic Law.

As the current traffic load on the project site access roads and additional traffic load caused by the project such as transportation of construction vehicles during construction phase are assessed, potential impact due to project traffic load will be negligible.

6.0 ASSOCIATED INFRASTRUCTURE and CUMULATIVE IMPACT

6.1 Natural Gas Pipeline

6.1.1 Introduction

The Project will use natural gas that will be supplied via a dedicated gas pipeline that will tee in to the existing Samsun-Ankara Natural Gas Pipeline. One option to supply gas to the Project is by “hot tap” in the Tüpraş pipeline passing 2.15 km southwest to the proposed Project site. This option was not selected since it was not suitable to connect this pipeline in terms of capacity. Another option is to supply natural gas through a connection to the main gas pipeline known as Samsun-Ankara Natural Gas Pipeline as shown in Figure 6-1. Natural gas will be supplied from the Samsun-Ankara Natural Gas Pipeline with a 12.6 km new pipeline. 9+150 km of this line will be parallel to the Tüpraş pipeline. The natural gas pipeline that will supply gas to the project will be constructed parallel to the existing pipeline that supplies natural gas to Tüpraş Orta Anadolu Refinery.

İç Anadolu Enerji signed an agreement with Petroleum Pipeline Corporation (BOTAŞ) for the gas connection. The specifications of hot-tap equipment and specifications of ball valve are presented in Table 6-1.

Table 6-1 Specifications of Hot Tap Equipment and Ball Valve

Hot Tap Equipment	
Design	Extruded Type
Design Code	ANSI B 31.8
Design Factor	0.72
Design of Flange	ANSI B 16.5
Design Pressure	100 bar for class 600
Design Temperature	-20 °C to 80 °C
Welding Code	ASME Section IX
Sleeve Material	TStE 355 as per DIN 17102 with EN 10204-3.1.B certificate or equivalent
Flange Material	ASTM A 105 with EN 10204-3.1.B certificate
48" X 12" Reducing Branch Fitting with L.O.R flange ANSI 600 with guide bar type plug which fits to 1200 H/T	
Ball Valve	
Specification	According to API 6D
Quantity	1
Valve Type	Ball valve
Pattern	Full bore
Valve class	Class 600
Valve Size	12"
Ends	Falnged according to ANSI B 31.5
Fully welded, under ground type, w/2 mt. stem extension, w/sealant injection clappers and drain, double block and body bleed	

Since, the natural gas pipeline that will supply gas to the project will be constructed parallel to the existing pipeline that supplies natural gas to Tüpraş Orta Anadolu Refinery, the areas located in the pipeline corridor for the proposed project were already expropriated during the construction of the existing Tüpraş gas pipeline. Thus, very limited or no expropriation will be required for the project.

The construction of the pipeline will involve heavy machinery, welding equipment, testing compressors, and transporting vehicles. The contractor will be a specialized contractor who will be awarded by the project owner and approved by BOTAŞ.

Construction of the gas pipeline will be the responsibility of the project owner. The technical specifications will be provided by BOTAŞ and the process will be controlled and approved by BOTAŞ. The detailed procedure for the construction of the pipeline includes: fencing off, removal of any vegetation and of topsoil, digging of pipe trench, inserting of the pipe along the route, welding of the pipe and coating of the weld, inspection to assure that welding is within the relevant standards, backfilling and reinstating the land to its original status.

The pipeline will be tested prior to use. During operation the pipeline will be inspected either visually or with the help of special equipment. The inspection of the line will be the responsibility of BOTAŞ.

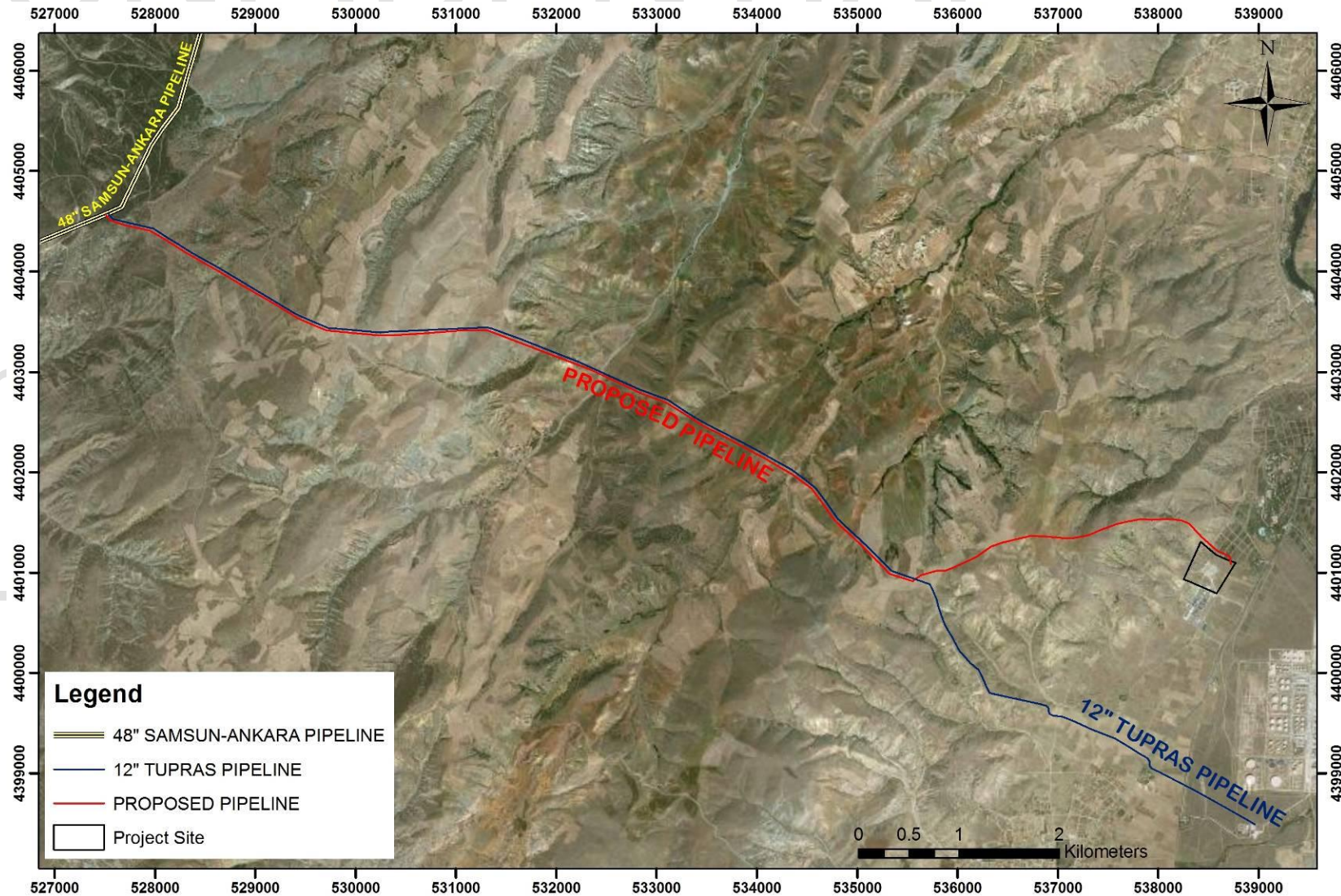


Figure 6-1 Proposed Pipeline Route

6.1.2 Existing Environment

The closest settlement to the proposed pipeline is Çamlıca Village situated in south of the pipeline route with the distance of about 750 m. The pipeline route crosses from three districts of Kırıkkale Province; Merkez District, Bahşılı District and Yahşihan District. The landuse of the proposed pipeline route is agricultural land. The pipeline crosses several croplands.

6.1.3 Impact Assessment

Air Quality

Dust will be the most important air quality issue, during the construction period of pipeline, digging the path of the gas pipeline, refilling the path, as well as movement of equipment and vehicles will tend to produce dust along the immediate construction route. This effect is expected to be temporary and limited since the construction will be completed in few months. Furthermore such effect will be moving along the pipeline with progress in the project which means the time interval of such effect will be short at each construction segment. The total impact of dust emissions will be much less than dust in open land which is expected naturally and quite common due to gusty wind in that open area. Mitigation measures will be implemented to limit the potential adverse effects of dust. Thus, potential air quality impacts of the new pipeline construction will be negligible and insignificant.

Vehicles and digging equipment will also produce combustion gases, but will be limited and temporary. The potential impact associated with vehicle and digging equipment emissions will be negligible due to dispersion of pollutants in air and lack of human activities along the route of the pipeline.

No impacts to air quality are expected during operation of the new pipeline.

Below mentioned mitigation measures will be taken to minimize dust impact:

- During the digging and backfilling of the pipeline trench, water sprays will be used in suppressing dust resulting from such operations.
- Activities that produce significant dust emissions will be monitored during periods of high winds and dust control measures will be implemented as appropriate.
- Stockpiles of soil and similar materials will be carefully managed to minimize the risk of windblown dust, e.g. water spray dampening soils and spoil and during delivery and dumping of sand and gravel.
- Where possible, drop heights for material transfer activities, e.g. unloading of friable materials, will be minimized and carefully managed.
- On-site and/or access roads will be well maintained through mechanical means (sweeping) or spraying with water.
- Vehicle speeds on un-surfaced roads will be limited to 30 km/hr.

- Lorries or trucks used for the transportation of friable construction materials and spoil off-site will be covered and sheeted.
- Engines will be switched off when not in use.
- All vehicles and engines will be properly maintained to reduce air emissions.

Wastewater

The wastewater that will be generated during the construction of the proposed pipeline will comprise of mainly domestic sanitary effluents by the workers. Such wastewater will be collected and disposed in a proper manner. Portable toilets will be used during construction activities and wastewater will be collected via vacuum trucks. There will be no wastewater discharge to environment and thus there will be no impact associated with wastewater.

Solid Waste

Most of the solid waste that will be produced during construction phase will consist of excavation debris. Any debris or other wastes produced during such activities will be collected, reused, or otherwise disposed in a proper manner to prevent any lasting impacts to the area. In addition solid waste may be produced as domestic household type waste produced by and the workers will be collected and disposed of properly. Therefore there will be negligible impact associated with solid waste.

Emergency Plan

Due to the nature of the proposed gas pipeline, emergency situations may arise at any time. Such emergencies may include pipeline breakage, gas leakage, fires, earthquakes, and flash floods.

Such emergency plans will be ready and updated regularly. Proper training will be provided to workers and inspectors. Fire hazards and accident risks will be included in this plan.

Visual Impact

The construction phase will be a typical construction site where different construction equipment and machinery are used. Such equipment will include cranes, trucks, and hoists. The landscape of the proposed pipeline route due to ground disturbance will be affected temporarily. Any debris or wastes produced during such activities will be collected, reused, or otherwise disposed in a proper manner to prevent any lasting impacts to the area. Below mentioned mitigation measures will be taken to minimize visual impact:

- The contractor will try as much as possible to size construction equipment such as cranes so as to provide an efficient construction activity while reducing any visual effects to the nature of the area.
- Pipeline project equipment storage area will be maintained properly to prevent adverse visual impact.

- All debris and wastes will be collected, stored, and transported in a proper manner to prevent any adverse visual impact on the surrounding area.
- Construction camp site and equipment lay down area will be reinstated to original after the construction.

Socioeconomics

The proposed route of the gas pipeline is through agricultural lands and Government owned land. The pipeline will be constructed parallel to the existing pipeline that supplies natural gas to Tüpraş Orta Anadolu Refinery. Thus, the areas located in the pipeline corridor for the proposed project were already expropriated during the construction of the existing Tüpraş gas pipeline. Thus, it is expected that there will be a limited expropriation. The expropriation will be performed by BOTAŞ. The proposed gas pipeline is not expected to have negligible impact on the value of land in that area.

During the construction phase of the proposed pipeline a maximum of 50 construction workers including skilled labor will be employed. During the initial phase of construction of the civil works, a small unskilled workforce will be required, later the mechanical and electrical works will require a larger workforce with more specialized skills. However, it is clear that there will be direct opportunities for local employment, although limited and temporary, which will result in positive social and economic impacts.

It is expected that construction contract will be awarded to a qualified contractor by the project owner. It is anticipated that there will also be unskilled construction labor force that need to be hired for the job. Therefore, there will be good opportunities, although short termed, for local employment from the local population during the construction phase. Although short termed, small shops, food and beverage stores, spare part suppliers, vehicle maintenance workshops and other local businesses will also be positively affected.

The proponent will seek to maximize the positive socio-economic impact of the project where practical/possible in all stages of the project by:

- Giving priority to qualified local people in recruitment for skilled and non-skilled construction and operation staff.
- Local vehicle maintenance workshops will be used during the construction and operation phases.
- Contractors will be encouraged to source supplies, food, beverages and spare parts from local stores during construction phase.
- To protect the roads, trucks which will be used for transporting activities will have a gross weight within the axial permissible load.

Ecology

As stated above the proposed route of the gas pipeline is through agricultural lands. Thus, the vegetation cover is extremely poor and includes only crops. The lack of natural vegetation cover has reduced the possibility of any mammals along the pipeline route.

Following mitigation measures will be implemented during construction:

- Use the existing access roads in the area for the construction activities and do not construct additional side roads as much as possible.
- Prohibit hunting of animals and collecting ground nests for resident birds.
- Avoid working at night hours as much as possible to decrease disturbance.
- Collect all wastes during construction and dispose them properly to decrease the impact on fauna.

Naturally Protected and Archeological Areas

There are no national parks, nature reserves, natural monuments, wildlife protection areas, wildlife improvement areas and key biodiversity areas within the pipeline and its vicinity. In addition, there are no archaeological, historical and cultural assets in the close vicinity of the pipeline route.

Construction works will be monitored for archaeological remains and chance-find procedures prepared. Construction works will be stopped if any archaeological remains are found. An application will be made to the Ministry of Culture and Tourism related to the archaeological remains may be found there.

6.2 Substation and Transmission Lines

The power will be connected to the 380 kV Gölbaşı Substation and 380 kV switchyard of the proposed 1200 MW Kırıkkale Natural Gas Power Plant that will be constructed in Yahşıhan District of Kırıkkale Province. This connection will be accomplished through a 58 km transmission line. The connection scheme of the power plant was advised by the Turkish Electricity Transmission Inc. (TEİAŞ). İç Anadolu Enerji signed an agreement with TEİAŞ for connection. GAMA Energy will have an EIA report prepared for the transmission line once the route of the line is determined.

7.0 OCCUPATIONAL HEALTH AND SAFETY

Occupational health and safety mitigation measures will be taken during construction, operation and decommissioning period of this project. Main health and safety concerns that should be considered are non-ionizing radiation, heat, noise, confined spaces, electrical hazards, fire and explosion hazards, chemical hazards and dust. Mitigation measures to be taken are explained under these subsections.

7.1 Non-ionizing Radiation

Employees working in a power plant may expose to electric and magnetic fields (EMF) highly due to working in proximity to electric power generators, equipment and connecting high-voltage transmission lines. Through the mitigation measures to be taken during this project, occupational EMF exposure will be prevented or minimized. An EMF safety program to be prepared and implemented will include following concerns:

- Potential exposure levels in the workplace will be identified and surveys of exposure.
- Employees working in EMF will be trained while identifying occupational EMF levels and hazards.
- According to EMF levels determined safety zones will be identified and established.

7.2 Heat

Workers may expose to heat during operation and maintenance of combustion units, pipes and related hot equipment. On order to prevent or minimize this heat exposure, mitigation measures below will be taken:

- Pressure vessels and piping will be controlled periodically.
- Necessary work areas will be ventilated in order to reduce heat and humidity.
- Working time in high temperature will be kept short and water will be supplied to the workers working here.
- Surfaces of hot equipment with which workers may contact closely will be covered.
- Warning signs will be placed near high temperature surfaces and appropriate personal protective equipment (insulated gloves and shoes) will be provided.

7.3 Noise

In order to reduce noise arising from the plant will be prevented or minimized with mitigation measures below:

- Noise level will be kept below 60 dBA with sound-insulated control rooms.

- Generators will be designed as so as to conform to applicable occupational noise levels.
- High noise areas will be described and personal noise protecting equipment will be supplied all the time while working in these areas (typically areas with noise levels >85 dBA).

7.4 Confined Spaces

A confined space is a place which is substantially enclosed (though not always entirely), and where serious injury can occur from hazardous substances or conditions within the space or nearby (e.g. lack of oxygen). In order to prevent or minimize these potential injuries, measures below will be taken:

- Confined space entry will be permit-required.
- Confined spaces will be provided with permanent safety measures for venting, monitoring, and rescue operations, to the extent possible. The area will be appropriate for emergency and rescue operations.
- Access hatches will accommodate 90% of the worker population with adjustments for tools and protective clothing. The most current ISO and EN standards will be consulted for design specifications;
- Before entering into a permit-required confined space :
 - Process or feed lines into the space will be disconnected or drained, and blanked and locked-out.
 - Mechanical equipment in the space will be disconnected, de-energized, locked-out, and braced, as appropriate.
 - The atmosphere within the confined space will 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 will be ventilated until the target safe atmosphere is achieved, or entry is only to be undertaken with appropriate and additional PPE.
- Safety precautions will 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 will be verified. Further, adequate and appropriate rescue and / or recovery plans and equipment will be in place before the worker enters the confined space.

7.5 Electrical Hazard

Workers may expose to electrical hazards while working with energized equipment so necessary measures will be taken in order to prevent, minimize and control these hazards:

- Hazard warning signs will be installed inside electrical equipment rooms.
- Voltage sensors will be used and these sensors will work when workers enter into rooms in which electrical components are located.
- Live power equipment and distribution lines (before work is performed on or proximal to them) will be deactivated and grounded properly. Applicable legislation and guidelines will be consulted.
- Workers working with or around exposed components of electric circuits will be trained in specialized electrical safety including proper safe work procedures, hazard awareness and identification, proper use of PPE etc. Provisions will be made for periodic retraining as necessary.

7.6 Fire and Explosion Hazards

Measures listed below will be taken in order to prevent, control and minimize physical hazards due to fire and hazard:

- Automated and safety controls will be utilized.
- Boilers will be maintained periodically.
- Startup and shutdown procedures to minimize the risk of suspending hot coal particles will be performed during startup.

7.7 Chemical Hazards

Precautions below will be taken during the construction and operation period of the project in order to prevent or reduce hazards that may arise from chemical materials:

- Hazardous materials will be replaced with a less hazardous substitute.
- Engineering and administrative control measures will be performed in order to prevent or reduce the release of hazardous materials into the work site. Level of exposure will be kept below internationally established or recognized limits.
- The number of workers to be exposed will be kept in minimum.
- Hazardous materials will be labeled and marked properly considering national and international regulations and guidelines. International Chemical Safety Cards (ICSC) or Materials Safety Data Sheets (MSDS) will be prepared. All written communication will be readable and available to workers to be exposed and first-aid personnel.
- Workers will be trained in use of information related to hazardous materials (MSDSs etc.), safe work practices and appropriate use of PPE.

7.8 Fire

Compartmentation

Compartmentation will be implemented in order to prevent or slow the spread of fire and smoke, including:

- Separations
- Fire walls
- Floors
- Doors
- Dampers
- Smoke control systems

Fire Suppression and Control

Fire suppression and control will include all automatic and manual fire protection installations:

- Automatic sprinkler systems
- Manual portable extinguishers
- Fire hose reels

Operation and Maintenance

Operation and Maintenance will involve preparing schedules for mandatory regular maintenance and testing of life and fire safety features to ensure that mechanical, electrical, and civil structures and systems are at all times in conformance with life and fire safety design criteria and required operational readiness.

Additional information related to fire fighting is included in EMP.

7.9 Means of Egress

Means of egress will facilitate a safe evacuation by residents and/or occupants in case fire or other emergency. Means of egress will be designed as so as to include all design measures below:

- Clear, unimpeded escape routes
- Accessibility to the impaired/handicapped
- Marking and signing

- Emergency lighting

7.10 Contact List

The company will develop a list of contact information for all internal and external resources and personnel. The list will include the name, description, location and contact details (telephone, email) for each of the sources and be maintained annually.

7.11 Public Access

The proposed project will not cause any risk in terms of public access. All the necessary precautions will be taken in order to prevent un-authorized access to project site. There will be security personnel during the operation period. Hence, entrance of unauthorized people to the power plant area will be prevented.

7.12 Traffic Safety

In order to prevent traffic accidents and minimize injuries, measures listed below will be taken during the project:

- Dangerous routes will be avoided to reduce the risk of accidents.
- Speed limits will be determined in the project site and speed control devices (governors) on trucks and driver actions will be monitored.
- Vehicles will be maintained regularly and manufacturer approved parts will be used to minimize the potentially serious accidents caused by equipment malfunction or premature failure.
- Pedestrian interaction with construction vehicles will be minimized.
- Emergency responders will be in coordination to ensure that appropriate first aid is provided in the event of the accidents.
- Locally sourced materials will be used whenever possible in order to minimize transport distances and associated facilities such as worker camps will be located close to the project site and worker bus transport will be arranged so as to minimize external traffic.

7.13 Disease Prevention

Illness among workers will be prevented in local communities by:

- Undertaking health awareness and education initiatives, for example, by implementing an information strategy to reinforce person-to-person counseling addressing systemic factors that can influence individual behavior as well as promoting individual protection, and protecting others from infection, by encouraging condom use

- Training health workers in disease treatment
- Conducting immunization programs for workers in local communities to improve health and guard against infection
- Providing health services

Treatment will be provided through standard case management in on-site or community health care facilities. Ready access to medical treatment, confidentiality and appropriate care, particularly with respect to migrant workers will be ensured.

Collaboration with local authorities will be promoted to enhance access of workers families and the community to public health services and promote immunization.

8.0 ANALYSIS OF ALTERNATIVES

8.1 Project Site Selection Criteria and Alternatives

Aside from the planned activity, no-action alternative and execution alternatives, which include fuel and technology alternatives, are assessed below:

No-Action Alternative

In this report "no action" alternative will be considered in terms of continuing with the present course of action until that action is changed which represent that the NGCCPP would not be constructed at the site.

Under the No Action Alternative, the demand for electricity exceeding supply, with an increasing deficit as demand increases in future years. A lack of a secure and reliable electricity generation and supply system has significant social and economic implications, since:

- Existing and future economic development and investments will be constrained because of the shortage of energy resources which will not meet the social and industrial energy demand, and
- Social services including public health and education will be decelerated because of the lack of energy.

As a result, the "no action" option is not a viable or acceptable alternative to the proposed project.

Project Site Selection Criteria

It is expected that proposed power plant will help to meet regional electricity requirement. EMRA accepted the area proposed for the project and expressed its opinion related to the connection between the project area and the transmission system. The project owner evaluated many sites, conducted environmental researches and considered potential risks during selection of the project area. While choosing the project area, minimum area requirement for technical, administrative and social activities and concerns below were considered.

Following criteria were considered during the selection of the site:

- Environmental conditions (Ecology, air, water and soil pollution, noise etc.);
- Closeness to the natural gas pipeline;
- Closeness to the industrial sites;
- Transportation and shipping conditions;

- Condition and terms of acquisition of the field;
- No expropriation requirement;
- Distance to the residential areas;
- Not being an agricultural field;
- No cultural and touristic related restriction;
- No military or national safety restrictions.

