ÖZMEN - 3 GEOTHERMAL POWER PLANT PROJECT

Environmental and Social Impact Assessment Report

MARCH 2018

ANKARA

ÖZMEN - 3 GEOTHERMAL POWER PLANT PROJECT ENVIRONMENTAL and SOCIAL IMPACT ASSESSMENT REPORT

Version	Revision	Date	Prepared by				Checked by	Approved by
Final	C.0	9 May 2017	Yasemin Çelikel Social Expert	Celal Denizli Ecologist	Elçin Kaya Sociologist	Zeynep Çeliker Env. Eng.	Turgay Eser Env. Eng.	G. Ozenirler Env. Eng, M.S.
Final	C.1	6 November 2017	Yasemin Çelikel Social Expert	Celal Denizli Ecologist	Elçin Kaya Sociologist	Zeynep Çeliker Env. Eng.	Turgay Eser Env. Eng.	G. Ozenirler Env. Eng, M.S.
Final	C.2	12 December 2017	Yasemin Çelikel Social Expert	Celal Denizli Ecologist	Elçin Kaya Sociologist	Zeynep Çeliker Env. Eng.	Turgay Eser Env. Eng.	G. Ozenirler Env. Eng, M.S.
Final	C.3	16 January 2018	Yasemin Çelikel Social Expert	Celal Denizli Ecologist	Elçin Kaya Sociologist	Zeynep Çeliker Env. Eng.	Turgay Eser Env. Eng.	G. Ozenirler Env. Eng, M.S.
Final	C.4	01 March 2018	Yasemin Çelikel Social Expert	Celal Denizli Ecologist	Elçin Kaya Sociologist	Zeynep Çeliker Env. Eng.	Turgay Eser Env. Eng.	G. Ozenirler Env. Eng, M.S.

Revision Codes: A: Draft, B: Final Draft, C: Final

Project No: 17/008

March 2018

Client:

Sahil Yolu Cd. Turgut Özal Bulvarı
No:65 B Blok, Küçükyalı
Maltepe - İstanbul/TÜRKİYE
☎ +90 (216) 309 7550
🖷: +90 (216) 309 7535

Consultant:

Tepe Prime İş ve Yaşam Merkezi
Mustafa Kemal Mahallesi
Dumlupınar Bulvarı
No: 266 B-Blok Kat: 2 Daire: 37
Çankaya - ANKARA / TÜRKİYE
☎: +90 (312) 287 25 07-08
🖷: +90 (312) 287 25 09

TABLE OF CONTENTS

1. EXECUTIVE SUMMARY 1

2. INTRODUCTION 3

2.1 Objectives 3
2.2 Scope of the Report 3
2.3 Limitations of the Study 4

3. PROJECT DESCRIPTION 5

3.1 Purpose of the Project 5
3.2 Project Location 6
3.3 Project Components 7
3.3.1 Drilling of Geothermal Wells 7
3.3.2 The Power Plant 7
3.3.3 Geothermal Fluid Transmission Lines 9
3.3.4 Electricity Transmission Lines 9
3.3.5 Access Roads 10
3.4 Project Proponents 10
3.5 Project Alternatives 10

4. LEGAL FRAMEWORK 13

4.1 Turkish Legislation 13
4.1.1 Turkish Environmental, Health and Safety (EHS) Legislation 13
4.1.2 Turkish Energy Legislation 15
4.1.3 Turkish Legislation on Land Use 16
4.1.4 Turkish Legislation on Conservation of Nature and Wildlife 17
4.2 International Standards 17
4.3 Environmental and Social Risk Categorization 19

5. METHODOLOGY 20

5.1 Area of Influence 20
5.2 Methodology for the Environmental Baseline Assessment 22
5.3 Methodology for the Social Baseline Assessment 22
5.4 Methodology for the Impact Assessment 23

6. ENVIRONMENTAL BASELINE 26

6.1 Geology and Earthquake Risks 27
6.2 Surface Water and Groundwater Quality 32
6.3 Climate 35
6.4 Soil Quality 35
6.5 Air Quality 37
6.6 Environmental Noise 42