After evaluating these it is clarified that the location of the site is positive in terms of many criteria. The proposed project site is selected as it is close to natural gas pipeline, it is owned by the owner of the project therefore there are no expropriation and resettlement needs, it is in the industrial site, it is far from the residential areas and it is close the connection point to natural gas transmission line of Samsun-Ankara Natural Gas Pipeline.

8.2 Fuel and Technology Alternatives

The natural gas combined cycle power plant technology was selected after economic and technical specifications, fuel requirement of the alternatives below were analyzed comparatively.

- Fuel-Oil Fired Thermal Power Generation Facility
- Coal-Fired Steam Turbine Generator Power Plant

Important specifications of these alternatives and the reasons why natural gas combined cycle power plant was selected instead of these two are explained briefly.

Fuel-Oil Fired Thermal Power Generation Facility

A fuel-oil fired thermal power generation facility with similar capacity will contain 30-40 internal combustion engines/generator set and a boiler. A facility of this type will require 6-8 million tons fuel oil annually. In this case, SO₂ and PM emissions will be very high due to poor combustion of internal combustion engines. Moreover, noise level will increase. Since sulfur content of fuel oil consumed in Turkey is relatively high, SO₂ formed as a result of combustion should be controlled by a FGD (Flue-Gas Desulphurization) system. When FGD systems are not installed, emissions from these facilities will result in high SO₂ level. In conclusion, fuel-oil fired thermal power generation facilities should be provided with the systems such as FGD or SO₂ control technologies in order to meet the air quality standards. In addition, ESPs (electrostatic precipitators) should be installed in order to control ash and dust emissions. According to emission control units, limestone supply/storage systems and ash, gypsum and solid waste storage areas will be required and these additional units mean extra area and load for the power plant.

Fuel oil to be used in the facility will be supplied from a close refinery by tankers. In this case, storage tanks with sufficient capacity to store the fuel oil for 30 operation days should be constructed. For 30 days-storage, extra area will be used for these huge storage tanks.

When area and environmental requirements of a fuel-oil fired thermal power generation facility are compared to a natural gas combined cycle power plant, it can be evaluated that disadvantages of the fuel-oil fired thermal power generation facility are more than the advantages. These disadvantages are explained below:

- High SO₂ emission when applicable control technologies are not implemented.
- Additional units to be installed in order to conform to emission standards.
- When a FGD system is installed, additional area to be required for the system, ash, dust, gypsum and solid wastes.
- Traffic load due to the fuel-oil tankers.
- Despite of similar investment costs and construction periods, different fuel costs and low productivity due to the technology.

In conclusion, a fuel-oil fired thermal power generation facility was not preferred for any potential areas in Kırıkkale.

Coal-Fired Steam Turbine Generator Power Plant

A coal-fired power plant with 800 MW-capacity requires about 6 million tons imported coal. If domestic coal is used, this coal requirement will be tripled. Since coal-fired boilers are bigger than natural gas-fired boilers, coal-fired power plants take up more space. However, main reason why coal-fired power plants take up more space is coal storage areas and ash disposal areas.

All of large areas are agricultural lands or close to residential areas. Converting these areas to industrial areas means that hundreds of people will be resettled and agricultural lands will be destroyed. In conclusion, there is no suitable area for a coal-fired thermal power plant in Kırıkkale Province.

It was also determined that CO₂ emission of a lignite-fired power plant is approximately is much more than CO₂ emission of a natural gas-fired power plant.

Cooling System Alternatives

There are a few methods used for cooling in natural gas combined cycle power plants. The most common cooling systems are water cooling and air cooling systems. Both of these systems are analyzed for this planned project considering specific criteria such as water requirement, investment cost, performance and noise level.

Water Requirement

If cooling water source is available, the most economic way is taking the water from the source and condensing waste heat using water while waste heat is condensed again. A water source to be used as cooling water for the proposed project is not available within the borders of Kırıkkale Province Hacilar Municipality. The closest water source to the project site is 2.5 km away. So it was determined that air cooling system will be used for this project since its water requirement is much less than water cooling system.

Conventional cooling systems are processes consuming huge amount of water. Water requirement of these systems can be supplied from the sources such as sea and river. In addition, these systems generate thermal pollution by discharging waste heat. On the other hand, dry cooling systems remove cooling water utilization. These systems discharge only warm and clean air so these systems damage the environment less.

Investment Cost

During selection period of the cooling system, investment and operation costs of two systems were analyzed and compared.

When similar facilities are analyzed, it is seen that when water source from which cooling water is supplied is close, investment cost of water cooling systems is less than air cooling systems. However, there is not a water source near the facility. Although investment cost of air cooling systems are more than water cooling systems, it was determined that air cooling system is more appropriate for İç Anadolu Natural Gas Combined Cycle Power Plant when its operation cost is considered.

Performance

Performance is an important criterion while comparing cooling systems. When similar facilities are analyzed, it is seen that the performance of water cooling systems are higher than air cooling systems'. However there is not a water source near the facility. So air cooling system was selected for this power plant.

In accordance with the criteria analyzed, it was determined that a water resource is not available for a water cooling system to be installed for İç Anadolu CCPP. When calculated, it was determined that a water cooling system would be more economical than an air cooling system if a water source was available in the vicinity. It is clear that a water cooling system is not applicable since the closest water source to the project site is Kızılırmak, 2.5 km away. Furthermore it is thought that meteorological characteristics (temperature and wind) will be affected performance of the air cooling system positively.

9.0 ENVIRONMENTAL and SOCIAL MANAGEMENT PLAN

9.1 Environmental and Social Management Plan

The environmental and social management plan is given below in Table 9-1, respectively.

Table 9-1 Environmental and Social Management Plans

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
AIR EMISSIONS and AMBIENT AIR QUALITY							
CONSTRUCTION							
Dust	Minor	Where possible, the contractor will select equipment designed to minimize dust emissions	Negligible	EIA Commitment	Contractor	Visual inspection	Daily
	Minor	Activities that produce significant dust emissions will be monitored during periods of high winds and dust control measures will be implemented as appropriate and dust-emitting operations will be stopped until high winds stop.	Negligible	EIA Commitment	Contractor	Visual inspection	Daily and when strong winds are observed
	Minor	Stockpiles of soil and similar materials will be carefully managed to minimize the risk of windblown dust, e.g. water spray dampening soils and spoil during delivery and dumping of sand and gravel during periods of dry weather.	Negligible	EIA Commitment	Contractor	Visual inspection	Daily
	Minor	Where possible, drop heights for material transfer activities, e.g. unloading of friable materials, will be minimized and carefully managed.	Negligible	EIA Commitment	Contractor	Visual inspection	Daily
	Minor	On-site and access roads will be well maintained through mechanical means (sweeping or vacuuming) or spraying with water.	Negligible	EIA Commitment	Contractor	Visual inspection	Daily
	Minor	Lorries used for the transportation of friable construction materials and spoil off-site will be covered/sheeted.	Negligible	EIA Commitment	Contractor	Visual inspection	Daily
	Minor	Engines will be switched off when not in use.	Negligible	EIA Commitment	Contractor	Visual inspection	Daily
	Minor	All vehicles and engines will be properly maintained to reduce air emissions.	Negligible	EIA Commitment	Contractor	Visual inspection	Daily
OPERATION							
Emissions	Moderate	Natural gas will be used as fuel, with significantly lower pollutant emissions than other fossil fuels.	Negligible	EIA Commitment	Operator	Stack emissions will be monitored continuously for; NO _x , SO ₂ , CO, O ₂ and PM with CEMS.	Continuously
	Moderate	CEMS is subject to control by means of parallel measurements with the reference methods at least every year. Representative measurements, i.e. sampling and analysis, of relevant pollutants and process parameters as well as reference measurement methods to calibrate automated measurement systems shall be	Negligible	Large Combustion Plants Regulation	Operator	Checking annual report presence	Annual

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		carried out in accordance with CEN standards as soon as they are available. If CEN standards are not available ISO standards, national or international standards which will ensure the provision of data of an equivalent scientific quality shall apply.					
	Moderate	The operator is subject to submit a written notification about the continuous, individual and all other measurements carried out including measurement results of parameters monitored by CEMS to the competent authority (Ministry of Environment and Forest) until March 31 of each year. The operator is subject to submit a written notification about the checking of measurement systems to the Ministry of Environment and Forest until March 31 of each year.	Negligible	Large Combustion Plants Regulation	Operator	Checking annual report presence	Annual
	Moderate	The operator is subject to submit a report including the total annual emissions of SO ₂ , NO _x and dust (as total suspended particles) and the total annual amount of energy input, related to the net calorific value, broken down in terms of the five categories of fuel: biomass, other solid fuels, liquid fuels, natural gas, other gases to the Ministry of Environment and Forest until March 31 of each year starting from 2011.	Negligible	Large Combustion Plants Regulation	Operator	Checking annual report presence	Annual
	Moderate	The operator is subject to keep the reports, information and documents related to the compliance with the standards of measurements and the checking of measurement systems for at least 5 years.	-	Large Combustion Plants Regulation	Operator	Checking the report presence	Annual
	Moderate	The operator is subject to submit Emissions Report to the Ministry of Environment and Forest in every three year.	-	Industrial Air Pollution Control Regulation	Operator	Checking the report presence	In every three years
	Moderate	Emissions from the plant should not contribute more than 25% of the applicable (Turkish) ambient air quality standards to allow additional, future sustainable development in the same airshed.	Negligible	IFC General EHS Guidelines: Environmental Air Emissions and Ambient Air Quality	Contractor	Modeling during ESIA	NA
	Moderate	Dry low-NO _x burner system will be used which is designed to minimize NO _x emissions. Emissions and air quality will comply with the Regulation on Large Combustion Plants, Industrial Air Pollution Control Regulation and Air Quality Assessment and Management Regulation.	Negligible	EIA Commitment	Contractor	Measurement of stack emissions by operator in accordance with the Regulation.	Continuously

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
	Moderate	NO _x emissions from combustion turbine (dry gas, 15% excess O ₂ content) will be below 50 mg/Nm ³ (as NO ₂). (Nm ³ is at 1 atm pressure, 0 °C). NO _x emission limit can be taken as 75 mg/Nm ³ (as NO ₂) for gas turbines used in combined cycle plants having an annual average overall electrical efficiency greater than 55 %.	Negligible	Large Combustion Plants Regulation	Contractor	Continuous stack gas monitoring for NO _x concentration with CEMS.	Continuously
	Moderate	NO _x emissions from combustion turbine (dry gas, 15% excess O ₂ content) will be below 51 mg/Nm ³ (Nm ³ is at 1 atm pressure, 0 °C).	Negligible	IFC Environmental, Health, and Safety Guidelines for Thermal Power Plants	Contractor	Continuous stack gas monitoring for NO _x concentration with CEMS.	Continuously
	Minor	SO ₂ emissions from combustion turbine (dry gas, 15% excess O ₂ content) will be below 11.7 mg/Nm ³ (Nm ³ is at 1 atm pressure, 0 °C).	Negligible	Large Combustion Plants Regulation	Contractor	Continuous stack gas monitoring for SO ₂ concentration with CEMS.	Continuously
	Minor	CO emissions from combustion turbine (dry gas, 15% excess O ₂ content) will be below 100 mg/Nm ³ (Nm ³ is at 1 atm pressure, 0 °C).	Negligible	Large Combustion Plants Regulation	Contractor	Continuous stack gas monitoring for CO concentration with CEMS.	Continuously
	Moderate	Stack height, flue gas exit temperature and velocity will be selected to ensure adequate dispersion of emissions in the air.	Negligible	EIA Commitment	Contractor	-	-
	Moderate	Greenhouse gases will be monitored and a monitoring plan will be prepared for the greenhouse gas emissions in accordance with Regulation on Tracking of Greenhouse Gas Emissions, Official Gazette No. 28274 dated April 25, 2012 starting from January 1, 2015. Greenhouse gases will be reported to the Ministry of Environment and Urbanization yearly starting from January 1, 2016.	Negligible	Regulation on Tracking of Greenhouse Gas Emissions	Contractor	Monitoring or calculation in accordance with Annex 3 of Regulation	Continuously
WASTEWATER and AMBIENT WATER QUALITY							
CONSTRUCTION							
Water Quality and Availability	Minor to Moderate	Project activities involving wastewater discharges, water extraction, diversion or impoundment will prevent adverse impacts to the quality and availability of groundwater and surface water resources.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS	Contractor	Visual inspection to ensure the effectiveness of the mitigation measure	Daily and as required

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
				Guidelines			
Wastewater	Moderate	Domestic wastewater generated during construction will be discharged to Hacilar Municipality sewerage network after it is treated at the package treatment plant in case it is completed before the construction. A protocol will be signed with the Municipality regarding this issue and connection permit will be secured. In case the sewerage network is not going to be completed, wastewater generated during construction will be collected in leakproof tanks and will be transferred by vacuum trucks of Municipality. In this case the protocol with the Municipality and the document taken for wastewater discharge with vacuum trucks will be kept for 5 years and will be declared in case requested by the officials during audits in accordance with the Article 32 of the Water Pollution Control Regulation.	Negligible	EIA Commitment, Water Pollution Control Regulation	Contractor	Check whether the sewerage connection is completed and the protocol is secured. Or check leakproof septic tanks are in place and wastewater collected in these tanks are transferred by vacuum trucks to a wastewater treatment plant.	Prior and during construction
Wastewater	Moderate	The project of the treatment plant that will be constructed during the construction period will be approved in accordance with the Project Approval Circular No. 2005/5. The project will comply with the Water Pollution Control Regulation issued in Official Gazette No. 25687 dated December 12, 2004.	Negligible	Project Approval Circular No. 2005/5, Water Pollution Control Regulation	Contractor	Check whether project approval is secured	Prior construction
Septic Systems	Moderate	Septic systems are commonly used for treatment and disposal of domestic sanitary sewage in areas with no sewerage collection networks. Septic systems should only be used for treatment of sanitary sewage, and unsuitable for industrial wastewater treatment. When septic systems are the selected form of wastewater disposal and treatment, they should be; - Properly designed and installed in accordance with local regulations and guidance to prevent any hazard to public health or contamination of land, surface or groundwater. - Well maintained to allow effective operation. - Installed in areas with sufficient soil percolation for the design wastewater loading rate. - Installed in areas of stable soils that are nearly level, well drained, and permeable, with enough separation between the drain field and the groundwater table or other receiving waters.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Visual Inspection, Check whether septic systems are well maintained and operated	Prior and during construction
Site Drainage	Minor to	Engineered site drainage systems will be provided during	Negligible	EIA	Contractor	Visual inspection	Daily and as required

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
	Moderate	construction to collect, balance, treat as required and control the discharge of site run-off and erosion.		Commitment		to ensure the effectiveness of the mitigation measure	
Water Supply	Minor to Moderate	Water demand of the facility will be supplied from water network of Hacilar Municipality. Groundwater will not be used. Drinking water will be supplied as bottled water. Water from Kızılırmak River will not be used during construction.	Negligible	EIA Commitment	Contractor	Visual Inspection	Weekly
Soil Erosion - Sediment mobilization and transport	Moderate	Erosion will be reduced or prevented by: - Heavy rainfall periods will be scheduled to the extent practical to avoid them, - Contouring and minimizing length and steepness of slopes will be contoured and minimized, - Areas will be re-vegetating promptly, - Lining steep channel and slopes, - Reducing or preventing off-site sediment transport through use of settlement ponds, silt fences, and water treatment, and modifying or suspending activities during extreme rainfall and high winds to the extent practical.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Visual Inspection	Daily
OPERATION							
Wastewater	Moderate	Understand the quality, quantity, frequency and sources of liquid effluents. This includes knowledge about the locations, routes and integrity of internal drainage systems and discharge points.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Determine the liquid effluent characteristics and routes	Prior to start operation
Wastewater	Moderate	Plan and implement the segregation of liquid effluents principally along industrial, utility, sanitary, and storm water categories, in order to limit the volume of water requiring specialized treatment.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Check whether the liquid effluents are segregated properly	Prior to start operation
Wastewater	Moderate	Identify opportunities to prevent or reduce wastewater pollution through such measures as recycle/reuse within the facility, input substitution, or process modification (e.g. change of technology or operating conditions/modes).	Negligible	IFC Environmental Health and Safety Guidelines:	Contractor	Check water reuse/recycle opportunities	Prior to start operation

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
				General EHS Guidelines			
Wastewater	Moderate	Generation and discharge of wastewater of any type should be managed through a combination of: - Water use efficiency to reduce the amount of wastewater generation; - Process modification, including waste minimization, and reducing the use of hazardous materials to reduce the load of pollutants requiring treatment - If needed, application of wastewater treatment techniques to further reduce the load of contaminants prior to discharge, taking into consideration potential impacts of cross-media transfer of contaminants during treatment (e.g., from water to air or land)	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Check water use efficiency opportunities, reduction the load of pollutant requiring treatment	Prior to start operation
Wastewater	Moderate	Assess compliance of wastewater discharges with the applicable: (i) discharge standard (if the wastewater is discharged to a surface water or sewer), and (ii) water quality standard for a specific reuse (e.g. if the wastewater is reused for irrigation).	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	A manhole will be constructed at the point of wastewater connection and will be monitored to check if the connection standards are exceeded or not.	At intervals determined by Hacilar Municipality.
Wastewater	Moderate	When wastewater treatment is required prior to discharge, the level of treatment should be based on: - Whether wastewater is being discharged to a sanitary sewer system, or to surface waters - National and local standards as reflected in permit requirements	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Ensure that the wastewater treatment plant is designed to meet required standards	Prior to start operation
Wastewater	Moderate	Discharges of industrial wastewater, sanitary wastewater, wastewater from utility operations or storm water into public or private wastewater treatment systems should meet the pretreatment and monitoring requirements of the sewer treatment system into which it discharges and; - Not interfere, directly or indirectly, with the operation and maintenance of the collection and treatment systems, or pose a risk to worker health and safety, or adversely impact characteristics of residuals from wastewater treatment operations.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	A manhole will be constructed at the point of wastewater connection and will be monitored to check if the connection standards are	At intervals determined by Hacilar Municipality.

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		- Be discharged into municipal or centralized wastewater treatment systems that have adequate capacity to meet local regulatory requirements for treatment of wastewater generated from the project. Pretreatment of wastewater to meet regulatory requirements before discharge from the project site is required if the municipal or centralized wastewater treatment system receiving wastewater from the project does not have adequate capacity to maintain regulatory compliance.				exceeded or not.	
Wastewater	Moderate	Wastewater generated during operation will be discharged to Hacilar Municipality sewerage network after it is treated in case it is completed before the operation. A protocol will be signed with the Municipality regarding this issue and connection permit will be secured. In case the sewerage network is not going to be completed, wastewater generated during operation will be collected in leakproof septic tank and will be transferred by vacuum trucks of Municipality. In this case the protocol with the Municipality and the document taken for wastewater discharge with vacuum trucks will be kept for 5 years and will be declared in case requested by the officials during audits in accordance with the Article 32 of the Water Pollution Control Regulation.	Negligible	EIA Commitment, Water Pollution Control Regulation	Contractor	Check whether the sewerage connection is completed and the protocol is secured. Or check leakproof septic tanks are in place and wastewater collected in these containers is transferred by vacuum trucks to a wastewater treatment plant.	Prior and during operation
Wastewater	Moderate	The project of the treatment plant that will be constructed during the operation period will be approved in accordance with the Project Approval Circular No. 2005/5. The project will comply with the Water Pollution Control Regulation issued in Official Gazette No. 25687 dated December 12, 2004.	Negligible	Project Approval Circular No. 2005/5, Water Pollution Control Regulation	Contractor	Check whether project approval is secured.	Prior operation
Wastewater	Moderate	The wastewater treatment plant will consist of 3 wastewater treatment systems. The systems will treat chemically contaminated water, TSS, TDS and domestic wastewater. The treated water will be combined and discharged to Hacilar Municipality sewerage network or septic tank. The sludge from the WWTP will also be treated.	Negligible	EIA Commitment	Contractor	Check whether the treatment plant constructed properly.	Prior operation
Wastewater	Moderate	The treatment plant will treat wastewater from the facility and discharged wastewater will comply with the limits.	Negligible	Water Pollution Control Regulation, Table 25 or	Operator	A manhole will be constructed at the point of wastewater	At intervals determined by Hacilar Municipality.

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
				Table 20.7 Water Softening Demineraliza- on and Regeneration, Active Carbon Washing and Regeneration Plants		connection and will be monitored to check if the connection standards are exceeded or not.	
Wastewater	Moderate	Transfer of pollutants to another phase, such as air, soil, or the sub-surface, should be minimized through process and engineering controls.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Visual Inspection	Continuously
Sanitary Wastewater	Moderate	Recommended sanitary wastewater management strategies include: - Segregation of wastewater streams to ensure compatibility with selected treatment option (e.g. septic system which can only accept domestic sewage); - Segregation and pretreatment of oil and grease containing effluents (e.g. use of a grease trap) prior to discharge into sewer systems; - If sewage from the industrial facility is to be discharged to surface water, treatment to meet national or local standards for sanitary wastewater discharges or, in their absence, the indicative guideline values applicable to sanitary wastewater discharges shown in Table 1.3.1; - If sewage from the industrial facility is to be discharged to either a septic system, or where land is used as part of the treatment system, treatment to meet applicable national or local standards for sanitary wastewater discharges is required. - Sludge from sanitary wastewater treatment systems should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Ensure that the sanitary wastewater is managed in accordance with the IFC guidelines.	Continuously
Wastewater	Moderate	- Sludge from a wastewater treatment plant needs to be evaluated	Negligible	IFC	Operator	Ensure that the	Continuously

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
Treatment Plant Sludge		on a case-by-case basis to establish whether it constitutes a hazardous or a non-hazardous waste and managed accordingly as described in the Waste Management section of IFC General EHS Guidelines. - Sludge should be handled in accordance with the Hazardous Waste Control Regulation dated March 14, 2005.		Environmental Health and Safety Guidelines: General EHS Guidelines, Hazardous Waste Control Regulation		sludge from wastewater treatment plant is analyzed and handled according to its content.	
Wastewater Monitoring	Moderate	- Monitoring parameters selected for monitoring should be indicative of the pollutants of concern from the process, and should include parameters that are regulated under compliance requirements; - Wastewater monitoring should take into consideration the discharge characteristics from the process over time. The monitoring location should be selected with the objective of providing representative monitoring data. - Monitoring programs should apply internationally approved methods for sample collection, preservation and analysis. - Sampling should be conducted by or under the supervision of trained individuals. Analysis should be conducted by entities permitted or certified for this purpose.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Ensure that the wastewater is analyzed for the monitoring parameters given in Water Pollution Control Regulation, Table 25 or Table 20.7 or specific parameters determined by Hacilar Municipality.	At intervals determined by Hacilar Municipality.
Stormwater Management	Moderate	In order to reduce the need for stormwater treatment, the following principles should be applied: - Stormwater should be separated from process and sanitary wastewater streams in order to reduce the volume of wastewater to be treated prior to discharge - Surface runoff from process areas or potential sources of contamination should be prevented - Where this approach is not practical, runoff from process and storage areas should be segregated from potentially less contaminated runoff - Runoff from areas without potential sources of contamination should be minimized (e.g. by minimizing the area of impermeable surfaces) and the peak discharge rate should be reduced (e.g. by using vegetated swales and retention ponds); - Where stormwater treatment is deemed necessary to protect the quality of receiving water bodies, priority should be given to managing and treating the first flush of stormwater runoff	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Check whether proper stormwater management practices are implemented.	Continuously

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		where the majority of potential contaminants tend to be present; - When water quality criteria allow, stormwater should be managed as a resource, either for groundwater recharge or for meeting water needs at the facility; - Oil water separators and grease traps should be installed and maintained as appropriate at refueling facilities, workshops, parking areas, fuel storage and containment areas. - Sludge from stormwater catchments or collection and treatment systems may contain elevated levels of pollutants and should be disposed in compliance with local regulatory requirements, in the absence of which disposal has to be consistent with protection of public health and safety, and conservation and long term sustainability of water and land resources.					
Site Drainage	Minor to Moderate	Engineered site drainage systems will be provided during operation to collect, balance, treat as required and control the discharge of site run-off. The site-runoff amount will be calculated using the values recorded when it is most rainy in Kırkkale Province. The drained water will be treated in the wastewater treatment plant and will be discharged to Hacilar Municipality sewerage network or collected at the fosseptic to be transferred to a wastewater treatment plant via vacuum trucks.	Negligible	EIA Commitment	Contractor	Visual inspection to ensure the effectiveness of the mitigation measure	Daily and as required
Site Drainage	Minor to Moderate	Official opinion of State Hydraulic Works will be taken for flood prevention and site drainage systems.	Negligible	EIA Commitment	Contractor	Check whether the opinion is secured.	Once before operation
Water Conservation	Minor to Moderate	Water conservation programs should be implemented commensurate with the magnitude and cost of water use. These programs should promote the continuous reduction in water consumption and achieve savings in the water pumping, treatment and disposal costs. Water conservation measures may include water monitoring/management techniques; process and cooling/heating water recycling, reuse, and other techniques; and sanitary water conservation techniques.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Check the efficiency of water conservation programs	Continuously
Water Supply	Minor to Moderate	Water demand of the facility will be supplied from water network of Hacilar Municipality. Groundwater will not be used. Drinking water supplied as bottled water. Water from Kızılırmak will not be used during operation.	Negligible	EIA Commitment	Contractor	Visual Inspection	Weekly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
HAZARDOUS MATERIALS MANAGEMENT							
CONSTRUCTION and OPERATION							
Hazardous Material Management	Moderate	- Establish hazardous materials management priorities based on hazard analysis of risky operations identified - Where practicable, avoiding or minimizing the use of hazardous materials. - Prevent uncontrolled releases of hazardous materials to the environment or uncontrolled reactions that might result in fire or explosion - Using engineering controls (containment, automatic alarms, and shut-off systems) commensurate with the nature of hazard - Implement management controls (procedures, inspections, communications, training, and drills) to address residual risks that have not been prevented or controlled through engineering measures.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Conduct regular inspections to control implementation of hazardous material management practices.	Weekly
Hazardous Material Management	Moderate	Responding to seismic issues will be incorporated into the Emergency Response Plan (ERP) and measures will be incorporated into the design to minimise escape of pollutants to the environment in the event of a seismic event.	Negligible	-	Contractor and Operator	Conduct regular inspections to control implementation of hazardous material management practices.	Weekly
Hazard Assessment	Moderate	The level of risk should be established through an on-going assessment process based on: - The types and amounts of hazardous materials present in the project. - Analysis of potential spill and release scenarios using available industry statistics on spills and accidents where available - Analysis of the potential for uncontrolled reactions such as fire and explosions - Analysis of potential consequences based on the physical geographical characteristics of the project site, including aspects such as its distance to settlements, water resources, and other environmentally sensitive areas	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Develop hazardous material risk assessment and visually check the effectiveness of the assessment and update as necessary	Once before construction and operation
Release Prevention	Moderate	Where there is risk of a spill of uncontrolled hazardous materials, facilities should prepare a spill control, prevention, and countermeasure plan as a specific component of their Emergency Preparedness and Response Plan.	Negligible	IFC Environmental Health and Safety	Contractor and Operator	Check whether Emergency Preparedness and Response	Monthly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		- Train operators on release prevention, including drills specific to hazardous materials as part of emergency preparedness response training - Implement inspection programs to maintain the mechanical integrity and operability of pressure vessels, tanks, piping systems, relief and vent valve systems, containment infrastructure, emergency shutdown systems, controls and pumps, and associated process equipment - Prepare written Standard Operating Procedures (SOPs) for filling USTs, ASTs or other containers or equipment as well as for transfer operations by personnel trained in the safe transfer and filling of the hazardous material, and in spill prevention and response - Prepare SOPs for the management of secondary containment structures, specifically the removal of any accumulated fluid, such as rainfall, to ensure that the intent of the system is not accidentally or willfully defeated - Identify locations of hazardous materials and associated activities on an emergency plan site map - Document availability of specific personal protective equipment and training needed to respond to an emergency - Document available spill response equipment sufficient to handle at least initial stages of a spill and a list of external resources for equipment and personnel, if necessary, to supplement internal resources - Describe response activities in the event of a spill, release, or other chemical emergency.		Guidelines: General EHS Guidelines		Plan is prepared and implemented by regular inspections	
Occupational Health and Safety	Moderate	The Hazardous Materials Management Plan should address applicable, essential elements of occupational health and safety, including: - Job safety analysis to identify specific potential occupational hazards and industrial hygiene surveys, as appropriate, to monitor and verify chemical exposure levels, and compare with applicable occupational exposure standards - Hazard communication and training programs to prepare workers to recognize and respond to workplace chemical hazards. Programs should include aspects of hazard identification, safe operating and materials handling procedures, safe work practices, basic emergency procedures, and special hazards unique to their jobs. Training should incorporate information from Material Safety	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Check whether Occupational Health and Safety measures while handling hazardous materials are implemented	Weekly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		Data Sheets (MSDSs) for hazardous materials being handled. MSDSs should be readily accessible to employees in their local language. - Definition and implementation of permitted maintenance activities, such as hot work or confined space entries - Provision of suitable personal protection equipment (PPE) (footwear, masks, protective clothing and goggles in appropriate areas), emergency eyewash and shower stations, ventilation systems, and sanitary facilities - Monitoring and record-keeping activities, including audit procedures designed to verify and record the effectiveness of prevention and control of exposure to occupational hazards, and maintaining accident and incident investigation reports on file for a period of at least five years					
Documentation	Minor to moderate	The Hazardous Materials Management Plan should be incorporated into, and consistent with, the other elements of the facility ES/OHS MS and include: - Written process safety parameters (i.e., hazards of the chemical substances, safety equipment specifications, safe operation ranges for temperature, pressure, and other applicable parameters, evaluation of the consequences of deviations, etc.) - Written operating procedures - Compliance audit procedures	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Check whether Hazardous Materials Management Plan documentation is prepared	Once before construction and operation
Hazardous Materials Transfer	Moderate	Prevention of hazardous material releases from processes include: - Use of dedicated fittings, pipes, and hoses specific to materials in tanks (e.g., all acids use one type of connection, all caustics use another), and maintaining procedures to prevent addition of hazardous materials to incorrect tanks - Use of transfer equipment that is compatible and suitable for the characteristics of the materials transferred and designed to ensure safe transfer - Regular inspection, maintenance and repair of fittings, pipes and hoses - Provision of secondary containment, drip trays or other overflow and drip containment measures, for hazardous materials containers at connection points or other possible overflow points.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Check all necessary precautions are taken during hazardous material transfer to prevent hazardous material releases, regularly inspect maintenance and repair of fittings, pipes and hoses	When required, monthly
Overfill Protection	Moderate	Overfills of vessels and tanks should be prevented as they are among the most common causes of spills resulting in soil and water	Negligible	IFC Environmental	Contractor and Operator	Check whether precautions are	When required

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		contamination, and among the easiest to prevent. Recommended overfill protection measures include: - Prepare written procedures for transfer operations that includes checklist of measures to follow during filling operations and the use of filling operators trained in these procedures - Installation of gauges on tanks to measure volume inside - Use of dripless hose connections for vehicle tank and fixed connections with storage tanks - Provision of automatic fill shutoff valves on storage tanks to prevent overfilling - Use of a catch basin around the fill pipe to collect spills - Use of piping connections with automatic overfill protection (float valve) - Pumping less volume than available capacity into the tank or vessel by ordering less material than its available capacity - Provision of overfill or over pressure vents that allow controlled release to a capture point		Health and Safety Guidelines: General EHS Guidelines		implemented to prevent overfill of tanks	
Reaction, Fire, and Explosion Prevention	Moderate	Reactive, flammable, and explosive materials should also be managed to avoid uncontrolled reactions or conditions resulting in fire or explosion. Recommended prevention practices include: - Storage of incompatible materials (acids, bases, flammables, oxidizers, reactive chemicals) in separate areas, and with containment facilities separating material storage areas - Provision of material-specific storage for extremely hazardous or reactive materials - Use of flame arresting devices on vents from flammable storage containers - Provision of grounding and lightning protection for tank farms, transfer stations, and other equipment that handles flammable materials - Selection of materials of construction compatible with products stored for all parts of storage and delivery systems, and avoiding reuse of tanks for different products without checking material compatibility - Storage of hazardous materials in an area of the facility Separated from the main production works. Where proximity is unavoidable, physical separation should be provided using structures designed to prevent fire, explosion, spill, and other emergency situations from affecting facility operations - Prohibition of all sources of ignition from areas near	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Check whether precautions are implemented against reactive, flammable, and explosive materials	Weekly

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		flammable storage tanks					
Secondary Containment (Liquids)	Moderate	Secondary containment measures that should be applied depending on site-specific conditions include: - Secondary containment design should also consider means to prevent contact between incompatible materials in the event of a release. - Transfer of hazardous materials from vehicle tanks to storage in areas with surfaces sufficiently impervious to avoid loss to the environment and sloped to a collection or a containment structure not connected to municipal wastewater/stormwater collection system - Where it is not practical to provide permanent, dedicated containment structures for transfer operations, one or more alternative forms of spill containment should be provided, such as portable drain covers (which can be deployed for the duration of the operations), automatic shut-off valves on storm water basins, or shut off valves in drainage or sewer facilities, combined with oil-water separators - Appropriate secondary containment structures consist of berms, dikes, or walls capable of containing the larger of 110 percent of the largest tank or 25% percent of the combined tank volumes in areas with above-ground tanks with a total storage volume equal or greater than 1,000 liters and will be made of impervious, chemically resistant material. - Storage of drummed hazardous materials with a total volume equal or greater than 1,000 liters in areas with impervious surfaces that are sloped or bermed to contain a minimum of 25 percent of the total storage volume - Provision of secondary containment for components (tanks, pipes) of the hazardous material storage system, to the extent feasible - Conducting periodic (e.g. daily or weekly) reconciliation of tank contents, and inspection of visible portions of tanks and piping for leaks; - Use of double-walled, composite, or specially coated storage and piping systems particularly in the use of underground storage tanks (USTs) and underground piping. If doublewalled systems are used, they should provide a means of detecting leaks between the two walls.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Check whether the secondary containment measures are taken appropriately and secondary containment structures are inspected regularly	Monthly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
Storage Tank and Piping Leak Detection	Moderate	Use leak detection especially important in situations where secondary containment is not feasible or practicable, such as in long pipe runs. Acceptable leak detection methods include: - Use of automatic pressure loss detectors on pressurized or long distance piping - Use of approved or certified integrity testing methods on piping or tank systems, at regular intervals - Considering the use of SCADA if financially feasible	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Use leak detection systems where necessary	When required
Underground Storage Tanks	Moderate	If USTs are going to be used below mentioned techniques can be used to manage risks: - Avoiding use of USTs for storage of highly soluble organic materials - Assessing local soil corrosion potential, and installing and maintaining cathodic protection (or equivalent rust protection) for steel tanks - For new installations, installing impermeable liners or structures (e.g., concrete vaults) under and around tanks and lines that direct any leaked product to monitoring ports at the lowest point of the liner or structure - Monitoring the surface above any tank for indications of soil movement - Reconciling tank contents by measuring the volume in store with the expected volume, given the stored quantity at last stocking, and deliveries to and withdrawals from the store - Testing integrity by volumetric, vacuum, acoustic, tracers, or other means on all tanks at regular intervals - Considering the monitoring groundwater of quality down gradient of locations where multiple USTs are in use - Evaluating the risk of existing UST in newly acquired facilities to determine if upgrades are required for USTs that will be continued to be used, including replacement with new systems or permanent closure of abandoned USTs. - Ensuring that new USTs are sited away from wells, reservoirs and other source water protection areas and floodplains, and maintained so as to prevent corrosion.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Check whether USTs are checked regularly and all precautions against leakage are taken.	Monthly
Management of Major Hazards	Moderate	Projects involving production, handling, and storage of hazardous materials at or above threshold limits should prepare a Hazardous Materials Risk Management Plan. Containing all of the elements: Management of Change, Compliance Audit, Incident Investigation, Employee Participation, Contractors, Training.	Negligible	IFC Environmental Health and Safety Guidelines:	Operator	Prepare Hazardous Materials Risk Management Plan and ensure that it	Monthly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
				General EHS Guidelines		is implemented.	
Preventive Measures	Moderate	- Process Safety Information: Procedures should be prepared for each hazardous materials. - Operating Procedures: SOPs should be prepared for each step of all processes or operations within the project. - Mechanical Integrity of process equipment, piping and instrumentation: Inspection and maintenance procedures should be developed and documented to ensure mechanical integrity of equipment, piping, and instrumentation and prevent uncontrolled releases of hazardous materials from the project. - Hot work permit is required for any operation involving open flames or producing heat and/or sparks. The section of SOPs on hot work should include the responsibility for hot work permitting, personal protection equipment (PPE), hot work procedures, personnel training, and recordkeeping. - Pre-Start Review: Procedures should be prepared to carry out pre-start reviews when a modification is significant enough to require a change in safety information under the management of change procedure.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Check that procedures are prepared and implemented for each hazardous material.	Monthly
Emergency Preparedness and Response	Moderate	When handling hazardous materials, procedures and practices should be developed allowing for quick and efficient responses to accidents that could result in human injury or damage to the environment. An Emergency Preparedness and Response Plan should be prepared to cover the following: Planning Coordination, Emergency Equipment, Training.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Ensure that an Emergency Preparedness and Response Plan is prepared and implemented.	Monthly
Community Involvement and Awareness	Minor to Moderate	When hazardous materials are in use above threshold quantities, the management plan should include a system for community awareness, notification and involvement that should be commensurate with the potential risks identified for the project during the hazard assessment studies.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Ensure that the community is notified against potential risks of hazardous materials.	Prior to operation
Explosive and Flammable Materials	Moderate	The gases such as oxygen, nitrogen, argon used for welding will be maintained in the metal cylinders. The flammable substances such as hydraulic oils and solvents will	Negligible	EIA Commitment	Contractor	Visual Inspection	Daily

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		be transported, stored and used in a way that they will not create any hazard to the employers and environment. Other than those mentioned above any explosive, flammable, hazardous and toxic substances will not be used during construction.					
Hazardous Materials	Moderate	Water and chemical-based paints and solvents will be used for dyeing of various buildings and units. These materials will be stored at their original boxes, bins or barrels and they will be located on impermeable surface and protected from rain.	Negligible	Hazardous Waste Control Regulation	Contractor	Visual inspection	Daily
WASTE MANAGEMENT							
CONSTRUCTION							
Waste Management	Moderate	- Waste management priorities at the outset of activities will be established. - A waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes will be established. - Waste generation will be avoided or minimized as far as practical. - Waste management plan will be prepared addressing issues linked to waste minimization, generation, transport, disposal, and monitoring. - New waste sources during planning, siting, and design activities will be reviewed. - Data and information will be collected about the process and waste streams in existing facilities, including characterization of waste streams by type, quantities, and potential use/disposition - Opportunities for source reduction, as well as reuse and recycling and procedures and operational controls for on- site storage will be defined. - Definition of options / procedures / operational controls for treatment and final disposal. - Priorities based on a risk analysis will prepared that takes into account the potential EHS risks during the waste cycle and the availability of infrastructure to manage the waste in an environmentally sound manner.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Check whether waste management practices are established and implemented by visual check and record check.	Before and during the construction

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
Waste Management	Moderate	Generated waste will be characterized according to composition, source, types of wastes produced, and generation rates.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Visual Inspection and Record Check	During the construction
Waste Management	Minor to Moderate	Spoil from construction activities will be monitored and controlled; waste materials which are unsuitable for reuse on-site will be disposed at landfill site approved by the Municipality.	Negligible	EIA Commitment	Contractor	Visual inspection of construction grounds	Weekly
Waste Management	Minor	Wastes will be collected separately at source in accordance with the Regulation on General Principles of Waste Management.	Negligible	EIA Commitment, Regulation on General Principles of Waste Management	Contractor	Visual inspection, official records kept on disposal, recycling and storage of waste	Daily
Waste Management	Minor	Good housekeeping and operating practices will be instituted including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off- specification, contaminated, damaged, or excess to plant needs.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Visual inspection and record check	Weekly
Solid Wastes	Minor	Solid, non-hazardous wastes generated during construction are stored in appropriate containers.	Negligible	Solid Waste Control Regulation	Contractor	Visual inspection	Daily
Hazardous Waste Management	Minor to Moderate	Hazardous wastes will be segregated from non- hazardous wastes.	Negligible	Hazardous Waste Control Regulation	Contractor	Visual inspection	Daily
Hazardous Waste Management	Moderate	- Required precautions will be taken in order to minimize hazardous waste generation; to provide waste management in a way that minimizes the adverse affects of wastes on human health and environment; - Prepare Waste Declaration Form in Annex 8 in January of each year for the last year's information and submit to the Ministry within two months; - Provide proper packaging and labeling; and to dispose and transfer the hazardous wastes in conformity with the principles	Negligible	Hazardous Waste Control Regulation	Contractor	Visual inspection and record check	Weekly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		stated in the regulation. - Transportation of the wastes will be carried out by the licensed persons and entities with appropriate vehicles for the properties of the transported waste. - The vehicles that are used to transport hazardous wastes should carry a waste transport form as specified in the regulation. - The hazardous wastes should be sent to licensed hazardous waste disposal sites.					
Hazardous Waste Storage	Moderate	- Waste will be stored in a manner that prevents the commingling or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills. - Waste will be stored in closed containers away from direct sunlight, wind and rain. - Secondary containment systems will be constructed. - Adequate ventilation will be provided where volatile wastes are stored. - Hazardous waste storage activities will be subject to special management actions, conducted by employees who have received specific training in handling and storage of hazardous wastes.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	- Regular visual inspection of all waste storage collection and storage areas - Tracking of waste generation trends by type and amount of waste generated - Visual inspection, regular audits of waste segregation and collection practices. - Manifests or other records that document the amount of waste generated and its destination will be kept. - Periodic auditing of third party treatment, and disposal services including re-use and recycling facilities when significant quantities of hazardous wastes are managed by	Continuously during construction

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
						third parties.	
Hazardous Waste Storage	Moderate	Records for hazardous waste collected, stored, or shipped will 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.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Control hazardous waste records	Continuously during construction
Waste Oils	Minor to Moderate	The waste oil types to be generated in the construction activities will be restricted to the motor oils generated from machines and equipment used.	Negligible	EIA Commitment	Contractor	Visual Check	Daily
Waste Oils	Moderate	- Waste oils will be collected, stored temporarily, transported and disposed in accordance with the related Regulation. - Waste oils will be collected in the red containers labeled as "Waste Oil" which will be located on impermeable surface and they will be protected from rain. - Closed areas and/or storage tanks will be provided as far as proper and practical. - Waste oils should be transported by licensed transporters to the licensed processing and disposal facilities. - The National Transportation Form in the case of transporting the waste oil out of the facility and waste oil declaration form annually must be prepared and submitted to the Kırıkkale Environment and Forestry Directorate before the end of February. - All records including waste oil declaration forms, analyses report and national waste transportation form should be kept for at least five years.	Negligible	Waste Oil Control Regulation	Contractor	Visual inspection and record check	Monthly
Waste Batteries	Moderate	Waste batteries and accumulators will be collected, stored temporarily, transported and disposed in accordance with the related Regulation.	Negligible	Used Batteries and Accumulators Control	Contractor	Visual Check	Monthly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
				Regulation			
Waste Transportation	Moderate	On-site and Off-site transportation of waste will 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 will 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 shipping paper (i.e., manifest) that describes the load and its associated hazards.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Visual Inspection and Record Check	Weekly
Packing Waste	Minor	Packaging waste will not be mixed with other wastes, will be collected and stored separately.	Negligible	Packaging Waste Control Regulation	Contractor	Visual inspection and record check	Weekly
Recycling and Reuse	Moderate	Potentially recyclable materials will be identified. Recycling objectives will be established and waste generation and recycling rates will be tracked formally. Training and incentives will be supplied to employees in order to meet objectives.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Visual inspection and record check	Monthly
Recycling and Reuse	Minor	During construction among construction wastes such as metal sheet and metal scraps, packages and boxes, lumber etc., recyclable solid wastes (paper, plastic, glass etc.) will be collected separately, stored and will be recycled. The non-reusable solid wastes will be collected in sanitary waste bins with closed top and will be transported to the waste disposal area of the related Municipality	Negligible	EIA Commitment	Contractor	Visual inspection and record check	Monthly
Domestic Waste	Minor	Domestic waste will be collected in closed bags and will be carried to the area determined by the Governorate or the Municipality. If necessary, the protocol in this regard will be signed by the Governorate and Municipality.	Negligible	EIA Commitment, Solid Waste Control Regulation	Contractor	Visual inspection and record check	Weekly
Excavation Waste	Minor	Excavated materials will not be stored at the project site arbitrarily. Excavated soil will be collected, stored temporarily, transported, reused as far as possible (in landscaping primarily), and remaining part will be disposed at the area determined by the Municipality or by the Governorate in accordance with the related regulation. In this process necessary permits will be taken from the municipality and the governorate.	Negligible	The Excavation, Construction and Demolition Waste Control Regulation	Contractor	Visual inspection and record check	Weekly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
Residual Waste	Minor	Remaining waste materials after the implementation of feasible waste prevention, reduction, reuse, recovery and recycling measures, will be treated and disposed of and all measures will be taken to avoid potential impacts to human health and the environment.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Visual inspection	Weekly
OPERATION							
Waste Management	Moderate	- Waste management priorities at the outset of activities will be established. - A waste management hierarchy that considers prevention, reduction, reuse, recovery, recycling, removal and finally disposal of wastes will be established. - Waste generation will be avoided or minimized as far as practical. - Waste management plan will be prepared addressing issues linked to waste minimization, generation, transport, disposal, and monitoring.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Check whether waste management practices are established and implemented by visual check and record check.	Before and during operation
Waste Management	Moderate	Generated waste will be characterized according to composition, source, types of wastes produced, and generation rates.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Visual Inspection, Record Check	Weekly
Waste Management	Low	Wastes will be collected separately at source in accordance with the Regulation on General Principles of Waste Management.	Negligible	EIA Commitment	Operator	Visual Inspection, Record Check	Weekly
Waste Management	Low	Good housekeeping and operating practices will be instituted including inventory control to reduce the amount of waste resulting from materials that are out-of-date, off- specification, contaminated, damaged, or excess to plant needs.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Visual inspection and record check	Weekly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
Hazardous Waste Management	Minor to Moderate	Hazardous wastes will be segregated from non- hazardous wastes.	Negligible	Hazardous Waste Control Regulation	Operator	Visual inspection	Daily
Hazardous Waste Management	Moderate	- Required precautions will be taken in order to minimize hazardous waste generation; to provide waste management in a way that minimizes the adverse affects of wastes on human health and environment; - Prepare a 3-year waste management plan within six months from the issue date of this Regulation and obtain approval from the Governorate - Prepare Waste Declaration Form in Annex 8 in January of each year for the last year's information and submit to the Ministry within two months; - Provide proper packaging and labeling; and to dispose and transfer the hazardous wastes in conformity with the principles stated in the regulation. - Transportation of the wastes will be carried out by the licensed persons and entities with appropriate vehicles for the properties of the transported waste. - The vehicles that are used to transport hazardous wastes should carry a waste transport form as specified in the regulation. - The hazardous wastes should be sent to licensed hazardous waste disposal sites.	Negligible	Hazardous Waste Control Regulation	Operator	Visual inspection and record check	Weekly
Hazardous Waste Storage	Moderate	- Waste will be stored in a manner that prevents the commingling or contact between incompatible wastes, and allows for inspection between containers to monitor leaks or spills. - Waste will be stored in closed containers away from direct sunlight, wind and rain. - Secondary containment systems will be constructed. - Adequate ventilation will be provided where volatile wastes are stored. - Hazardous waste storage activities will be subject to special management actions, conducted by employees who have received specific training in handling and storage of hazardous wastes.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	- Regular visual inspection of all waste storage collection and storage areas - Tracking of waste generation trends by type and amount of waste generated - Visual inspection, regular audits of waste segregation and collection practices. - Manifests or other records that document the	Continuously during operation