6.7 Ecology 45
6.7.1 Flora 49
6.7.2 Fauna 54
7. SOCIAL BASELINE 61
7.1 Demography and Population 62
7.2 Livelihoods and Employment 63
7.3 Education 65
7.4 Health 65
7.5 Infrastructure and Services 65
7.6 Vulnerable Groups 66
7.7 Project Information Level 67
8. ENVIRONMENTAL IMPACT ASSESSMENT 70
8.1 Construction Stage Impacts 71
8.1.1 Impacts on Ecology 71
8.1.2 Water Supply 73
8.1.3 Wastewater Generation 73
8.1.4 Impacts of Geothermal Fluid from Well Testing 74
8.1.5 Impacts of Solid Wastes on Soil and Groundwater 76
8.1.6 Impacts on Air Quality 80
8.1.7 Noise Impact 83
8.2 Operation Stage Impacts 86
8.2.1 Impacts on Ecology 86
8.2.2 Impacts of Domestic Wastewater on Surface Waters 87
8.2.3 Impacts of Spent Geothermal Fluid on Surface Waters 87
8.2.4 Impacts of Solid Wastes 89
8.2.5 Impacts of Storage of Chemicals 91
8.2.6 Impacts on Air Quality and Odor Impacts 93
8.2.7 Environmental Noise Impacts 94
8.2.8 Climate Change Impacts 97
8.3 Closure Stage Impacts 100
8.3.1 Impacts on Ecology 100
8.3.2 Water Supply 100
8.3.3 Wastewater Generation 100
8.3.4 Impacts of Geothermal Fluid 101
8.3.5 Impacts of Solid Wastes on Soil and Groundwater 101
8.3.6 Impacts on Air Quality 101
8.3.7 Noise Impact 101
8.4 Impacts of Energy Transmission Line 101
9. SOCIAL IMPACT ASSESSMENT 107
9.1 National Economy 107

9.2 Land Acquisition 108
9.3 Local Economy and Livelihood 112
9.3.1 Employment 112
9.3.2 Local Economy 114
9.3.3 Labour Influx 114
9.4 Transportation / Traffic 116
9.5 Community Health and Safety 117
9.6 Occupational Health and Safety 119
9.7 Cultural Heritage 121
9.8 Closure Phase Impacts 122
9.8.1 Economy and Employment 123
9.8.2 Land Use 123
9.8.3 Visual and Landscape 123
9.8.4 Community Health and Safety 123
9.8.5 Occupational Health and Safety 123
9.8.6 Cultural Heritage 124
10. INSTITUTIONAL ARRANGEMENTS 125
11. CUMULATIVE IMPACTS 126
12. E&S MITIGATION AND MONITORING PLAN 128
12.1 Construction Stage 128
12.2 Operation Stage 135
13. Bibliography 141

LIST OF ANNEXES

ANNEX-1 Photo-Log
ANNEX-2 Test Results
ANNEX-3 Social Profile
ANNEX-4 Stakeholder Engagement Plan
ANNEX-5 Emergency Response Plan

LIST OF TABLES

Table 3-1. Production and Reinjection Well Coordinates 5
Table 3-2. Analysis of Alternatives 11
Table 4-1. Turkish EHS Legislation Related to the Project 14
Table 4-2. Turkish Energy Legislation Related to the Project 15
Table 4-3. Project-related Turkish Legislation on Land-use 16
Table 4-4. Project-related Turkish Legislation on Conservation of Nature and Wildlife 17
Table 5-1. Impact Types and Definitions 23