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
						amount of waste generated and its destination will be kept. - 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.	
Hazardous Waste Storage	Moderate	Records for hazardous waste collected, stored, or shipped will 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.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Control hazardous waste records	Continuously during operation
Hazardous Waste Transportation	Moderate	- There will be no temporary or permanent storage of the hazardous wastes at the facility. - Collected hazardous waste will be sent to the licensed disposal facilities before exceeding 6,000 tones in amount and 180 days storage duration. - National Hazardous Waste Transportation Form will be filled as determined in the Hazardous Waste Control Regulation.	Negligible	Hazardous Waste Control Regulation	Operator	Visual Inspection and Record Check	Weekly
Hazardous Waste Minimization	Moderate	Hazardous waste generation will be minimized by implementing stringent waste segregation to prevent the commingling of non-	Negligible	IFC Environmental	Operator	Visual Inspection and Record	Monthly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		hazardous and hazardous waste to be managed.		Health and Safety Guidelines: General EHS Guidelines		Check	
Waste Oils	Moderate	- Waste oils will be collected, stored temporarily, transported and disposed in accordance with the related Regulation. - Waste oils will be collected in the red containers labeled as "Waste Oil" which will be located on impermeable surface and they will be protected from rain. - Closed areas and/or storage tanks will be provided as far as proper and practical. - Waste oils should be transported by licensed transporters to the licensed processing and disposal facilities. - The National Transportation Form in the case of transporting the waste oil out of the facility and waste oil declaration form annually must be prepared and submitted to the Kırıkkale Environment and Forestry Directorate before the end of February. - All records including waste oil declaration forms, analyses report and national waste transportation form should be kept for at least five years.	Negligible	Waste Oil Control Regulation	Contractor	Visual inspection and record check	Monthly
Waste Oil and Hazardous Wastes	Moderate	The waste oils, wash waters, filters and oily equipments generated during maintenance of the equipments will be transported by licensed firms to the licensed hazardous waste and waste oil disposal facilities.	Negligible	Waste Oil Control Regulation	Operator	Visual Inspection and Record Check	Weekly
Battery and Accumulator Wastes	Moderate	The used batteries and accumulator will be collected, temporarily stored, transported and disposed in accordance with the related regulation.	Negligible	Used Batteries and Accumulators Control Regulation	Operator	Visual Inspection and Record Check	Monthly
Contaminated Waste	Moderate	Used boxes, bins or barrels will be collected properly and will be stored in way that preventing leakage and disposed in regular intervals.	Negligible	EIA Commitment	Operator	Visual inspection and record check	Monthly
Recycling and Reuse	Moderate	Recycling objectives will be established and generation and recycling rates of waste will be tracked. Training and incentives will be given to employees in order to meet objectives	Negligible	IFC Environmental Health and Safety Guidelines: General EHS	Operator	Visual inspection and record check	Weekly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
				Guidelines			
Residual Waste	Moderate	The non-reusable/ non-recyclable solid wastes will be collected in sanitary waste bins with closed top and will be transported to the waste disposal area of the related Municipality.	Negligible	EIA Commitment	Operator	Visual inspection and record check	Weekly
NOISE							
CONSTRUCTION							
Noise	Moderate	Noise impact levels at the closest receptor will be below 70 dBA. In case of an exceedence of 70 dBA, all necessary precautions will be taken at the source to control the noise emission.	Negligible	Regulation on Assessment and Management of Environmental Noise	Contractor	Inspection with a Sound Meter	In every six months and as necessary
Noise	Moderate	Maximum pulse noise impact levels (LCmax) from the construction works will be below 100 dBC.	Negligible	Regulation on Assessment and Management of Environmental Noise	Contractor	Inspection with a Sound Meter	In every six months and as necessary
Noise	Moderate	Construction activities will be performed during daytime hours (07:00 – 19:00). Construction activities can be performed in evening time and nighttime hours with the decision taken by Province Environment Board providing that the noise impact levels from the construction works will not exceed 65 dBA in evening time hours (19:00 – 23:00) and 60 dBA in nighttime hours (23:00 – 07:00).	Negligible	Regulation on Assessment and Management of Environmental Noise	Contractor	Inspection with a Sound Meter	In every six months and as necessary
Noise	Moderate	The contractor will show construction start, end date, activity periods and permissions obtained from greater city municipality or province/district municipality on a signboard located in the construction site.	Negligible	Regulation on Assessment and Management of Environmental Noise	Contractor	Visual Inspection	In every six months
Noise	Moderate	Exhaust mufflers will be employed on engine-powered construction equipment and vehicles.	Negligible	EIA Commitment	Contractor	Visual Inspection	Before using vehicle or equipment

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
	Moderate	All vehicles will be driven responsibly and below 30 km/h within the construction site.	Negligible	EIA Commitment	Contractor	Visual Inspection	Weekly
	Moderate	Night-time construction activities will normally be restricted to relatively quiet activities.	Negligible	EIA Commitment	Contractor	Visual Inspection	As necessary Night- Weekly
	Moderate	All mechanical and engine powered equipment should be maintained regularly to minimize noise generation.	Negligible	EIA Commitment	Contractor	Visual Inspection	Monthly
	Moderate	The use of trucks during construction will be optimized as much as possible to reduce number of trucks and thus reduce the potential for traffic noise.	Negligible	EIA Commitment	Contractor	Visual Inspection	As necessary
	Moderate	All major compressors will be sound reduced models with lined and enclosed to reduce noise impacts.	Negligible	EIA Commitment	Contractor	Visual Inspection	As necessary
	Moderate	Noise monitoring should be conducted regularly to assure compliance.	Negligible	EIA Commitment	Contractor	Inspection through daytime and nighttime along the construction border fence.	As necessary
	Moderate	The peak vibration levels at the closest receptors caused by heavy construction machines and other activities such as pile driving will be below 5 mm/sec for continuous vibration and 10 mm/sec for discrete vibration.	Negligible	Regulation on Assessment and Management of Environmental Noise	Contractor	-	Once during use of the machinery
OPERATION							
Noise	Moderate	Noise impact levels at the closest receptor will be below 68 dBA, 63 dBA and 58 dBA for daytime hours (07:00-19:00), evening time hours (19:00-23:00) and nighttime hours (23:00-07:00), respectively. In case of an exceedence of limit values, all necessary precautions will be taken at the source to control the noise emission.	Negligible	Regulation on Assessment and Management of Environmental Noise	Contractor	Inspection with a Sound Meter	Annually and as necessary
	Moderate	Maximum pulse noise impact levels (LCmax) from the operation of the plant will be below 100 dBC.	Negligible	Regulation on Assessment and Management of Environmental Noise	Contractor	Inspection with a Sound Meter	Annually and as necessary

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Noise	Moderate	Noise impact levels at the closest receptor will not exceed 55 dBA and 45 dBA for daytime hours (07:00-22:00) and nighttime hours (22:00-07:00), respectively or noise impact levels result in a maximum increase in background noise levels of 3 dB at the closest receptor. In case of an exceedence of limit values, all necessary precautions will be taken at the source to control the noise emission.	Negligible	IFC General EHS Guidelines: Environmental Noise Management	Contractor	Inspection with a Sound Meter	Annually and as necessary
	Moderate	The operator will conduct ambient noise monitoring every year to three years depending on the project circumstances.	Negligible	IFC General EHS Guidelines for Thermal Power Plants	Operator	Checking report presence	Annual or In every three years
	Moderate	Noise mitigation measures will be incorporated into the design of the power plant, including: - High efficiency baffle mufflers and filters on the gas turbine inlets - Acoustic enclosures around the steam turbines and generators - Attenuation of the noise from the gas turbine exhausts by the HRSGs - Sound barriers around the main power transformers - Low noise specification for fuel gas metering and control systems, motors, pumps, etc - inlet and exhaust mufflers on the cooling fans	Negligible	EIA Commitment	Contractor	Noise inspection through daytime and nighttime in the facility borders.	Related Regulation and, per year at first year and per three years at following years.
	Moderate	Steam cleaning process will take place only during daytime.	Negligible	EIA Commitment	Contractor	Daily inspection with a Sound Meter	During implementation
CONTAMINATED LAND							
Site Drainage	Minor to Moderate	Engineered site drainage systems will be provided during construction to collect, balance, treat as required and control the discharge of site run-off.	Negligible	EIA Commitment	Contractor	Visual inspection to ensure the effectiveness of the mitigation measure	Daily and as required
Groundwater, Surface Water and Soil Contamination	Moderate	Bunds or blind sumps will be installed to isolate areas of potential oil or other spillages.	Negligible	EIA Commitment	Contractor	Visual inspection by operator to ensure the effectiveness of the mitigation measure	Daily

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Groundwater, Surface Water and Soil Contamination	Moderate	Oil storage tanks and chemical storage tanks, such as the acid and caustic storage tanks, will have secondary containment structures that will hold more than the contents of the storage tanks and have drainage valves that are normally closed.	Negligible	EIA Commitment	Contractor	Visual inspection by operator to ensure the effectiveness of the mitigation measure	Daily
Groundwater, Surface Water and Soil Contamination	Moderate	Areas for unloading hazardous chemicals will be isolated by curbs and provided with a sump equipped with a manually.	Negligible	EIA Commitment	Contractor	Visual inspection by operator	Weekly
Groundwater and Soil Contamination	Moderate	Transformers will be provided with pits to retain 110% of the coolant capacity of the transformers.	Negligible	EIA Commitment	Contractor	Visual inspection by operator	When required
Groundwater and Soil Contamination	Moderate	Storm water run-off from equipment slabs that may be subject to oil contamination will be collected and directed through an oil/water interceptor prior to discharge.	Negligible	EIA Commitment	Contractor	Visual inspection	Weekly
Groundwater and Soil Contamination	Minor to Moderate	Spillages and contaminated run-off will be collected in a temporary site drainage system incorporating of sediment traps, oil/water interceptors and inspection manholes.	Negligible	EIA Commitment	Contractor	Visual inspection to ensure the effectiveness of the mitigation measure	Weekly
Groundwater Contamination	Moderate	An oil and chemical spill contingency plan will be prepared and implemented.	Negligible	EIA Commitment	Contractor	Visual inspection to ensure the effectiveness of the mitigation measure	Weekly
Groundwater and Soil Contamination	Moderate	Emergency Response Plan will be prepared and implemented.	Negligible	EIA Commitment	Operator	Drills will be conducted to ensure the effectiveness of the plan	When required
Groundwater and Soil Contamination	Moderate	The drums and barrels that will contain the liquid chemicals (paint, thinner, solvent, lubricant and hydraulic oil) will be located on impermeable surface and they will have the secondary containment with valves.	Negligible	EIA Commitment	Contractor	Visual inspection	Weekly
Groundwater and Soil Contamination	Minor to Moderate	Spillages and contaminated run-off will be collected in a temporary site drainage system incorporating of sediment traps, oil/water interceptors and inspection manholes.	Negligible	EIA Commitment	Contractor	Visual inspection to ensure the effectiveness of the mitigation measure	Weekly
Groundwater Contamination	Moderate	An oil and chemical spill contingency plan will be prepared and implemented.	Negligible	EIA Commitment	Contractor	Visual inspection to ensure the	Weekly

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
						effectiveness of the mitigation measure	
Contaminated Land	Moderate	- Contamination of land will be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil to the environment. - When contamination of land is suspected or confirmed during any project phase, the cause of the uncontrolled release will be identified and corrected to avoid further releases and associated adverse impacts. - Contaminated lands should be managed to avoid the risk to human health and ecological receptors.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor	Visual inspection to ensure the effectiveness of the mitigation measure	Weekly
Contaminated Land	Moderate	Activities causing the pollution will be avoided and complied with the provisions of Regulation.	Negligible	Regulation on Soil Pollution Control and Point Source Contaminated Sites	Contractor	Visual inspection	Weekly
OPERATION							
Groundwater, Surface Water and Soil Contamination	Moderate	Bunds or blind sumps will be installed to isolate areas of potential oil or other spillages.	Negligible	EIA Commitment	Contractor	Visual inspection by operator to ensure the effectiveness of the mitigation measure	Daily
Groundwater, Surface Water and Soil Contamination	Moderate	Oil storage tanks and chemical storage tanks, such as the acid and caustic storage tanks, will have secondary containment structures that will hold more than the contents of the storage tanks and have drainage valves that are normally closed.	Negligible	EIA Commitment	Contractor	Visual inspection by operator to ensure the effectiveness of the mitigation measure	Daily
Groundwater, Surface Water and Soil Contamination	Moderate	Areas for unloading hazardous chemicals will be isolated by curbs and provided with a sump equipped with a manually.	Negligible	EIA Commitment	Contractor	Visual inspection by operator	Weekly
Groundwater and Soil Contamination	Moderate	Transformers will be provided with pits to retain 110% of the coolant capacity of the transformers.	Negligible	EIA Commitment	Contractor	Visual inspection by operator	When required

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Groundwater and Soil Contamination	Moderate	Storm water run-off from equipment slabs that may be subject to oil contamination will be collected and directed through an oil/water interceptor prior to discharge.	Negligible	EIA Commitment	Operator	Visual inspection	Weekly
Groundwater and Soil Contamination	Moderate	Emergency Response Plan and Oil Spill Contingency Plan will be prepared and implemented.	Negligible	EIA Commitment	Operator	Record Check, Drills	Monthly
Contaminated Land	Moderate	- The maintenance and repair of the equipments will be done on the area with appropriate infrastructure, thus the generation of the waste oil will be minimized. - For the storage of the chemicals and construction tools that will be used during construction segmented area will be established.	Negligible	EIA Commitment	Operator	Visual inspection	Weekly
Contaminated Land	Moderate	- Contamination of land will be avoided by preventing or controlling the release of hazardous materials, hazardous wastes, or oil to the environment. - When contamination of land is suspected or confirmed during any project phase, the cause of the uncontrolled release will be identified and corrected to avoid further releases and associated adverse impacts. - Contaminated lands should be managed to avoid the risk to human health and ecological receptors.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Visual inspection	Weekly
Contaminated Land	Moderate	Activities causing the pollution will be avoided and comply with the provisions of Regulation.	Negligible	Regulation on Soil Pollution Control and Point Source Contaminated Sites	Operator	Visual inspection	Weekly
LANDSCAPING -VISUAL							
CONSTRUCTION							
Landscaping	Minor to moderate	- During the storage, topsoil and subsoil will be stored separately. - Topsoil will be excavated and stored according to its depth and quality. - It will be considered that slope of the area on which the topsoil will be stored will not be more than 5%. - During storage, loss of topsoil will be prevented and quality of the topsoil will be maintained. This topsoil will be used to landscape parks and gardens. - During pre-construction activities, soil excavated from high lands will be used on low lands in order to remove the elevation difference. In addition, excavated foundation and trenches will be refilled with excavated soil. Refilled soil will be compressed for	Negligible	EIA Commitment	Contractor	Visual inspection	Before and after construction

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		foundation works. Generally, soil will be used for landscaping purposes.					
Landscaping	Moderate to High	The design of the buildings and installations and the architectural vision of the plant will be simple and clean.	Negligible	EIA Commitment	Operator	Visual inspection	After construction
Landscaping	Minor to moderate	Vegetation destroyed due to the construction activities will be rehabilitated. After the completion of the construction of the plant, landscaping will be done in order to provide shielding and improving the vicinity of the project site visually.	Negligible	EIA Commitment	Contractor	Visual inspection	After construction
Waste Management	Moderate	All debris and wastes will be collected, stored, and transported in an orderly manner to prevent any adverse visual impact on the surrounding area.	Negligible	EIA Commitment	Contractor	Visual inspection	Daily
Good House Keeping	Moderate	Construction camp site will be compact, kept clean and well maintained. Building material at the camp will be well maintained and newly painted to match with the local environment.	Negligible	EIA Commitment	Contractor	Visual inspection	Daily
Good House Keeping	Moderate	Project equipment storage area will be maintained properly to prevent adverse visual impact.	Negligible	EIA Commitment	Contractor	Visual inspection	Daily
Good House Keeping	Moderate	Construction camp site and equipment lay down area will be reinstated to original after the construction.	Negligible	EIA Commitment	Contractor	Visual inspection	After construction
OPERATION							
Landscaping	Minor to moderate	During the landscaping activities performed in the scope of the project, forestation works will be carried on and the tree species growing over that region will be planted.	Negligible	EIA Commitment	Contractor	Visual inspection	Prior to operation
Landscaping	Minor to moderate	Currently, there is not natural vegetation on the project area. Plant species appropriate to the natural characteristics of the environment will be selected. Due to fire risk, front of the administrative building and outside of the energy production area will be planted. Number of trees to be planted will be determined later.	Negligible	EIA Commitment	Contractor	Visual inspection	Prior to operation
Landscaping	Moderate	Local flora species will be planted for landscaping.	Negligible	EIA Commitment	Operator	Visual inspection	Prior to operation
Color	Moderate	Attention will be paid to color treatment, finishes and choice of materials to ensure the use of paling colors on elevated structures and thus reduction in their impact on the skyline.	Negligible	EIA Commitment	Operator	Visual inspection	Prior to operation
Light	Moderate	The lights will be directional and will not point outward to the highway and the town.	Negligible	EIA Commitment	Operator	Visual inspection	Prior to operation
Landscaping	Moderate	- Following the life time of the facility, plant site will be reorganized and will serve as industrial area again. - After the flattening of the site, disturbed land will be vegetated with appropriate plants and rehabilitated as far as possible.	Negligible	EIA Commitment	Operator	Visual inspection	During Decommissioning

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		- Following the land recovery stable vegetation will be created to prevent soil erosion.					
ECOLOGY							
CONSTRUCTION							
Fauna	Moderate	The only suitable place in the project site for amphibian species is an old water tank. <i>Bufo viridis</i> individuals that habituate there will be caught and released to Kızılırmak.	Negligible	BERN Annex II, EIA Commitment	Contractor	Visual Inspection	Before construction
Fauna	Moderate	The individuals of <i>Testudo graeca</i> will be identified in the project site by visual controls. They will be removed from the project site by appropriate means of methods and relocate similar habitats that will not be affected from the activities, or make them leave the site.	Negligible	Central Hunting Commission 2010-2011 Annex 1 list. VU (Vulnerable). According to European Red List of Conservation BERN Annex II	Contractor	Visual Inspection	Before construction
Fauna	Minor	Some of the trees that can be nesting areas of birds may be cut for the project. The cutting/ stripping will be started either before the breeding season or after the young birds are able to take care of them. The activities will not overlap with nesting and breeding. Construction will be conducted either before breeding period, that is middle of March or after the middle of June when the breeding completed.	Negligible	EIA Commitment	Contractor	Visual Inspection	Before construction
	Moderate	Maximum attention will be paid in order to prevent any damage to the mole species in the project site. Similarly, in the soil near the upper surface the herpatofauna components such as frogs, lizards and snakes are present. Therefore, care should be spent working on these parts. In order not to harm any of these components either they will let to leave the place by themselves or additional transfers will be applied as explained above.	Negligible	EIA Commitment	Contractor	Visual Inspection	Daily
	Moderate	If the construction phase overlap with the breeding season, the wild forms will be avoided from the present and possible nest sites and breeding sites. This can be managed by putting physical barriers or signs that protect the entrance.	Negligible	EIA Commitment	Contractor	Visual Inspection	Daily
	Moderate	Even the number of the trees is low; the cutting period will be arranged by considering the damage to the organisms that will lose	Negligible	EIA Commitment	Contractor	Visual Inspection	Before construction

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		their habitats.					
	Moderate	The construction time will be arranged in a way that the breeding and reproduction of the bird species not destroyed. The activities should be conducted in early March, before the breeding period, or after June when the breeding has finished.	Negligible	EIA Commitment	Contractor	Visual Inspection	Before construction
	Moderate	There can be species that already begin nesting or later on will begin nesting according to the starting of the construction. If the produced level of noise is high there is risk of those species to quit nesting and looking after the offsprings with suitable conservation measures, it can be possible to keep that level to avoid migration of the species inhabiting the region. Or else, since the breeding period of all, at least conserved species is known by the experts, a break will be given to the vehicles that cause that kind of noise for only in nesting period. Additionally, in the vicinity of project area there are similar kinds of habitats that those species can move.	Negligible	EIA Commitment	Contractor	Visual Inspection	Before construction
Flora-Fauna	Moderate	Following actions will be prohibited in scope of project: All forms of deliberate capture and keeping and deliberate killing, The deliberate damage to or destruction of breeding or resting sites, The deliberate disturbance of wild fauna, particularly during the period of breeding, rearing and hibernation, insofar as disturbance, The deliberate destruction or taking of eggs from the wild or keeping these eggs even if empty.	Negligible	BERN Convention	Contractor	Visual Inspection	Daily
Fauna	Moderate	Provisions for wild fauna species covered in Annex-III are specified in Article 7. Accordingly, all countries party to the convention must take all necessary legal and administrative measures for wild fauna species covered in Annex-III. These measures must be arranged in such a manner of that none of the operational activities in the area not to endanger populations of wild animal species.	Negligible	BERN Convention	Contractor	Visual Inspection	Daily
	Moderate	For species in protection lists prepared by Central Hunting Commission of the General Directorate of Nature Conservation and National Parks 2010-2011, protection measures will be implemented in accordance with the provisions of that commission's decisions. Wild animals listed in Annex-I have been taken under preservation following the Article 4 Paragraph 1 of the Hunting Law #4915 enacted by the Ministry of Environment and Forestry. It is forbidden to hunt, carry dead or alive, or transport the wild animals in this list.	Negligible	According to the 2010-2011 Decisions of Central Hunting Commission, Appendix -I lists the species	Contractor	Visual Inspection	Daily