Table 5-2. Impact Criteria 24
Table 5-3. Significance Rating 25
Table 5-4. Overall Impact Rating 25
Table 6-1. Scoping of Environmental Issues 26
Table 6-2. Earthquakes in the Region 30
Table 6-3. The Geographical Coordinates of the Surface Water Sampling Point 32
Table 6-4. Results of Surface Water Quality Analysis 33
Table 6-5. The Geographical Coordinates of the Groundwater Sampling Point 34
Table 6-6. Test Results for Groundwater 34
Table 6-7 The Geographical Coordinates of the Soil Sampling Points 36
Table 6-8 The Results of the Analysis of the Soil Samples 37
Table 6-9 The Geographical Coordinates of the PM_{10} Measurement Point 38
Table 6-10 The Results of the PM_{10} Measurements 39
Table 6-11 The Geographical Coordinates of the Points where the Diffusion Tubes have been installed 39
Table 6-12. The Results of the Measurements of the Baseline H2S Concentrations for the First Period 40
Table 6-13. The Results of the Measurements of the Baseline H2S Concentrations for the Second Period 41
Table 6-14 The Geographical Coordinates of the Noise Measurement Point 42
Table 6-15 The Results of the Measurements of the Baseline Noise Levels 43
Table 6-16. Ecological Survey Points 49
Table 6-17. Flora in the Project Area and its Environs 52
Table 6-18. Species of Reptiles and Amphibians in the Project Region 55
Table 6-19. Bird Species in the Region 56
Table 6-20 Mammals in the Project Region 59
Table 7-1. Scoping of Social Issues 62
Table 7-2 Population Figures of the Area of Impact 63
Table 7-3. Population Dynamics 63
Table 7-4. Common Economic Activities within the AoI 64
Table 7-5. Type of the Lands within the AoI 64
Table 7-6. Vulnerable Groups 67
Table 7-7. Suggested Information Disclosure and Grievance Tools 68
Table 8-1: Impacts of Construction Stage on Ecology 72
Table 8-2 Impacts of Drilling Effluents 76
Table 8-3: Impacts of Waste Storage 79
Table 8-4. Controlled Dust Emission Factors according to Turkish IAPCR 80
Table 8-5. Controlled Dust Emissions During Site Preparation 81
Table 8-6. Controlled Dust Emissions During Construction 81
Table 8-7. Power Outputs and Emission Factors for the Construction Equipment 82
Table 8-8. Exhaust Emissions of the Construction Equipment 82
Table 8-9. Impacts of Construction Activities on Air Quality 83

Table 8-10. Sound Level of Construction Equipment 84
Table 8-11. Noise Impacts of the Construction Stage 84
Table 8-12. Impacts of Spent Geothermal Fluid 88
Table 8-13. Impacts of Waste Generation and Storage at Operation Stage 91
Table 8-14. Impacts of Chemicals Storage 92
Table 8-15. Air Quality and Odor Impacts During Operation Stage 93
Table 8-16. Sound Power Level of the Power Plant Equipment 94
Table 8-17. Sound Power Level with Respect to Distance 95
Table 8-18. IFC/WB Noise Limits 96
Table 8-19. Noise Impact of the Operation Stage 96
Table 8-20. ICNIRP Exposure Limits for General Public Exposure to Electric and Magnetic Fields 103
Table 8-21. Minimum Horizontal Distances of the Overhead Line Conductors to the Structures with Maximum Oscillation 105
Table 8-22. Minimum Horizontal Distances of Overhead Line Conductors to Trees 105
Table 8-23. Minimum Vertical Distances of Overhead Line Conductors to the Places Over Which They Pass with Maximum Sag 105
Table 9-1. Impacts on National Economy 108
Table 9-2. Land Take for the Project Activities 109
Table 9-3. Impacts of Land Acquisition on Local Communities 111
Table 9-4. Impacts on Local Employment 112
Table 9-5. Impacts on Local Economy 114
Table 9-6. Impacts on Labour Influx 115
Table 9-7. Impacts of Project Transportation Activities 116
Table 9-8. Impacts on Community Health and Safety 118
Table 9-9. Impacts on Occupational Health and Safety 120
Table 9-10. Impacts on Cultural Heritage 122
Table 10-1. Roles and Responsibilities 125