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		The activities that will affect the species that have Vulnerable (Vu) status according to European Red List Directly or indirectly will be avoided.		protected by the MoEF. Appendix -II lists species allowed to be hunted for a time period			
Flora- Fauna	Moderate	The existing access roads in the area will be used for the construction activities and additional side roads will not be constructed.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	-
Fauna	Moderate	Adjacent habitats will be protected from disturbance by the construction workforce, e.g. by fencing off of unused areas, warning signs and training of workers.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	Weekly
CULTURAL HERITAGE							
CONSTRUCTION							
Archaeological Remains	Moderate	Construction works will be monitored for archaeological remains and chance-find procedures prepared. Construction works will be stopped if any archaeological remains are found.	Negligible	EIA Commitment	Contractor	Visual Inspection	When required
Archaeological Remains	Moderate	An application will be made to the Ministry of Culture and Tourism related to the archaeological remains may be found there.	Negligible	EIA Commitment	Contractor	Visual Inspection	When required
TRAFFIC – INFRASTRUCTURE							
CONSTRUCTION							
Access Roads	Moderate	In the context of the project there will be no new road construction and existing roads will be used to access the project site.	Negligible	EIA Commitment	Contractor	Visual Inspection	Before construction
Safety and traffic signs	Moderate	Safety and traffic signs will be clearly placed near and around the project site.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Scheduling of traffic	Moderate	- Scheduling of traffic will be undertaken to avoid the peak hours on the local road network wherever practicable. - Limits for trip duration and arranging driver rosters will be adopted	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of	During the activity

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		to avoid overtiredness				the mitigation measure	
Special loads	Moderate	Special loads will adhere to prescribed routes to be agreed with the appropriate authorities - these will be scheduled to avoid peak hours on local roads and published well in advance to minimize possible disruption.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Road safety training	Moderate	Road safety training and adherence to speed limits will be stressed to all drivers.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Prescribed routes	Moderate	Prescribed routes for construction traffic will be agreed with the appropriate authorities, particularly with respect to tanker and truck traffic and special loads.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Entrance to the Site	Moderate	Entrance to the site will be clear and properly designed.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Gross weight	Moderate	To protect the roads, trucks which will be used for transporting activities should have a gross weight within the axial permissible load determined in related regulation.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Public transport	Moderate	Minibuses and buses will be encouraged and used to transport construction workers to and from the site during construction period.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Minimize accidents	Moderate	Vehicles and use of manufacturer approved parts will be maintained regularly to minimize potentially serious accidents caused by equipment malfunction or premature failure.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Equipment Transfer	Moderate	- The heavy and wide equipments such as gas and steam turbines, and transformers will be transported from the closest port to the project site.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of	Before transportation

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		- Before the transportation necessary permissions will be taken from the authorized institutions, and during transportation guide vehicles will be used and vehicles will comply with all traffic rules.				the mitigation measure	
OPERATION							
Road safety training	Moderate	Road safety training and adherence to speed limits will be stressed to all drivers.	Negligible	EIA Commitment	Operator	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Safety and traffic signs	Moderate	Safety and traffic signs will be clearly placed near and around the project site.	Negligible	EIA Commitment	Operator	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Road protection	Moderate	To protect the roads, trucks which will be used for transporting activities should have a gross weight within the axial permissible load determined in related regulation.	Negligible	EIA Commitment	Operator	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Traffic Management Plan	Moderate	A Traffic Management Plan will be prepared and implemented for the operations.	Negligible	EIA Commitment	Operator	Inspection to ensure the effectiveness of the mitigation measure	During the activity
Traffic Safety		- Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits - Ensuring drivers undergo medical surveillance - Ensuring moving equipment with restricted rear visibility is outfitted with audible back-up alarms - Establishing rights-of-way, site speed limits, vehicle inspection requirements, operating rules and procedures (e.g. prohibiting operation of forklifts with forks in down position), and control of traffic patterns or direction - Restricting the circulation of delivery and private vehicles to defined routes and areas, giving preference to 'one-way' circulation, where appropriate.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Inspection to ensure the effectiveness of the mitigation measure	During the activity
SOCIO-ECONOMY							

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
CONSTRUCTION and OPERATION							
Socio-Economy	Moderate	Environmental and Social Policy and Procedures will be prepared and implemented for the construction and operations.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Inspection to ensure the effectiveness of Environmental and Social Policy	During construction and operation
	Moderate	Human Resources Policy will be prepared and implemented.	Negligible	-	Contractor and Operator	Inspection to ensure the effectiveness of Human Resources Policy	During construction and operation
	Moderate	SAP and a SEP will be prepared and will be communicated to relevant contractors.	Negligible	-	Contractor and Operator	Inspection to ensure the effectiveness of SAP and SEP.	During construction and operation
	Moderate	- Pre-construction period of the project will last approximately 10 months, construction period will last 3 years and operation period will last 49 years. - Approximately 900 employees will be employed for the construction of the proposed power plant and these employees will be hired from local people. - Service buses or minibuses will be provided for the workers staying in the nearby the plant. - Some necessary material and service will be provided from the local opportunities. - Expenses of pre-construction and construction period include fees to be paid for workforce, renting equipment, fuel and services provided from local facilities. - During the operation period of the proposed plant, approximately 60 employees, thus the contribution to the local economy will be restricted to salaries paid to the employees, and expenditures of them such as accommodation, food and clothing consumptions. - If it is possible, it is planned that employees will be employed from the local community. Thus, temporary and permanent job opportunities will be provided in the region during the construction and operation period of the plant.	Negligible	EIA Commitment	Contractor and Operator	-	-

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	Moderate	Since workers working during the construction period will be employed from the local community and only 60 employees will work during the operation period, this project will not result in an important migration or a population movement.	Negligible	EIA Commitment	Contractor and Operator	-	-
	Moderate	Entire area will be located in the area determined as industrial zone in Hacilar Municipality Master Plan. Extra land will not be required during the construction.	Negligible	EIA Commitment	Contractor and Operator	-	-
	Moderate	Food service will be required for the employees working during construction and operation period of the project. This service will be provided from a company located at that region. Similarly, local purchases will be provided from local companies.	Negligible	EIA Commitment	Contractor and Operator	-	-
	Moderate	Loss of agricultural land or agricultural products will not be occurred due to the land acquisition.	Negligible	EIA Commitment	Contractor and Operator	-	-
Socio-Economy	Moderate	- All kinds of need of employees will be supplied by the units such as cafeteria, showers and dressing rooms that will be located in the camp area. - Employees not living in the nearby the plant, member of the construction control group and test run group will stay in the houses located in close cities, districts and villages. -Transportation of the employees will be provided by Hacilar Municipality Buses working between Kırıkkale City Center and Hacilar Village, and by private service companies.	Negligible	EIA Commitment	Contractor and Operator	-	-
	Moderate	It is planned that 60 employees will be employed for the operation period of the proposed İç Anadolu CCPP Project. There is no housing problem in this region. So, it is not planned to construct any housing complex for employees and their families nearby the plant.	Negligible	EIA Commitment	Contractor and Operator	-	-
	Moderate	Food need and other needs of the employees working during the construction and operation period of the plant will be provided from the local opportunities.	Negligible	EIA Commitment	Contractor and Operator	-	-
	Moderate	The project company will encourage seeking local contractors for construction works related to project site excavation and leveling, construction of buildings and internal roads.	Negligible	EIA Commitment	Contractor and Operator	-	-
	Moderate	Job vacancies will be preferentially advertised in Hacilar Municipality and the nearby towns maximizing the opportunity for local people to apply for skilled and non-skilled construction and operation jobs.	Negligible	EIA Commitment	Contractor and Operator	-	-
	Moderate	The Project company will include an apprentice system or similar approach to help local manual workers to gain additional skills.	Negligible	EIA Commitment	Contractor and Operator	-	-

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	Moderate	Local vehicle maintenance workshops will be used and fuel brought from local sellers as far as possible during both construction and operation phases of the plant.	Negligible	EIA Commitment	Contractor and Operator	-	-
	Moderate	Various contractors will be encouraged to source supplies, food, and beverage and spare parts from local stores during construction and operation phases of the plant.	Negligible	EIA Commitment	Contractor and Operator	-	-
HEALTH AND SAFETY (On Site)							
CONSTRUCTION and OPERATION							
General Health and Safety	Moderate	- All employees working during operation period will be trained on Environment, Health and Safety. - All personnel will be provided with personal protective equipment. Usage of this equipment will be compulsory. - Entrance of irrelevant people to the project area and switch yard will be prevented with hazard warning and signs. - If necessary the project area will be hedged by double fence and secured by a personnel. - The project will comply with all the rules stated in Worker Health and Work Safety Statute.	Negligible	EIA Commitment	Contractor and Operator	Visual inspection, record check	During the activity
Geotechnical study and land survey	Moderate	- In pre-construction period, geotechnical study and land survey will be conducted according to the characteristic of the units. In these studies, especially carrying capacity and settlement analysis will be analyzed in detail. Project construction will be performed according to the results of these studies. - During excavation activities, no blasting will be carried out.	Negligible	EIA Commitment	Contractor	Visual inspection	Prior to construction
Health and Safety Plan	Moderate	- Contractor performing construction activities will prepare a Health and Safety Plan in order to make project area safer. All health and safety rules accepted by Turkish regulation and world will be included by this plan. - An Emergency Response Plan will also be prepared.	Negligible	EIA Commitment	Contractor	Visual inspection, drills	Monthly
H&S Legislation	Moderate	The project will comply with EIA commitments given in the EIA Report, Public Health Law No. 1593, Labor Law No. 4857 and related statutes and regulations during the construction, operation and decommissioning period. In this scope, the project will also comply with Worker Health and Work Safety Statute and Regulation on Health and Safety for Construction Works during construction.	Negligible	EIA Commitment	Contractor and Operator	Visual inspection, record check	During the activity
HS Training	Moderate	Necessary precautions will be taken and all employees will be trained so adverse effects of the activities performed in the scope of the project on human health and environment will be prevented.	Negligible	EIA Commitment	Contractor and Operator	Visual inspection	During the activity

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Safety Criteria for BOTAS Natural Pipeline	Moderate	While construction of the line "Planning Conditions and Safety Criteria for activities performed around BOTAS Natural Pipeline and Plant" will be complied. Necessary permits and approvals for construction of the natural gas pipe line will be obtained then related engineering studies will start.	Negligible	EIA Commitment	Contractor and Operator	Visual inspection	During the activity
Lightning	Minor	Necessary lighting will be provided in the project area and security personnel will be employed in order to ensure the necessary safety.	Negligible	EIA Commitment	Contractor and Operator	Visual inspection	During the activity
Medical Services	Moderate	Since number of employees working during the operation period of the plant will be less than 50, an infirmary will not be constructed. For surgical interventions, the nearest health center will be used. If any serious surgical intervention will be required, health centers in Kırıkkale City Center will be used. A first aid room will be in the plant. In this room, no serious surgical intervention will be applied.	Negligible	EIA Commitment	Contractor and Operator	Visual inspection	During the activity
Toxic and flammable substances	Moderate	Toxic and flammable substances to be used in operation will be transported to the sites by tracks and only competent personnel will deal with these substances. For all chemical that can not be stored in closed tanks: - Carried to the project are within closed containers and they will be placed in closed storage having impervious floor. - All storage tanks will be named and labeled according to their content. - Buildings in which the chemicals will be stored will be constructed with reinforced concrete. - Against the risk of leakage, storage will be connected to neutralization tank with deep channels and to discharge system with closed system.	Negligible	EIA Commitment, Statute No.7/7551 on workplaces where Explosive, Flammable, Dangerous and Hazardous Substances are used	Contractor and Operator	Visual inspection	During the activity
Noise	Moderate	Ear protection equipment will be used in all areas of a potential source of high noise.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	Daily
	Moderate	Office and management buildings will be isolated as far as possible from noise sources and insulated to prevent the noise from harming people and workers.	Negligible	EIA Commitment	Contractor	Indoor noise monitoring	As necessary
Hazardous Chemicals and Waste	Moderate	- Material Safety Data Sheets for all chemicals used at the plant will be available at site and in easy reach to concerned employees. - Proper and approved Personal Protective Equipment (PPE) will be provided to all employees handling chemicals and will be trained on their use and maintenance.	Negligible	EIA Commitment	Contractor	Inspection to ensure the effectiveness of the mitigation measure	As necessary

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		- Hydrochloric acid (HCl) will be stored on site in a single above ground tank within an impermeable secondary containment area of 110% volume of the storage tank. In the event of leakage of the tank the acid will be pumped out to a road tanker to be reused or disposed of in a safe and approved manner. If such facilities are not available the HCl solution will be neutralized and then discharged to the evaporation pond. - Caustic soda (NaOH) will be stored in an above ground tank within an impermeable containment area of 110% volume of the storage tank. In the event of leakage of the tank the acid will be pumped out to a road tanker to be reused or disposed of in a safe and approved manner. If such facilities are not available the NaOH solution will be neutralized and then discharged to the evaporation pond. - Liquid chemicals, such as Hydrochloric acid, sodium hydroxide storage tanks will be constructed of appropriate materials and appropriate manner suitable for the material to be stored in them. Tanks will be surrounded by secondary containment area which can hold 110 % of the total volume of the tank. If a group of tanks to be surrounded by a single containment area it should contain 110% of the largest volume tank it surrounds. - All transformers will be oil filled and the oil will be PCB free. Each transformer will be provided with a containment pond that will contain all the transformer oil in the event of a spillage which will be pumped to an oil separator after that. - Lubricating oils will be stored on the site within steel tanks in an impermeable contamination area. The oils are used to lubricate the gas and steam turbines bearings. All waste oil and oil filters produced by vehicles and equipment during construction and operation phases will be stored in tightly closed containers in secured place on site awaiting proper disposal in accordance with Waste Oil Control Regulation.					
Accidents	Moderate	The plant personnel and its contractors will be provided with adequate first aid facilities as may be required or permitted during all phases of the Project. Key personnel will be trained in first aid and have a valid training certificate. First Aid stations will be clearly marked and regularly checked by the plant administration and its contractors.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Inspection to ensure the effectiveness of the mitigation measure	As necessary
Accidents	Moderate	A Safety Manual will be prepared for the construction and operation	Negligible	IFC	Operator	Inspection to	As necessary

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		activities. The Safety Manual will include excavations and trenches, abrasive wheels, confined spaces, working at height, lifting equipment and compressed gases.		Environmental Health and Safety Guidelines: General EHS Guidelines		ensure the effectiveness of the mitigation measure	
Heat	Moderate	The following control measures will be taken to minimize employees' exposure to heat: - Regular inspection and maintenance of 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. - Providing cold water sources for employees working in elevated temperature areas.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Inspection to ensure the effectiveness of the mitigation measure	As necessary
Fire Hazards	Moderate	- Fire fighting systems and equipments will be in compliance with Regulation for Fire Safety of Buildings. - Fire fighting systems and equipment will be maintained regularly. - Employees will be trained on the use of fire fighting systems and equipment and periodic refresher training courses will be organized. - Fire alarm system will be installed in accordance with Regulation for Fire Safety of Buildings.	Negligible	EIA Commitment	Operator	Inspection to ensure the effectiveness of the mitigation measure	As necessary
Medical Care	Moderate	Proper medical care facilities will be available for the contractor and plant employee workers.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Operator	Inspection to ensure the effectiveness of the mitigation measure	As necessary
Disease Prevention	Moderate	Surveillance and active screening and treatment of workers will be provided. Health awareness and education initiatives will be undertaken Employers will be educated on risks, prevention, and available treatment of vector-borne diseases Safety guidelines will be followed for the storage, transport, and	Negligible	IFC Environmental Health and Safety Guidelines: General EHS	Operator	Inspection to ensure the effectiveness of the mitigation measure	As necessary

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		distribution of pesticides to minimize the potential for misuse, spills, and accidental human exposure		Guidelines			
Noise	High	Noise level in the sound-insulated control rooms will be below 60 dBA. - Design of generators to meet applicable occupational noise levels; - 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).	Negligible	IFC General EHS Guidelines for Thermal Power Plants	Contractor	Indoor noise monitoring	Annual
HEALTH AND SAFETY (Off Site)							
CONSTRUCTION and OPERATION							
Security fence	Moderate	The plant will be located within a security fence ensuring to prevent trespass or accidental entry of the site by local people.	Negligible	EIA Commitment	Contractor and Operator	Inspection to ensure the effectiveness of the mitigation measure	As necessary
Transport of waste	Moderate	The transport of raw materials and the transport and disposal of waste will be undertaken in an appropriate manner.	Negligible	EIA Commitment	Contractor and Operator	Inspection to ensure the effectiveness of the mitigation measure	As necessary
Speed limit	Moderate	Project vehicles will be requested to travel no faster than the speed limit.	Negligible	EIA Commitment	Contractor and Operator	Inspection to ensure the effectiveness of the mitigation measure	As necessary
Health Protection Zone	High	Length of health protection strip for the proposed project will be determined by assessment commission and "Operations Permit" will be obtained.	Negligible	Regulation related to Workplace Opening and Operation Permit	Operator	-	-
Emergency Preparedness and Response	Moderate	Emergency Preparedness and Response Plan will be prepared that is commensurate with the risks of the facility.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Drills will be conducted to check the efficiency of the Emergency Preparedness and Response Plan	Yearly

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Emergency Coordinator	Moderate	In the case of emergency, there will be a person appointed to be responsible for this work at the site according to the Emergency Response Plan. This person will be named and appointed as "Emergency Coordinator". Another person has to present at the site and has a full authority about the occurrence is named and appointed as "First Observer".	Negligible	EIA Commitment	Contractor and Operator	-	-
Communication Systems - Worker Notification and Communication	Moderate	Alarm bells, visual alarms, or other forms of communication should be used to reliably alert workers to an emergency. Warning systems will be tested at least annually (fire alarms monthly), and more frequently if required by local regulations, equipment, or other considerations. Back-up system will be installed for communications on-site with off-site resources, such as fire departments, in the event that normal communication methods may be inoperable during an emergency.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Visual inspection, Record check, drills	During the activity
Emergency Resources - Fire Services	Moderate	Level of local fire fighting capacity and whether equipment is available for use at the facility in the event of a major emergency or natural disaster will be considered. Fire fighting capacity will be included that may include pumps, water supplies, trucks, and training for personnel.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Visual inspection, Record check	During the activity
Emergency Resources - Medical Services	Moderate	First aid attendants for the facility as well as medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital will be provided.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Visual inspection, Record check	During the activity
Emergency Resources - Contact List	Moderate	A list of contact information for all internal and external resources and personnel will be developed which includes name, description, location, and contact details (telephone, email) for each of the resources, and be maintained annually.	Negligible	IFC Environmental Health and Safety Guidelines: General EHS Guidelines	Contractor and Operator	Visual inspection, Record check	During the activity
Training and Updating	Moderate	Emergency response plans will be maintained, reviewed, and updated to account for changes in equipment, personnel, and facilities. Training programs and practice exercises will be provided for	Negligible	IFC Environmental Health and Safety	Contractor and Operator	Visual inspection, Record check	During the activity

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		testing systems to ensure an adequate level of emergency preparedness.		Guidelines: General EHS Guidelines			
Non-ionizing radiation	Moderate	- Identification of potential exposure levels in the workplace, including surveys of exposure levels in new projects 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).	Negligible	IFC General EHS Guidelines for Thermal Power Plants	Contractor and Operator	Indoor measurements	As necessary
Electrical Hazards	Moderate	- 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.	Negligible	IFC General EHS Guidelines for Thermal Power Plants	Contractor and Operator	Visual Check, Record check	As necessary
GENERAL							
Environmental Monitoring	Moderate	After the project secured 'EIA Positive Certificate' audits will be conducted and monitoring reports will be submitted to Ministry of Environment and Forestry every six months until the plant is operational.	Negligible	EIA Commitment	Operator	Check whether the audits are conducted	Per 6 months during construction
Environment Permit	High	The plant is subjected to Environment Permit and Licenses Regulation and should secure Environment Permit from the Ministry	Negligible	EIA Commitment	Operator	Ensure that the permit is secured.	-

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		of Environment and Forestry. Moreover, the plant should either hire two Environmental Officers or assign an Environmental Unit that consist of three Environmental officers or receive this service from an environmental consultant in accordance with Environmental Audit Regulation.					
Regulatory Requirements	Moderate	The project construction will comply with the Regulation on Structures that will be built in Disaster Regions and Regulation on Buildings that will be built in Earthquake Regions	Negligible	Regulation on Structures that will be built in Disaster Regions, Regulation on Buildings that will be built in Earthquake Regions	Contractor	Measurements, tests	Construction period
Regulatory Requirements	High	The project will comply with: Large Combustion Plants Regulation, Official Gazette No. 27605 dated June 8, 2010; Industrial Air Pollution Control Regulation, Official Gazette No. 27277 dated July 03, 2009; Regulation on Tracking of Greenhouse Gas Emissions, Official Gazette No. 28274 dated April 25, 2012; Air Quality Assessment and Management Regulation, Official Gazette No. 26898 dated June 6, 2008; Air Pollution Control Regulation for Heating Sources, Official Gazette No. 25699 dated January 13, 2005; Exhaust Emission Control Regulation, Official Gazette No. 27190 dated April 04, 2009; Regulation on Reduction in Ozone Depleting Substances, Official Gazette No. 27052 dated November 12, 2008; Water Pollution Control Regulation, Official Gazette No. 25687 dated December 31, 2004. Regulation on General Principles of Waste Management, Official Gazette No. 26927 dated July 5, 2008; Solid Waste Control Regulation, Official Gazette No. 20814 dated March 14, 1991 The Excavation, Construction and Demolition Waste Control Regulation, Official Gazette No. 25406 dated March 18, 2004; Packaging Waste Control Regulation, Official Gazette No. 26562 dated June 24, 2007;	Negligible	EIA Commitment	Contractor and Operator	Regular Audits	Annual

ENVIRONMENTAL ISSUE/IMPACT	IMPACT SIGNIFICANCE	DESCRIPTION	RESIDUAL IMPACT	ASSESSMENT CRITERIA	RESPONSIBILITY	MONITORING	MONITORING / INSPECTION FREQUENCY
		Waste Oil Control Regulation, Official Gazette No. 26952 dated July 30, 2008; Vegetable Waste Oil Control Regulation, Official Gazette No. 25791 dated April 19, 2005 Medical Wastes Control Regulation, Official Gazette No. 25883 dated July 22, 2005; Waste Batteries and Accumulators Control Regulation, Official Gazette No. 25569 dated August 31, 2004; Hazardous Wastes Control Regulation, Official Gazette No. 25755 dated March 14, 2005; Waste Tires Control Regulation, Gazette No. 26357 dated November 25, 2006; Restrictions on the Production, Marketing and Use of Certain Dangerous Substances and Preparations, Gazette No. 27092 dated December 26, 2008; Regulation on Control of Polychlorinated Biphenyls (PCBs) and Polychlorinated Terphenyls (PCTs), Official Gazette No. 26739 dated December 27, 2007; Regulation on Soil Pollution Control and Contaminated Sites by Point Source, Official Gazette No. 27605 dated June 8, 2010; Regulation on Assessment and Management of Environmental Noise, Official Gazette No. 27601 dated June 4, 2010; Environmental Permits and Licenses Regulation, Official Gazette No. 27214 dated April 29, 2009; Environmental Audit Regulation, Official Gazette No. 27061 dated November 21, 2008; Environmental Impact Assessment Regulation, Official Gazette No. 27214 dated July 17, 2008; Regulation Related to Workplace Opening and Operation Permits, Official Gazette No. 25902 dated August 10, 2005					

10.0 PUBLIC CONSULTATION AND DISCLOSURE

10.1 Consultation Process

10.1.1 Consultation During Scoping

Scoping Meeting

The projects that are listed in Annex I of the EIA Regulation are directly subject to preparing an EIA Report. As the first requirement, an Environmental Impact Assessment Application File was prepared and submitted to the Ministry of Environment and Urbanization according to the format given in the Annex III of the EIA Regulation. The MoEU reviewed the EIA Application File and established a committee to review and evaluate the EIA report. Before the first meeting of the committee, the project owner conducted a public participation meeting at the proposed project location to inform the public about the project. The details of the public participation meeting are given in the Public Hearing and Public Disclosure section. The project has gone through this procedure for both with the first phase (420 MWe) and then in capacity increase phase (840 MWe)

The list of review and evaluation committee for both phases is given in the Table 10-1. The committee members were provided with Environmental Impact Assessment Application File and gave their official opinions on the project in the meeting conducted on April 29, 2010 at MoEU and on January 25, 2012. Then, MoEU prepared project specific format for the project based on the opinions of the committee members. The EIAs were prepared in accordance with these formats.

Table 10-1 Review and Evaluation Committee List

Ministry of Energy and Natural Resources
General Directorate of Electricity Generation Corporation (EÜAŞ)
Petroleum Pipeline Corporation (BOTAŞ)
General Directorate of Mineral Research & Exploration (MTA)
Ministry of Health
Basic Health Services General Directorate
General Directorate of Forestry
State Hydraulic Works General Directorate
Meteorological Service General Directorate
Environmental Management General Directorate
Air Management General Directorate
Water Soil Management Directorate
Waste Management Directorate
General Directorate of Nature Conservation and National Parks
Kırıkkale Governorate
Provincial Environment and Urbanization Directorate
Provincial Agricultural Directorate
Secretary General of Provincial Special Administration
Provincial Health Directorate
Kırıkkale Municipality

Planning and Strategic Environmental Assessment Directorate
Environmental Inventory Directorate

Public Hearing and Public Disclosure

People living in Hacılar Municipality that is the closest residential area to the project site are expected to be potentially affected by İç Anadolu CCPP.

According to Article 9 of the Environmental Impact Assessment Regulation, public participation meetings were organized in both phases of the project in order to inform people about the project and obtain their opinions and suggestions prior to the EIA study.

Prior to the meeting the EIA Application Files were posted on the internet site of the MoEU Environmental Impact Assessment Directorate for public review. Meeting dates, times and places were determined as April 24, 2010 and January 23, 2012; 14:00, Kırıkkale University Hacılar Hüseyin Aytemiz Vocational School by the Kırıkkale Governorate Provincial Environment and Urbanization Directorate. Announcements including meeting dates, times and places were published on national and local newspapers (İl Gazetesi and Akşam Gazetesi) before the meetings. In addition, a bus on which an announcement was attached was organized in order to transport people to the meeting place from the town center.

Before the meeting, pamphlets were distributed in order to supply briefing for participants. At the beginning of the meetings, a presentation including specifications, environmental and social impacts of the project and mitigation measures to be taken was made. Then opinions of people were received and their questions were answered. List of people participating to the meeting was provided in Table 10-2 and some photos taken during the meetings were provided in Figures 10-1, 10-2, 10-3 and 10-4.

Table 10-2 List of Public Participation Meeting Participants

Name and Surname	Institution/Title
Hacı İbrahim GÜNDOĞDU	Mayor
Gürses DEMİRTAŞ	Municipality Officer
Mevlüt YURDAKUL	Village Resident
Ahmet ALTINTAŞ	Village Resident
Aytekin GÜNDOĞDU	Village Resident
Aydın ALAKUŞ	Village Resident
Mehmet ULUSOY	Village Resident
Cemil BEKTAŞ	Village Resident
Ali KOYUNCU	Village Resident
İlhan YAĞIZ	Village Resident
Mehmet ALTINTAŞ	Village Resident
Zübeyde GÜNDOĞDU	Village Resident

Ayşegül GÜNDOĞDU	Village Resident
Zeliha GÜNDOĞDU	Village Resident
Makbule KOYUNCU	Village Resident
Cengiz ÜST	Kırıkkale Provincial Directorate of Environment and Forestry
İsa KOYUNCU	Village Resident
Üzeyir KOYUNCU	Village Resident
Nuri TUNCEL	Village Resident
Ömer KARAGÖZ	Village Resident
Mehmet Akif GÜNDOĞDU	Village Resident
Fatih KARAGÖZ	Village Resident
Dursun KARAGÖZ	Village Resident
Kemal KARAKOÇ	Village Resident
Burhan GÜNDOĞDU	Village Resident
Şerafettin DURMAZ	Village Resident
Turgut ÜNAL	Kırıkkale Provincial Directorate of Environment and Forestry/Department Chief
Murat ERDOĞAN	Village Resident
Muran İNCE	Village Resident
Atilla GÜNDOĞAN	Village Resident
Osman BAĞCI	Village Resident
Yakup GÜNDOĞDU	Village Resident
Ümit GÜNDOĞDU	Village Resident
Duran YILDIRIM	Village Resident
Mehtap GÜNDOĞDU	Village Resident
Hasan YILDIRIM	Village Resident
Duran GÜNDOĞDU	Village Resident
Türkan GÜNDOĞDU	Village Resident
Dursun ALAKUŞ	Village Resident
Ahmet GÜNDOĞDU	Village Resident
Ayşe KARABULUT	Village Resident
Mehmet KARABULUT	Village Resident
Mevlüt KARABULUT	Village Resident
Tevhide KARABULUT	Village Resident
Teslime KARABULUT	Village Resident
Hakan ERTUĞRUL	Student
Tolga GÜNDOĞDU	Village Resident
Gürkan KUNTASAL	AECOM
Ümit KÖSE	GAMA Enerji
Neslihan AYVAZ	AECOM
Hayrettin ACAR	EÜAŞ



Figure 10-1 Public Participation Meeting 1 View 1



Figure 10-2 Public Participation Meeting 1 View 2



Figure 10-3 Public Participation Meeting 1 View 3



Figure 10-4 Public Participation Meeting 2 View

During these meetings, people asked questions generally about employment opportunities and environmental impacts of the project. The mayor stated that the most important issue for their town is employment opportunities due to the project. He requested that the people that will work for the project will be employed from Hacılar Town. The project owner responded that qualified work force is needed for the project. However, he also stated that work force in the Town will be prioritized in case unqualified work force is needed by the contractors. One of the residents asked about the health effects of the project. The health effects of the project were explained in general during the meeting. Another resident asked about the monitoring frequency and the guarantee that will be given in terms of effects of project on environment and human health. It was responded that the project will be monitored in the periods determined by the MoEU by the an independent firm in accordance with the monitoring parameters stated in the EIA report and the project will also be monitored by the Provincial Environment and Urbanization Directorate. In general, the participants asked about the employment opportunities related with the project.

Evaluation and Assessment Committee Meeting

The EIA was prepared in accordance with the specific format given by the MoEU and submitted to the MoEU. For the first phase of the project the EIA was distributed to the committee members for their review and an evaluation meeting was held on September 02, 2010. As a result of the evaluation meeting by the MoEU and the evaluation committee, the evaluation process was finalized, the report was found to be appropriate by all the committee members and the project owner was requested to submit the final report by incorporating the necessary additional information. Then, the final report was made available for public review for 10 days in the MoEU web page and the Kırıkkale Governorate announcement board. No opinion or objections were received during this period by the public. The final report was reproduced for committee members and submitted to the MoEU. Finally, the MoEU issued the final opinion as "Affirmative Opinion on Environmental Impact Assessment".

For the capacity increase of the project, similarly the EIA was distributed to the committee members for their review and an evaluation meeting was held on January 25, 2012. As a result of the evaluation meeting by the MoEU and the evaluation committee, the evaluation process was finalized, the report was found to be appropriate by all the committee members and the project owner was requested to submit the final report by incorporating the necessary additional information. The process for obtaining "Affirmative Opinion on Environmental Impact Assessment" is on-going.

10.1.2 Consultation During Construction

The project owner will provide consultation during construction period together with the contractors. The implementation of mitigation measures will be monitored during construction. The contractor will be monitored and audited by the project owner. The community will be warned prior to any activity that they should be aware of. Community related issues that may impact on construction will be identified by the contractor and evaluated by the operator. The complaints against the project

during the construction period will be managed. The incidents and accidents will be reported during the construction period.

10.1.3 Consultation During Operation

The project owner will provide consultation during operation period. The communities in the vicinity of the project units will be made aware of the safety issues. The compliance of the landowners with the land use constraints will be maintained. The implementation of mitigation measures will be monitored. The complaints of the local people will be managed. The incidents and accidents will be reported during the operation period.

10.2 Grievance Mechanism

Local people need a trusted way to voice and resolve concerns linked to the proposed project, and companies need an effective way to address community concerns. A grievance resolution mechanism provides a promising avenue by offering a reliable structure and set of approaches where local people can find effective solutions for the questions and concerns. A well-functioning grievance mechanism:

- Provides a predictable, transparent, and credible process to all parties, resulting in outcomes that are seen as fair, effective, and lasting,
- Builds trust as an integral component of broader community relations activities, and
- Enables more systematic identification of emerging issues and trends, facilitating corrective action and preemptive engagement.

Questions and concerns of the people regarding the project will be obtained through the EMP requirements. İç Anadolu Enerji will be responsible to deliver the phone numbers, mail and e-mail addresses to interest groups (local people and NGO's) for receiving and recording any complaints related with the project. Hence, a public relations mechanism will be constructed for the complaints from NGO's and governmental establishments of the province.

The grievance mechanism will be implemented during construction and operation periods.

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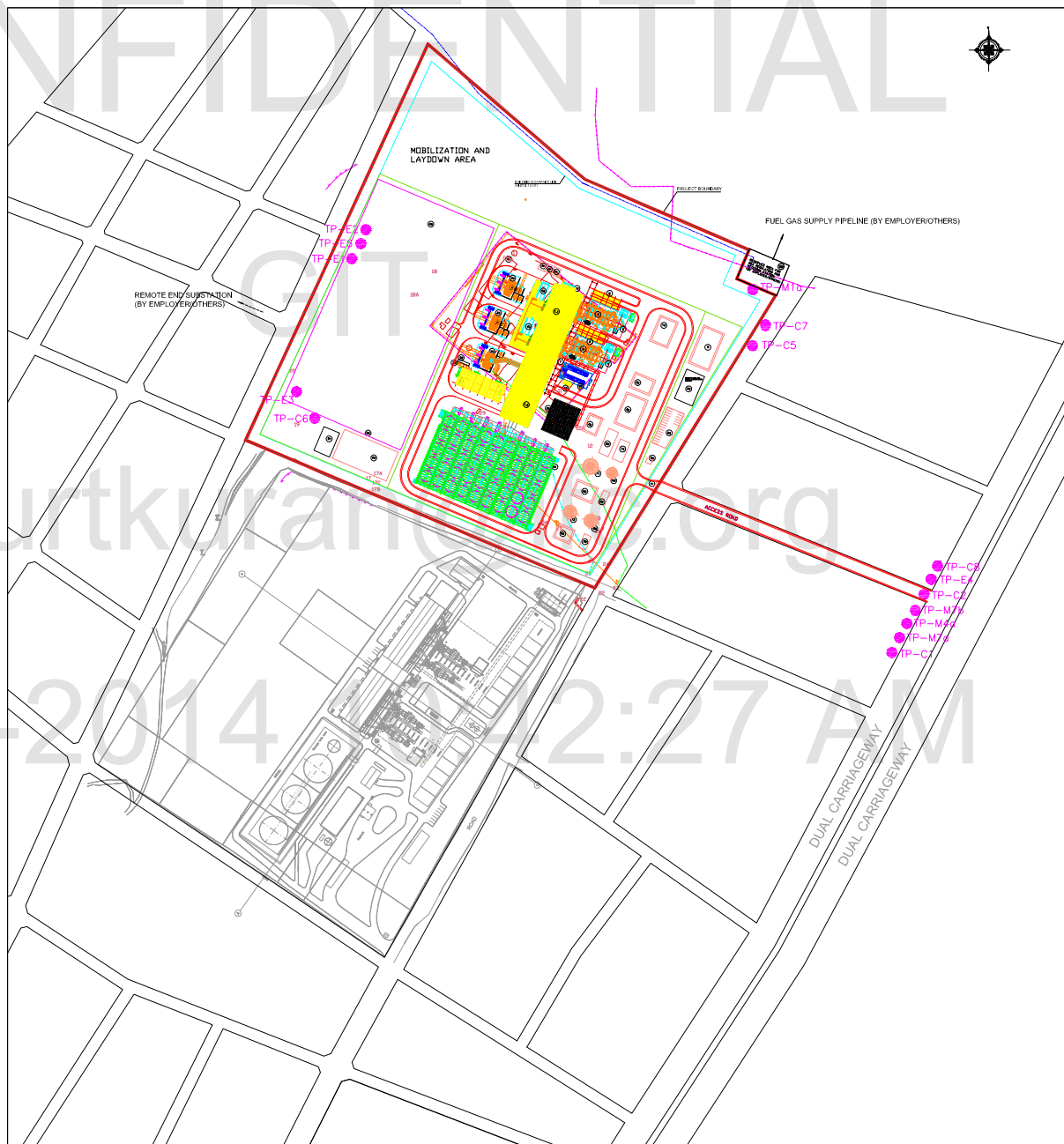
Appendix A

İç Anadolu CCPP Layout

CONFIDENTIAL

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- LEGEND
- 1. TYPING BUILDING-ST. HALL
 - 2. TYPING BUILDING-ST. HALL
 - 3. ELECTRICAL BUILDING
 - 4. WAREHOUSE
 - 5. STAGE
 - 6. GEAR TEST WATER PUMP HOUSE
 - 7. PIPE ROAD
 - 8. WAREHOUSE AND WAREHOUSE BUILDING
 - 9. THE BUILDING WITH ADMINISTRATIVE FACILITIES
 - 10. MET. HED
 - 11. NEW TRANSFORMER
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- TERMINAL POINTS
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 - TP-04: EXISTING WATER SUPPLY
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 - TP-100: EXISTING WATER SUPPLY

PRELIMINARY FOR PROPOSAL ONLY

NO.	DESCRIPTION	DATE	BY	CHKD.
1	PREPARED BY			
2	CHECKED BY			
3	APPROVED BY			
4	DATE			
5	SCALE			
6	PROJECT NO.			
7	PROJECT NAME			
8	PROJECT LOCATION			
9	PROJECT STATUS			
10	PROJECT OWNER			
11	PROJECT CONTACT			
12	PROJECT PHONE			
13	PROJECT FAX			
14	PROJECT E-MAIL			
15	PROJECT WEBSITE			
16	PROJECT ADDRESS			
17	PROJECT CITY			
18	PROJECT STATE			
19	PROJECT COUNTRY			
20	PROJECT ZIP CODE			
21	PROJECT POSTAL CODE			
22	PROJECT PROJECTOR			
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Appendix B

Noise Modeling Input and Output Files

Sound Power Level of each Noise Source

Source	Source Type	Sound Pressure Level (dB)									Lw (dBA)
		Octave Band Centre Frequency (Hz)									
		31	63	125	250	500	1000	2000	4000	8000	
RMS - West Facade	Area	23.2	32.4	43.4	47.8	47.1	48.3	50.3	52.8	45.9	57.3
RMS - Roof	Area	27.2	36.4	47.4	51.8	51.1	52.3	54.3	56.8	49.9	61.3
RMS - South Facade	Area	24.2	33.4	44.4	48.8	48.1	49.3	51.3	53.8	46.9	58.3
RMS - East Facade	Area	23.2	32.4	43.4	47.8	47.1	48.3	50.3	52.8	45.9	57.3
RMS - North Facade	Area	24.2	33.4	44.4	48.8	48.1	49.3	51.3	53.8	46.9	58.3
Turbine Hall 1 North Facade	Area	66	84.8	89.2	90.4	88.9	86.1	81.1	83.7	78.4	95.8
Exhaust Compartment Vent Fans 1	Point	32.9	47.1	58.2	66.7	72.1	75.3	74.5	70.3	67.2	80
Exhaust Compartment Vent Fans 2	Point	32.9	47.1	58.2	66.7	72.1	75.3	74.5	70.3	67.2	80
Roof Exhaust Vent Fan 1	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Roof Exhaust Vent Fan 2	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Roof Exhaust Vent Fan 3	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Roof Exhaust Vent Fan 4	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Roof Exhaust Vent Fan 5	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Roof Exhaust Vent Fan 6	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Load Compartment Vent Fan 1	Point	45.9	60.1	71.2	79.7	85.1	88.3	87.5	83.3	80.2	93
Load Compartment Vent Fan 2	Point	45.9	60.1	71.2	79.7	85.1	88.3	87.5	83.3	80.2	93
Turbine Hall 1 West Facade	Area	69.8	88.7	93	94.2	92.6	89.8	84.8	87.3	82	99.6
Turbine Hall 1 South Facade	Area	65.6	84.4	88.8	89.9	88.4	85.5	80.5	82.8	76.8	95.3
Turbine Hall 1 East Facade	Area	69.6	88.4	92.8	94	92.6	89.8	84.7	87.1	81.3	99.5
Turbine Hall 2 North Facade	Area	62.2	81.2	85.5	86.1	84.3	80.4	74.8	76.9	69.9	91.4
Roof Exhaust Vent Fan 7	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Roof Exhaust Vent Fan 8	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Roof Exhaust Vent Fan 9	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Roof Exhaust Vent Fan 10	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Roof Exhaust Vent Fan 11	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Roof Exhaust Vent Fan 12	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Lube Oil Module Vent Fan	Point	37.9	52.1	63.2	71.7	77.1	80.3	79.5	75.3	72.2	85
Steam Gland Condenser Vent	Point	50.9	65.1	76.2	84.7	90.1	93.3	92.5	88.3	85.2	98

Turbine Hall 2 West Facade	Area	66.4	85.4	89.6	90.3	88.4	84.5	78.8	81	74.6	95.5
Turbine Hall 2 South Facade	Area	62.6	81.6	85.8	86.4	84.4	80.2	74.5	76	68.1	91.5
Turbine Hall 2 East Facade	Area	66	84.9	89.2	89.9	88	84.2	78.6	80.8	74.3	95.1
HRSO 1 North Facade	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 1 Roof	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 1 North West Facade 1	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 1 North West Facade 2	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 1 West Facade	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 1 South West Facade 2	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 1 South West Facade 1	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 1 South Facade	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 1 East Facade	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 2 North Facade	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 2 Roof	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 2 North West Facade 1	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 2 North West Facade 2	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 2 West Facade	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 2 South West Facade 2	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 2 South West Facade 1	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 2 South West	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
HRSO 2 East Facade	Area	74.4	86.6	91.7	93.8	98.6	100.2	98	97.8	95.7	105.8
Stack Top 1	Point	52.4	69.6	81.7	89.2	93.6	94.8	94	89.8	81.7	100
Stack Top 2	Point	52.4	69.6	81.7	89.2	93.6	94.8	94	89.8	81.7	100
Boiler Feed Pump House 1 North Facade	Area	45.7	64.9	68.9	73.3	73.5	70.7	66.7	71	66.7	79.5
Boiler Feed Pump House 1 Roof	Area	49	68.1	72.1	76.5	76.8	74	70	74.4	70.4	82.8
Boiler Feed Pump House 1 West Facade	Area	40	59.2	63.2	67.5	67.7	64.8	60.7	64.8	59.7	73.5
Boiler Feed Pump House 1 South Facade	Area	46.1	65.3	69.3	73.7	74	71.1	67.1	71.5	67.4	79.9
Boiler Feed Pump House 1 East Facade	Area	42.3	61.5	65.5	69.9	70.2	67.3	63.4	67.8	63.7	76.1
Boiler Feed Pump House 2 North Facade	Area	45.3	64.5	68.5	72.9	73.1	70.3	66.2	70.5	66.1	79
Boiler Feed Pump House 2 Roof	Area	48.1	67.3	71.2	75.6	75.9	73	69	73.3	69	81.8
Boiler Feed Pump House 2 West Facade	Area	40.1	59.3	63.3	67.6	67.8	64.9	60.8	64.9	59.9	73.6
Boiler Feed Pump House 2 South Facade	Area	46.3	65.5	69.5	73.9	74.2	71.3	67.3	71.7	67.6	80.1
Boiler Feed Pump House 2 East Facade	Area	40	59.2	63.1	67.4	67.6	64.8	60.7	64.7	59.6	73.5

Transformer GT1 North Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer GT1 Roof	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer GT1 West Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer GT1 South Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer GT1 East Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer GT2 North Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer GT2 Roof	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer GT2 West Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer GT2 South Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer GT2 East Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer ST North Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer ST Roof	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer ST West Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer ST South Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
Transformer ST East Facade	Area	62.2	81.4	93.5	96	101.4	98.6	94.8	89.6	80.5	105
FinFan Cooler GTG1	Area	52.9	66.9	78.2	86.8	92.2	95.4	94.6	90.2	87	100
FinFan Cooler GTG2	Area	52.9	66.9	78.2	86.8	92.2	95.4	94.6	90.2	87	100
FinFan Cooler STG	Area	52.9	66.9	78.2	86.8	92.2	95.4	94.6	90.2	87	100
ACC	Area	67.9	82.1	93.2	101.7	107.1	110.3	109.5	105.3	102.2	115
Inlet Filter 1	Area	32.5	46.7	57.8	65.3	73.7	82.9	86.1	85.9	83.8	91
Inlet Filter 2	Area	32.5	46.7	57.8	65.3	73.7	82.9	86.1	85.9	83.8	91
Turbine Hall 3 North Facade	Area	41.3	55.5	62.4	67.7	69.9	78	74.7	79.5	75.7	83.7
Gas Fuel Module Vent Fan 1	Point	35.9	50.1	61.2	69.7	75.1	78.3	77.5	73.3	70.2	83
Gas Fuel Module Vent Fan 2	Point	35.9	50.1	61.2	69.7	75.1	78.3	77.5	73.3	70.2	83
Turbine Hall 3 West Facade	Area	46.4	60.6	67.5	72.7	74.9	83	79.7	84.2	79.8	88.5
Turbine Hall 3 South Facade	Area	40.4	54.5	61.4	66.7	68.8	76.9	73.5	78	73.1	82.2
Turbine Hall 3 East Facade	Area	46.6	60.8	67.7	73	75.2	83.3	80	84.6	80.5	88.9
ACC Duct	Point	71.1	90.3	98.4	100.9	102.3	101.5	99.7	91.5	83.4	108
Piperack	Point	60.1	79.3	87.4	89.9	91.3	90.5	88.7	80.5	72.4	97

Predicted Operational Sound Pressure Level at each NSR

NSR-1											
No	Source Name	Sound Pressure Level (dB)									Total (dBA)
		Octave Band Centre Frequency (Hz)									
		31	63	125	250	500	1000	2000	4000	8000	
1	RMS - West Facade	-31.79	-24.91	-18.21	-18.27	-21.84	-23.39	-24.73	-28.2	-51.31	-13.02
2	RMS - Roof	-30.11	-21.25	-10.59	-6.47	-7.56	-7.08	-6.73	-9.28	-32.18	0.1
3	RMS - South Facade	-20.98	-11.8	-3.22	-1.01	0.05	1.73	2.78	1.31	-20.08	8.51
4	RMS - East Facade	-22.11	-12.93	-4.37	-1.35	-0.3	0.82	1.86	0.47	-20.61	7.75
5	RMS - North Facade	-27.95	-19.7	-11.84	-10.46	-12.42	-13.25	-14.58	-18.61	-42.53	-4.93
6	Turbine Hall 1 North Facade	3.07	21.74	26.2	29.54	28.07	24.92	18.64	13.79	-18.48	34.01
7	Exhaust Compartment Vent Fans 1	-38.57	-25.56	-15.83	-9.14	-6	-5.68	-11	-25.54	-58.18	-1.22
8	Exhaust Compartment Vent Fans 2	-38.05	-25.23	-15.68	-9.07	-5.97	-5.65	-11.02	-25.74	-59.06	-1.19
9	Roof Exhaust Vent Fan 1	-32.86	-18.87	-8.14	-0.34	3.93	5.26	0.74	-13.05	-45.48	9.12
10	Roof Exhaust Vent Fan 2	-33.35	-19.54	-9.11	-1.77	1.91	2.61	-2.51	-16.95	-50.61	6.77
11	Roof Exhaust Vent Fan 3	-32.95	-18.96	-8.23	-0.42	3.86	8.2	3.67	-10.24	-43.2	10.98
12	Roof Exhaust Vent Fan 4	-32.08	-18.69	-8.57	-1.46	2.07	2.72	-2.33	-16.7	-50.55	6.95
13	Roof Exhaust Vent Fan 5	-33.08	-20.18	-10.53	-3.85	-0.76	-0.42	-5.77	-20.56	-54.52	4.04
14	Roof Exhaust Vent Fan 6	-34.72	-23.47	-16.25	-11.87	-10.2	-9.53	-12.44	-24.65	-56.87	-4.43
15	Load Compartment Vent Fan 1	-35.03	-24.44	-16.24	-9.34	-5.14	-3.03	-6.01	-17.63	-47.32	0.85
16	Load Compartment Vent Fan 2	-24.68	-11.99	-2.54	4.04	7.07	7.38	2.01	-12.75	-46.18	11.86
17	Turbine Hall 1 West Facade	-4.39	10.6	11.34	10.94	8.75	5.23	-1.87	-7.23	-41.32	16.95
18	Turbine Hall 1 South Facade	-6.51	9.63	10.58	8.39	5.14	1.16	-6.08	-11.49	-45.73	15.14
19	Turbine Hall 1 East Facade	6.55	25.38	29.2	31.04	30.13	26.95	20.35	15.48	-16.81	36.15
20	Turbine Hall 2 North Facade	-6.91	9.92	12.22	11.09	7.62	2.27	-6	-11.91	-47.43	16.75
21	Roof Exhaust Vent Fan 7	-33.22	-19.24	-8.48	-0.63	3.72	5.14	0.64	-13.42	-47.1	8.95
22	Roof Exhaust Vent Fan 8	-33.93	-20.27	-10.22	-3.9	-2.02	-2.85	-8.86	-24.01	-59.11	2.53
23	Roof Exhaust Vent Fan 9	-32.62	-18.97	-8.46	-0.68	3.65	5.09	0.58	-13.65	-48.07	8.89
24	Roof Exhaust Vent Fan 10	-33.91	-20.04	-9.51	-2.04	1.78	2.6	-2.53	-17.44	-53.06	6.68
25	Roof Exhaust Vent Fan 11	-33.28	-19.47	-8.82	-0.96	3.44	4.94	0.44	-13.97	-49.26	8.7
26	Roof Exhaust Vent Fan 12	-33.5	-19.88	-9.51	-2.07	1.78	2.63	-2.53	-17.65	-54.14	6.68
27	Lube Oil Module Vent Fan	-33.97	-20.16	-9.75	-2.44	1.19	1.82	-3.46	-18.43	-53.99	6

28	Steam Gland Condenser Vent	-20.91	-7.06	3.41	10.8	14.53	15.26	10.06	-4.85	-40.33	19.39
29	Turbine Hall 2 West Facade	-4.44	10.73	10.65	8.67	5.01	-0.26	-8.38	-14.64	-51.4	15.5
30	Turbine Hall 2 South Facade	-1.9	13.9	13.66	11.37	6.39	-0.58	-10.25	-18.17	-57.23	18.29
31	Turbine Hall 2 East Facade	6.68	25.92	29.58	29.77	27.79	23.24	15.68	10.08	-24.59	34.93
32	HRSO 1 North Facade	17.4	30.18	36.08	38.93	43.74	44.77	40.76	33.73	6.77	49.08
33	HRSO 1 Roof	7.07	18.45	22.6	23.5	26.79	26.39	20.78	12.07	-16.11	31.85
34	HRSO 1 North West Facade 1	11.92	24.38	32.25	34.09	38.59	39.63	35.51	27.98	-0.82	44
35	HRSO 1 North West Facade 2	7.1	15.87	17.18	16.8	20.11	20.48	15.99	8.18	-20.67	26.07
36	HRSO 1 West Facade	7.85	16.66	17.87	16.72	19.02	19.13	14.72	6.82	-22.4	25.52
37	HRSO 1 South West Facade 2	8.43	17.87	19.59	19.01	21.22	20.33	14.8	6.48	-22.26	27.11
38	HRSO 1 South West Facade 1	9.61	19.4	21.3	20.73	22.82	21.69	15.85	7.31	-21.23	28.65
39	HRSO 1 South Facade	12.36	23.14	25.91	25.99	28.44	27.37	21.39	12.91	-14.25	33.83
40	HRSO 1 East Facade	14.1	26.98	31.42	33.72	38.21	39.5	35.63	29.16	3.88	43.85
41	HRSO 2 North Facade	16.56	29.85	35.08	37.76	42.47	43.64	39.7	32.51	5.28	47.93
42	HRSO 2 Roof	7.86	19.45	23.76	24.76	28.09	27.68	21.97	12.98	-16.09	33.09
43	HRSO 2 North West Facade 1	13.19	25.43	31.55	35.58	39.97	40.89	36.67	29	-0.11	45.19
44	HRSO 2 North West Facade 2	13.38	25.59	32.68	35.67	40.15	41.16	37.01	29.43	0.55	45.47
45	HRSO 2 West Facade	6.9	15.62	16.72	15.54	18.07	18.73	14.36	6.37	-23.38	24.69
46	HRSO 2 South West Facade 2	8.53	17.68	19.07	18.34	20.53	19.71	14.27	5.89	-23.42	26.55
47	HRSO 2 South West Facade 1	9.98	19.27	20.78	20.01	22.22	21.35	15.81	7.21	-22.27	28.2
48	HRSO 2 South West	13.08	23.78	26.42	26.49	29.01	27.95	21.77	12.67	-15.86	34.36
49	HRSO 2 East Facade	14.79	26.65	31.42	33.08	37.62	38.82	34.81	28.08	2.22	43.22
50	Stack Top 1	-16.4	-0.1	10.97	17.14	19.7	18.36	13.45	0.05	-34.65	23.99
51	Stack Top 2	-16.55	-0.21	10.9	17.15	19.8	18.53	13.64	0.12	-35.14	24.08
52	Boiler Feed Pump House 1 North Facade	-15.55	3.17	6.61	10.45	9.99	5.96	-0.75	-4.31	-34.14	15.17
53	Boiler Feed Pump House 1 Roof	-15.99	2.67	5.82	8.89	7.32	1.93	-6.15	-10.9	-41.38	13.16
54	Boiler Feed Pump House 1 West Facade	-26.91	-10.7	-10.25	-9.06	-11.59	-16.8	-23.77	-27.06	-57.34	-3.96
55	Boiler Feed Pump House 1 South Facade	-19.44	-3.21	-2.74	-1.28	-3.72	-9.11	-16.15	-19.06	-47.48	3.71
56	Boiler Feed Pump House 1 East Facade	-18.59	0.29	3.95	7.95	7.65	3.81	-2.56	-5.42	-33.51	12.76
57	Boiler Feed Pump House 2 North Facade	-16.22	2.43	5.79	9.45	8.71	4.28	-2.98	-7.26	-38.23	14.01
58	Boiler Feed Pump House 2 Roof	-14.78	3.55	6.26	8.85	6.88	1.1	-7.4	-12.83	-44.94	13.14
59	Boiler Feed Pump House 2 West Facade	-22.55	-5.96	-5.07	-3.7	-6.28	-12.13	-20.13	-24.14	-55.24	1.16
60	Boiler Feed Pump House 2 South Facade	-14.53	2.01	1.34	2.79	6.13	1.24	-6.36	-10.92	-42.32	10.27

61	Boiler Feed Pump House 2 East Facade	-18.92	-0.91	1.68	5.2	4.43	0.09	-7.02	-11.03	-41.44	9.86
62	Transformer GT1 North Facade	-13.52	1.35	9.09	9.97	15	11.49	5.41	-8.44	-49.08	18.37
63	Transformer GT1 Roof	-16.07	-1.06	7.13	8.58	13.51	9.98	3.9	-9.98	-50.71	16.83
64	Transformer GT1 West Facade	-26.73	-11.44	-2.7	-0.81	4.23	0.72	-5.39	-19.34	-60.37	7.46
65	Transformer GT1 South Facade	-26.63	-10.72	0.05	2.04	7.07	3.56	-2.52	-16.41	-57.19	10.27
66	Transformer GT1 East Facade	-13.87	1.15	9.69	11.57	16.6	13.09	7.03	-6.76	-47.16	19.84
67	Transformer GT2 North Facade	-10.38	4.5	11.35	11.75	16.68	13.01	6.82	-7.21	-48.38	20.13
68	Transformer GT2 Roof	-13.85	1.1	8.59	8.96	13.65	9.97	3.77	-10.3	-51.61	17.16
69	Transformer GT2 West Facade	-22.11	-7	0.52	1.61	6.56	2.91	-3.33	-17.48	-59.07	9.89
70	Transformer GT2 South Facade	-21.19	-6.18	0.73	1.77	6.67	2.98	-3.25	-17.35	-58.76	10.03
71	Transformer GT2 East Facade	-10.51	4.37	11.1	11.88	16.78	13.09	6.9	-7.08	-48.07	20.18
72	Transformer ST North Facade	-8.43	6.7	13.35	11.99	16.85	13.11	6.85	-7.23	-48.5	20.65
73	Transformer ST Roof	-11.44	3.71	10.84	9.74	14	10.14	3.83	-10.33	-51.79	17.92
74	Transformer ST West Facade	-19.85	-4.94	2.1	2.04	6.9	3.1	-3.25	-17.5	-59.24	10.41
75	Transformer ST South Facade	-18.47	-3.52	2.74	2.52	7.25	3.27	-3.13	-17.38	-59.01	10.82
76	Transformer ST East Facade	-7.61	7.54	13.73	12.54	17.22	13.3	6.98	-7.11	-48.26	21.03
77	FinFan Cooler GTG1	-16.8	-5.2	2.99	12.49	16.64	18.55	15.11	2.43	-29.2	22.36
78	FinFan Cooler GTG2	-17.63	-5.7	4.45	11.59	15.87	18.04	15.13	3.24	-26.7	21.89
79	FinFan Cooler STG	-15.52	-2.43	7.85	15.82	21.58	23.86	20.68	8.18	-22.93	27.45
80	ACC	-4.97	8.57	18.73	25.88	29.54	30.41	25.45	10.54	-25.54	34.52
81	Inlet Filter 1	-41.99	-32.17	-25.24	-18.59	-10.6	-2.05	-0.96	-9.24	-40.79	2.17
82	Inlet Filter 2	-42.18	-32.31	-25.36	-18.65	-10.72	-2.21	-1.17	-9.59	-41.67	1.98
83	Turbine Hall 3 North Facade	-24.56	-12.37	-7.95	-4.82	-4.79	0.88	-6.13	-10.77	-44.58	3.87
84	Gas Fuel Module Vent Fan 1	-46.19	-35.05	-27.32	-21.98	-17.02	-14.48	-17.37	-29.52	-61.63	-10.78
85	Gas Fuel Module Vent Fan 2	-38.95	-27.61	-20.38	-15.75	-13.88	-14.33	-17.59	-29.91	-62.6	-8.73
86	Turbine Hall 3 West Facade	-27.22	-16.94	-13.46	-10.17	-9.21	-2.12	-7.68	-11.43	-46.12	0.57
87	Turbine Hall 3 South Facade	-35.64	-25.49	-20.99	-16.86	-15.45	-8.18	-13.74	-17.62	-52.67	-5.66
88	Turbine Hall 3 East Facade	-22.9	-11.12	-6.71	-3.72	-3.44	2.72	-3.57	-7.54	-40.9	5.64
89	ACC Duct	4.41	23.17	30.51	31.65	31.17	27.79	21.5	2.27	-39.53	36.86
90	Piperack	-9.72	6.2	11.07	11.34	10.83	8.35	4	-11.72	-46.02	17.17

NSR-2

No	Source Name	Sound Pressure Level (dB)									Total (dBA)
		Octave Band Centre Frequency (Hz)									
		31	63	125	250	500	1000	2000	4000	8000	
1	RMS - West Facade	-49.27	-41.13	-31.8	-29.75	-33.45	-36.35	-42.46	-63.77	-150.01	-25.94
2	RMS - Roof	-47.9	-38.21	-28.69	-26.4	-29.85	-32.57	-38.57	-59.73	-145.67	-22.57
3	RMS - South Facade	-48.27	-40.15	-30.82	-28.78	-32.48	-35.38	-41.48	-62.71	-148.67	-24.96
4	RMS - East Facade	-53.65	-47.05	-39.32	-38.27	-42.58	-45.32	-49.94	-68.77	-152.25	
5	RMS - North Facade	-53.14	-46.62	-38.95	-37.97	-42.32	-44.87	-49.23	-67.95	-151.7	
6	Turbine Hall 1 North Facade	-15.4	0.26	2.66	2.01	-0.82	-5.33	-15.35	-31.84	-106.56	7.54
7	Exhaust Compartment Vent Fans 1	-45.96	-33.2	-21.66	-15.9	-13.73	-14.65	-23.15	-48.99	-123.29	-9.41
8	Exhaust Compartment Vent Fans 2	-46.26	-33.92	-22.74	-17.23	-15.21	-16.16	-24.5	-49.53	-118.8	-10.83
9	Roof Exhaust Vent Fan 1	-40.9	-28.07	-16.46	-10.63	-8.43	-9.34	-17.88	-43.92	-119.06	-4.12
10	Roof Exhaust Vent Fan 2	-40.93	-28.09	-16.46	-10.63	-8.43	-9.34	-17.88	-43.93	-119.1	-4.12
11	Roof Exhaust Vent Fan 3	-41.08	-28.49	-16.04	-10.46	-8.41	-9.38	-17.85	-43.16	-115.29	-4.06
12	Roof Exhaust Vent Fan 4	-41.08	-28.49	-17.1	-11.45	-9.35	-10.29	-18.72	-44.2	-116.26	-5.01
13	Roof Exhaust Vent Fan 5	-41.33	-29.08	-17.98	-12.51	-10.51	-11.47	-19.78	-44.67	-113.05	-6.12
14	Roof Exhaust Vent Fan 6	-41.33	-29.08	-17.97	-12.51	-8.82	-9.82	-18.28	-43.66	-112.87	-4.9
15	Load Compartment Vent Fan 1	-32.99	-20.26	-8.75	-3.02	-0.86	-1.79	-10.27	-36.03	-109.83	3.46
16	Load Compartment Vent Fan 2	-33.31	-21.04	-9.91	-4.43	-2.42	-3.38	-11.7	-36.63	-105.25	1.96
17	Turbine Hall 1 West Facade	-12.95	2.61	6.26	6.12	3.65	-0.71	-10.45	-26.09	-97.69	11.29
18	Turbine Hall 1 South Facade	-9.7	5.91	9.05	6.84	2.08	-3.63	-13.75	-29.01	-98.79	12.78
19	Turbine Hall 1 East Facade	-8.02	9.62	12	9.95	5.72	0.25	-9.81	-25.68	-97.49	16.02
20	Turbine Hall 2 North Facade	-19.61	-4.15	0	-1.16	-4.07	-9.3	-19.56	-34.91	-105.62	4.28
21	Roof Exhaust Vent Fan 7	-41.77	-29.94	-19.13	-10.96	-8.96	-9.93	-18.26	-42.49	-110.02	-4.72
22	Roof Exhaust Vent Fan 8	-41.77	-29.94	-19.12	-13.83	-11.91	-12.89	-21.12	-44.44	-110.66	-7.49
23	Roof Exhaust Vent Fan 9	-42.54	-31.27	-20.82	-15.69	-13.85	-14.83	-22.49	-43.4	-107.42	-9.36
24	Roof Exhaust Vent Fan 10	-42.54	-31.27	-20.82	-15.69	-13.84	-14.83	-22.5	-43.42	-107.47	-9.36
25	Roof Exhaust Vent Fan 11	-44.44	-33.86	-23.73	-18.74	-16.95	-17.07	-22.08	-42.38	-104.23	-11.93
26	Roof Exhaust Vent Fan 12	-44.44	-33.85	-23.73	-18.74	-16.94	-17.08	-22.09	-42.4	-104.28	-11.93
27	Lube Oil Module Vent Fan	-41.95	-30.26	-19.54	-14.29	-12.39	-13.38	-21.57	-44.16	-109.78	-7.96
28	Steam Gland Condenser Vent	-29.15	-17.6	-6.97	-1.76	0.11	-0.88	-9.03	-30.89	-95.93	4.56
29	Turbine Hall 2 West Facade	-14.97	0.29	3.41	2.62	-0.29	-5.52	-15.51	-29.93	-96.94	8.04

30	Turbine Hall 2 South Facade	-17.03	-2.04	0.31	-0.66	-3.66	-9.14	-19.12	-33.44	-99.27	4.97
31	Turbine Hall 2 East Facade	-10.37	4.89	7.45	4.68	0.3	-5.47	-15.61	-30	-97.09	11.16
32	HRSO 1 North Facade	-6.76	3.49	5.51	5.73	9.06	8.89	1.68	-17.45	-88.49	14.32
33	HRSO 1 Roof	0.52	14.32	19.27	20.13	23.07	21.63	12.45	-8.99	-82.32	27.65
34	HRSO 1 North West Facade 1	-7.32	1.69	5.2	5.52	8.95	8.84	1.67	-17.4	-88.3	14.07
35	HRSO 1 North West Facade 2	-7.45	1.56	5.14	5.49	8.94	8.84	1.7	-17.35	-88.13	14.05
36	HRSO 1 West Facade	-6.4	3.33	7.13	7.37	10.43	9.86	2.29	-16.94	-87.6	15.5
37	HRSO 1 South West Facade 2	-1.49	8.94	12.95	12.69	14.88	13.37	4.74	-15.38	-86.46	20.1
38	HRSO 1 South West Facade 1	-1.59	8.84	12.81	12.58	14.83	13.34	4.72	-15.35	-86.3	20.02
39	HRSO 1 South Facade	-1.56	9.75	12.72	12.51	14.81	13.33	4.73	-15.3	-86.14	20.06
40	HRSO 1 East Facade	-5.74	4.45	6.47	6.51	9.61	9.26	1.94	-17.13	-87.73	14.93
41	HRSO 2 North Facade	-2.05	7.45	9.41	8.84	11.31	11.05	4	-14.58	-83.29	17.11
42	HRSO 2 Roof	0.74	15.72	20.06	20.33	22.64	20.66	11.16	-10.13	-81.46	27.49
43	HRSO 2 North West Facade 1	-7	1.92	5.49	5.88	9.37	9.35	2.41	-15.84	-83.7	14.5
44	HRSO 2 North West Facade 2	-7.1	1.81	5.44	5.85	9.37	9.36	2.43	-15.78	-83.52	14.49
45	HRSO 2 West Facade	-6.18	3.33	6.98	7.14	10.25	9.89	2.71	-15.56	-83.11	15.42
46	HRSO 2 South West Facade 2	0.71	10.51	14.52	13.54	14.98	12.72	4.19	-14.84	-82.55	20.65
47	HRSO 2 South West Facade 1	0.68	10.47	14.46	13.48	14.91	12.66	4.18	-14.81	-82.39	20.6
48	HRSO 2 South West	0.72	12.4	14.62	13.74	15.38	13.47	5.25	-13.83	-81.93	21.18
49	HRSO 2 East Facade	-5.15	5.86	7.9	8.13	11.41	11.22	4.11	-14.43	-82.72	16.68
50	Stack Top 1	-26.26	-6.78	5	11.86	15.33	14.74	8.38	-15.76	-94.25	19.52
51	Stack Top 2	-25.85	-6.36	5.48	12.48	16.18	16.01	10.51	-11.78	-85.78	20.58
52	Boiler Feed Pump House 1 North Facade	-37.59	-20.01	-19.18	-15.79	-16.39	-20.86	-29.95	-44.91	-119.39	-10.92
53	Boiler Feed Pump House 1 Roof	-37.16	-19.52	-18.72	-15.24	-16.04	-20.49	-29.51	-44.25	-118.06	-10.47
54	Boiler Feed Pump House 1 West Facade	-43.71	-27.83	-25.07	-21.69	-22.28	-26.7	-35.84	-50.91	-125.73	-17.01
55	Boiler Feed Pump House 1 South Facade	-36.99	-19.5	-18.59	-15.17	-15.79	-20.25	-29.27	-43.93	-117.41	-10.33
56	Boiler Feed Pump House 1 East Facade	-40.47	-23.14	-22.32	-18.89	-19.59	-24.1	-33.14	-47.9	-121.74	-14.08
57	Boiler Feed Pump House 2 North Facade	-35.02	-18.16	-17.57	-14.26	-14.81	-19.19	-28.09	-42.34	-114.25	-9.31
58	Boiler Feed Pump House 2 Roof	-34.81	-17.98	-17.37	-14.31	-15.03	-19.4	-28.27	-42.42	-113.94	-9.35
59	Boiler Feed Pump House 2 West Facade	-43.22	-27.39	-24.59	-21.17	-21.73	-26.08	-35	-49.21	-120.93	-16.48
60	Boiler Feed Pump House 2 South Facade	-34.36	-17.42	-16.64	-13.12	-13.69	-18.06	-26.89	-40.91	-111.87	-8.25
61	Boiler Feed Pump House 2 East Facade	-40.27	-23.45	-22.75	-19.29	-19.99	-24.41	-33.4	-47.82	-120.18	-14.46
62	Transformer GT1 North Facade	-32.82	-16.89	-6.5	-7.53	-2.92	-7.27	-16.01	-40.01	-117.63	0.58

63	Transformer GT1 Roof	-25.83	-10.07	0.91	-0.09	1.64	-5.52	-14.31	-38.17	-115.28	6.12
64	Transformer GT1 West Facade	-26.22	-10.33	0.28	-0.73	3.85	-0.47	-9.17	-33.04	-110.18	7.37
65	Transformer GT1 South Facade	-13.38	2.21	13.02	11.94	13.72	7.49	-1.18	-24.9	-101.51	18.28
66	Transformer GT1 East Facade	-15.61	0.03	10.84	9.77	11.54	5.01	-3.7	-27.55	-104.63	16.08
67	Transformer GT2 North Facade	-32.58	-16.75	-6.43	-6.87	-2.23	-6.51	-15.03	-38.2	-112.81	1.17
68	Transformer GT2 Roof	-26.82	-11.37	-0.61	-1.63	0.1	-5.09	-13.58	-36.62	-110.75	4.79
69	Transformer GT2 West Facade	-26.4	-10.61	-0.1	-0.48	4.15	-0.09	-8.57	-31.61	-105.74	7.54
70	Transformer GT2 South Facade	-14.47	0.87	11.45	10.33	12.26	8.01	-0.44	-23.34	-96.93	17
71	Transformer GT2 East Facade	-16.51	-1.13	9.45	8.35	10.16	5.65	-2.84	-25.87	-99.93	14.92
72	Transformer ST North Facade	-33.33	-17.63	-7.5	-6.83	-2.15	-6.35	-14.65	-36.98	-108.51	1.07
73	Transformer ST Roof	-30.21	-14.68	-4.12	-4.77	-0.34	-4.55	-12.82	-35.01	-106.06	3.18
74	Transformer ST West Facade	-26.71	-11.05	-0.75	0.1	4.8	0.64	-7.62	-29.82	-100.87	7.99
75	Transformer ST South Facade	-18.21	-2.65	7.62	8.05	12.74	8.55	0.32	-21.73	-92.25	15.99
76	Transformer ST East Facade	-20.15	-4.58	5.74	5.53	10.19	5.99	-2.28	-24.46	-95.45	13.56
77	FinFan Cooler GTG1	-33.78	-17.43	-10.02	-4.01	-0.77	0.53	-4.77	-26.14	-89.86	4.5
78	FinFan Cooler GTG2	-32.62	-19.14	-12.08	-6.05	-2.13	-0.45	-5.63	-26.65	-89.98	3.25
79	FinFan Cooler STG	-28.79	-13.24	-2.49	5.58	10.25	12.05	6.74	-14.23	-76.55	15.52
80	ACC	-8.67	5.45	18.76	26.81	31.57	33.52	28.64	9.37	-47.2	36.97
81	Inlet Filter 1	-49.44	-38.52	-28.72	-23.36	-16.18	-8.49	-10.19	-29.17	-99.77	-5.71
82	Inlet Filter 2	-50.16	-39.41	-29.35	-23.28	-15.74	-7.97	-9.46	-27.61	-95.2	-5.12
83	Turbine Hall 3 North Facade	-37.45	-25.47	-18.85	-16.51	-17.36	-12.19	-21.09	-35.72	-108.86	-9.02
84	Gas Fuel Module Vent Fan 1	-42.83	-29.81	-17.98	-12	-9.68	-10.5	-18.91	-44.55	-118.33	-5.38
85	Gas Fuel Module Vent Fan 2	-42.99	-30.36	-18.92	-13.23	-11.09	-11.98	-20.24	-45.09	-115.04	-6.74
86	Turbine Hall 3 West Facade	-35.31	-24.42	-18.95	-15.45	-14.57	-8.04	-16.07	-29.69	-100.44	-5.8
87	Turbine Hall 3 South Facade	-34.29	-23.09	-17.49	-15.64	-17.04	-12.44	-21.19	-34.49	-102.95	-8.69
88	Turbine Hall 3 East Facade	-29.02	-17.21	-11.63	-9.56	-10.73	-5.91	-14.95	-29.08	-99.58	-2.41
89	ACC Duct	-10.44	4.76	10.72	12.35	12.99	11.05	5.16	-18.83	-84.48	18.33
90	Piperack	-21.11	-5.3	0.37	0.24	0.62	-1.73	-8.42	-35.24	-111.22	6.45

NSR-3

No	Source Name	Sound Pressure Level (dB)									Total (dBA)
		Octave Band Centre Frequency (Hz)									
		31	63	125	250	500	1000	2000	4000	8000	
1	RMS - West Facade	-58.92	-52.8	-46.64	-46.16	-49.34	-50.51	-56.27	-82.99	-196.04	
2	RMS - Roof	-57.55	-51.4	-44.97	-44.2	-47.93	-49.51	-55.34	-82.15	-195.5	
3	RMS - South Facade	-59.68	-53.65	-48.37	-46.01	-48.08	-49.47	-55.28	-82.04	-195.19	
4	RMS - East Facade	-60.88	-54.84	-49.35	-46.87	-48.97	-50.52	-56.37	-83.28	-196.97	
5	RMS - North Facade	-59.17	-53.08	-46.88	-46.34	-48.4	-49.73	-55.48	-82.31	-195.88	
6	Turbine Hall 1 North Facade	-17.69	-0.26	0.78	-0.26	-3.57	-8.25	-20	-42.85	-140.77	5.68
7	Exhaust Compartment Vent Fans 1	-43.27	-26.84	-16.1	-8.3	-3.87	-2.55	-9.9	-39.39	-134.85	0.94
8	Exhaust Compartment Vent Fans 2	-42.71	-26.59	-15.88	-8.08	-3.63	-2.28	-9.48	-38.42	-131.87	1.21
9	Roof Exhaust Vent Fan 1	-38.39	-21.96	-11.29	-3.64	2.62	3.63	-4.23	-34.53	-131.46	7.01
10	Roof Exhaust Vent Fan 2	-38.88	-22.86	-12.94	-6.44	-3.82	-4.75	-14.64	-46.77	-144.6	0.28
11	Roof Exhaust Vent Fan 3	-38.15	-21.78	-11.11	-3.43	0.77	1.67	-6.33	-36.62	-132.49	5.36
12	Roof Exhaust Vent Fan 4	-38.66	-22.69	-12.78	-6.28	-3.64	1.2	-6.69	-36.57	-132.43	3.54
13	Roof Exhaust Vent Fan 5	-37.65	-21.52	-10.82	-3.01	1.45	2.82	-4.34	-33.09	-125.87	6.3
14	Roof Exhaust Vent Fan 6	-38.39	-22.51	-12.61	-6.11	-3.46	-4.34	-14.03	-45.35	-140.27	0.66
15	Load Compartment Vent Fan 1	-30.23	-13.82	-3.08	4.72	9.15	10.48	3.14	-26.29	-121.53	13.97
16	Load Compartment Vent Fan 2	-29.69	-13.56	-2.86	4.95	9.4	10.76	3.57	-25.3	-118.51	14.24
17	Turbine Hall 1 West Facade	-9.98	8.19	10.3	8.95	4.89	-1.27	-13.84	-36.81	-132.19	14.64
18	Turbine Hall 1 South Facade	-12.5	6.16	8.81	8.15	4.82	-0.62	-12.56	-34.98	-129.87	13.48
19	Turbine Hall 1 East Facade	-13.77	3.41	4.58	3.6	0.34	-4.86	-16.61	-39.29	-136.26	9.46
20	Turbine Hall 2 North Facade	-21.95	-4.24	-3.11	-4.5	-8.04	-13.97	-26.04	-48.15	-143.67	1.54
21	Roof Exhaust Vent Fan 7	-37.53	-21.41	-10.71	-2.89	1.58	2.97	-4.11	-32.58	-124.29	6.45
22	Roof Exhaust Vent Fan 8	-37.47	-21.34	-10.63	-2.8	1.67	3.08	-3.95	-32.2	-123.14	6.55
23	Roof Exhaust Vent Fan 9	-38.82	-22.88	-13.18	-6.94	-4.54	-5.58	-15.27	-46.21	-139.49	-0.39
24	Roof Exhaust Vent Fan 10	-37.32	-21.2	-10.48	-2.65	1.84	3.28	-3.65	-31.52	-121.07	6.75
25	Roof Exhaust Vent Fan 11	-41.54	-26.91	-18.47	-13.27	-11.59	-13.05	-22.89	-51.45	-140.45	-7.27
26	Roof Exhaust Vent Fan 12	-41.5	-26.87	-18.43	-13.23	-11.54	-12.98	-22.77	-51.06	-139.26	-7.21
27	Lube Oil Module Vent Fan	-37.39	-21.26	-8.68	-0.85	3.63	5.05	-1.95	-30.1	-120.62	8.52
28	Steam Gland Condenser Vent	-24.37	-8.24	2.47	12.14	16.62	18.04	11.03	-17.13	-107.65	21.48
29	Turbine Hall 2 West Facade	-8.83	13.07	16.56	16.06	12.65	6.37	-5.97	-28	-121.49	21.11

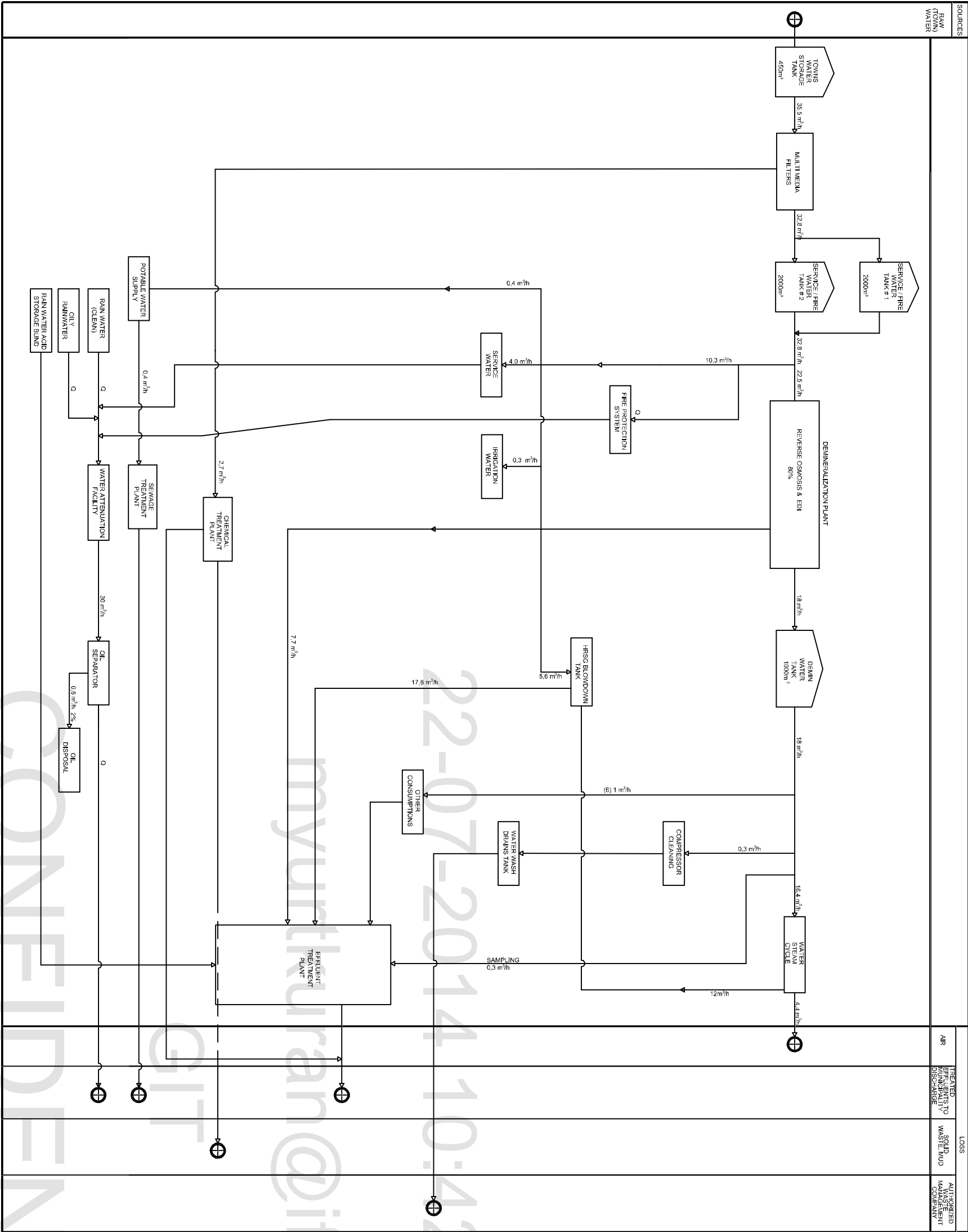
30	Turbine Hall 2 South Facade	-20.32	-2.32	-1.49	-3.75	-7.56	-13.71	-25.59	-47.34	-140.38	2.9
31	Turbine Hall 2 East Facade	-17.25	0.21	1.21	-0.3	-3.95	-9.96	-22.01	-43.81	-137.93	5.83
32	HRSO 1 North Facade	-9.59	0.85	2.89	2.87	5.85	5.11	-3.98	-30.12	-126.72	11.04
33	HRSO 1 Roof	-1.52	12.56	17.25	18.63	22.44	22.13	13.28	-12.59	-108.41	27.03
34	HRSO 1 North West Facade 1	-10.23	0.44	2.63	2.74	5.84	5.18	-3.79	-29.58	-125.04	10.96
35	HRSO 1 North West Facade 2	-10.09	0.69	3.11	3.37	6.59	6.01	-2.89	-28.54	-123.51	11.63
36	HRSO 1 West Facade	-1.49	11.31	15.01	15.57	18.76	18.01	8.91	-16.83	-111.54	23.59
37	HRSO 1 South West Facade 2	-3.34	8.34	12.5	13.63	17.37	17.05	8.29	-17.19	-111.58	22.05
38	HRSO 1 South West Facade 1	-2.5	9.44	13.45	14.4	17.92	17.43	8.52	-17.15	-111.89	22.64
39	HRSO 1 South Facade	-1.67	11.06	14.79	15.4	18.64	17.94	8.86	-17.1	-112.79	23.45
40	HRSO 1 East Facade	-8.54	1.64	3.49	3.29	6.11	5.24	-3.95	-30.24	-126.88	11.4
41	HRSO 2 North Facade	-9.28	1.13	3.13	5.53	7.75	6.38	-2.93	-28.61	-123.49	12.52
42	HRSO 2 Roof	-1.33	12.75	17.44	19.28	23.29	23.01	14.27	-11.17	-105.29	27.78
43	HRSO 2 North West Facade 1	-9.94	0.7	2.88	4.18	6.85	5.89	-3.03	-28.35	-121.97	11.78
44	HRSO 2 North West Facade 2	-9.85	0.88	3.23	3.43	6.59	5.99	-2.81	-27.94	-120.95	11.67
45	HRSO 2 West Facade	-1.58	10.96	14.66	15.27	18.52	17.83	8.92	-16.24	-108.91	23.34
46	HRSO 2 South West Facade 2	-3.99	7.54	11.58	12.73	16.47	16.17	7.54	-17.4	-109.82	21.16
47	HRSO 2 South West Facade 1	-3.02	8.67	12.59	13.5	17.03	16.56	7.76	-17.37	-110.14	21.76
48	HRSO 2 South West	-1.64	10.83	14.54	15.18	18.51	17.87	8.93	-16.53	-110.38	23.31
49	HRSO 2 East Facade	-8.02	2.11	3.87	3.65	6.43	5.56	-3.52	-29.29	-124	11.75
50	Stack Top 1	-24.08	-5.16	6.43	13.15	16.54	15.81	8.3	-21.88	-124.97	20.62
51	Stack Top 2	-23.86	-4.96	6.64	13.38	16.79	16.1	8.74	-20.88	-121.95	20.89
52	Boiler Feed Pump House 1 North Facade	-39.85	-21.93	-22.06	-18.8	-19.65	-24.62	-35.49	-57.34	-157.04	-13.93
53	Boiler Feed Pump House 1 Roof	-39.65	-21.84	-21.49	-18.21	-19.29	-24.26	-35.07	-56.75	-155.9	-13.5
54	Boiler Feed Pump House 1 West Facade	-44.98	-27.17	-27.6	-24.48	-25.35	-30.3	-41.21	-62.99	-162.32	-19.51
55	Boiler Feed Pump House 1 South Facade	-39.97	-22.32	-21.5	-18.22	-19.1	-24.07	-34.89	-56.54	-155.52	-13.5
56	Boiler Feed Pump House 1 East Facade	-42.67	-25.24	-25.13	-21.9	-22.9	-27.96	-38.88	-60.82	-160.87	-17.12
57	Boiler Feed Pump House 2 North Facade	-39.64	-20.33	-20.1	-17.53	-18.38	-23.3	-34.06	-55.48	-153.55	-12.49
58	Boiler Feed Pump House 2 Roof	-39.8	-20.87	-20.08	-17.51	-18.8	-23.74	-34.48	-55.8	-153.52	-12.71
59	Boiler Feed Pump House 2 West Facade	-44.66	-26.96	-25.57	-22.55	-23.4	-28.31	-39.09	-60.44	-158.13	-17.81
60	Boiler Feed Pump House 2 South Facade	-39.36	-21.76	-20.74	-16.94	-17.79	-22.72	-33.41	-54.59	-151.82	-12.38
61	Boiler Feed Pump House 2 East Facade	-44	-24.49	-24.54	-22.35	-23.39	-28.42	-39.36	-61.21	-160.72	-17.2
62	Transformer GT1 North Facade	-25.7	-7.22	1.75	0.95	2.74	-4.01	-15.14	-45.13	-143.04	7.19

63	Transformer GT1 Roof	-13.56	5.79	17.54	19.33	23.71	18.93	8.49	-21.86	-121.93	26.69
64	Transformer GT1 West Facade	-10.52	10.72	22.2	23.7	27.67	22.32	11.18	-19.65	-118.81	30.72
65	Transformer GT1 South Facade	-7.73	12.61	24.2	25.81	29.96	24.88	14.1	-16.44	-115.91	32.98
66	Transformer GT1 East Facade	-10.87	8.18	19.87	21.63	26	21.21	10.74	-19.69	-119.96	28.98
67	Transformer GT2 North Facade	-23.63	-5.74	3.28	2.48	4.32	-2.28	-13.04	-42.53	-138.9	8.76
68	Transformer GT2 Roof	-18.49	1.46	13.17	14.95	19.32	14.51	4.12	-25.71	-123.39	22.3
69	Transformer GT2 West Facade	-10.39	10.86	22.31	23.78	27.74	22.41	11.4	-18.88	-115.99	30.8
70	Transformer GT2 South Facade	-10.31	10.93	22.4	23.9	27.89	22.6	11.66	-18.53	-115.45	30.95
71	Transformer GT2 East Facade	-13.58	5.44	17.06	18.76	23.05	18.13	7.51	-22.82	-121.77	26.04
72	Transformer ST North Facade	-25.59	-6.98	2.12	1.38	3.24	-3.4	-14.26	-43.28	-137.64	7.64
73	Transformer ST Roof	-20.89	-1.89	8.29	8.85	12.28	6.91	-3.82	-33.48	-129.27	15.72
74	Transformer ST West Facade	-11.78	9.24	20.6	22.09	26.08	20.76	9.79	-20.22	-116	29.13
75	Transformer ST South Facade	-16.94	2.61	11.35	10.32	12.17	6.56	-3.38	-32	-126.18	16.79
76	Transformer ST East Facade	-20.52	-3.58	5.26	4.24	6.06	0.37	-9.86	-38.92	-134.7	10.68
77	FinFan Cooler GTG1	-34.02	-20.95	-13.5	-7.5	-3.34	-2.13	-9.34	-38.2	-130.6	1.53
78	FinFan Cooler GTG2	-33.59	-20.52	-13.06	-7.45	-3.39	-2.21	-9.47	-38.51	-131.55	1.5
79	FinFan Cooler STG	-34.81	-22.63	-15.6	-8.03	-3.89	-2.71	-9.89	-38.54	-130.11	0.92
80	ACC	-7.01	7.69	18.38	26.24	30.77	32.31	25.74	-0.7	-84.68	35.76
81	Inlet Filter 1	-53.47	-39.84	-32.31	-26.35	-19.07	-11.8	-15.04	-39.95	-132.23	-9.47
82	Inlet Filter 2	-53.47	-39.85	-32.32	-26.12	-18.83	-11.51	-14.6	-38.95	-129.18	-9.15
83	Turbine Hall 3 North Facade	-42.47	-29.62	-25.89	-22.83	-22.49	-16.67	-26.54	-46.71	-141.36	-14.16
84	Gas Fuel Module Vent Fan 1	-39.72	-23.57	-12.86	-5.05	-0.6	0.76	-4.77	-33.94	-127.85	4.42
85	Gas Fuel Module Vent Fan 2	-39.51	-23.36	-12.65	-4.83	-0.36	1.05	-5.99	-34.3	-125.45	4.52
86	Turbine Hall 3 West Facade	-26.15	-9.95	-3.48	1.07	2.22	8.41	-1.28	-21.11	-114.09	10.49
87	Turbine Hall 3 South Facade	-32.51	-16.19	-9.79	-5.33	-4.23	1.98	-7.6	-27.1	-119.2	4.07
88	Turbine Hall 3 East Facade	-37.07	-24.18	-20.4	-17.35	-17.01	-11.17	-20.79	-40.72	-134.27	-8.66
89	ACC Duct	-14.84	2.39	7.18	8.6	8.99	6.48	-1.35	-32.84	-125.91	14.37
90	Piperack	-27.68	-8.13	-3.81	-2.73	-2.63	-5.49	-13.94	-47.55	-148.33	2.95

Appendix C

Water Mass Balance

KIRIKKALE 209FB CCGT WATER MASS BALANCE



1		FLOW RATES CORRECTED	19.06.2012	TASDOK	
Rev.	DESCRIPTION - AQUILUM	DATE - Tarih	DATE - Tarih	APPROVAL	M
REVISIONS - REVIZYONLAR					
GE ENERGY & GAMA POWER SYSTEMS CONSORTIUM					
GAMA ENERJİ A.Ş.					
IC ANADOLU 800MW COMBINED CYCLE POWER PLANT PROJECT					
WATER MASS BALANCE					
Haz (Hazard) (Prepared By) ADEMIRALP					
Gama (Gama) (Drawn By) M.KACARSÖY					
Kontrol (Control) (Checked By) TANER KATMAK					
Tarih (Date) 09.03.2011					
NTS					
WMB-001					
1					