LIST OF FIGURES

Figure 2-1. Project Area and its Vicinity 7
Figure 2-2. Process Flow Chart 9
Figure 2-3 Predictive Route of the Electricity Transmission Line 10
Figure 5-1. The Geologic Map of the Project Area and its Vicinity 28
Figure 5-2. Earthquake Map of Manisa 29
Figure 5-3. The Location of the Surface Water Sampling Point 32
Figure 5-4. The Location of the Surface Water Sampling Point 34
Figure 5-5. The Locations of the Soil Sampling Points 36
Figure 5-6 The Location of the PM_{10} Measurement Point 38
Figure 5-7 Diffusion Tubes Location 40
Figure 5-8 The Location of the Noise Measurement Point 42
Figure 5-9. Ecological Survey Points 49

Figure 5-10. The Protected Areas Around the Project Area 51
Figure 5-11. Some Flora Species Observed in the Project Area and its Environs 54
Figure 5-12 Some Reptiles and Amphibians Species Observed in the Project Area and its Environs 55
Figure 5-13 Some Bird Species Observed in the Project Area and its Environs 59
Figure 5-14 Some Mammal Tracks Observed in the Project Area and its Environs 60
Figure 7-1 Time dependent NCG Decrease Projection at Özmen-1 Well of Özmen-3 GPP Project 98
Figure 7-2 CO_2 Emission Distribution Map 99
Figure 10-1. Özmen-3 GPP and other GPPs 126

LIST OF PHOTOS

Photo 6-1. Agricultural Areas Around the Project Site 50

ABBREVIATIONS

2U1K	2U1K Engineering and Consultancy Inc.
AoI	Area of Influence
CO_2	Carbon Dioxide
EA	Environmental Assessment
EHS	Environment, Health and Safety
EIA	Environmental Impact Assessment
EMF	Electromagnetic Field
EPRP	Emergency Preparedness and Response Plan
ESA	Environmental and Social Assessment
ESDD	Environmental and Social Due Diligence
ESMMP	Environmental and Social Management and Monitoring Plan
GD NCNP	General Directorate of Nature Conservation and National Parks
GPP	Geothermal Power Plant
HS	Health and Safety
H_2S	Hydrogen Sulphide
IFC	International Finance Corporation
MoEU	Ministry of Environment and Urban Planning
NGO	Non-Governmental Organization
OHS	Occupational Health and Safety
ORC	Organic Rankine Cycle
PDR	Project Description Report
PS	Performance Standards
SEP	Stakeholder Engagement Plan

1. EXECUTIVE SUMMARY

Sis Enerji Üretim Ticaret A.Ş. (Sis Enerji) has committed to operate Özmen - 3 Geothermal Power Plant (the Project) with capacity of 19 MW in Alaşehir District of Manisa Province. The Project is planned to provide contribution to the national grid with generation of 166.44 GWh electricity annually. This Environmental and Social Impact Assessment Report has been prepared for this Project development and includes project description, project components, schedule and alternatives, legal framework, ESIA methodology, environmental and social baseline conditions, impact assessment, institutional arrangements and environmental and social mitigation and monitoring plan. Along with the ESIA report, a Stakeholder Engagement Plan (SEP) has been prepared for the Project.

The Project is anticipated to have environmental and social impacts for which the details are discussed in the following sections. The main environmental issues focused in this Report are impacts on ecology, water resources, soil quality and air quality, as well as odor, noise and climate change impacts. After specification of the impacts, mitigation measures are described related to the impacts. The following mitigation measures have been defined for the environmental impacts that may occur during the geothermal power generation:

- An impermeable collection pond with a capacity of 1,500 m^3 is planned to be constructed in case of any failure during reinjection, operation of the Power Plant or during maintenance of the wells. Currently, collection ponds for 6 drilling locations have been established for collection of geothermal fluid. It is also possible to use more than one pond during testing by the use of pipeline between the ponds. In case of any emergency, the operation is stopped through the installed automated system. The geothermal fluid collected in the pond will be reinjected back to the system by reinjection pump and hence, geothermal fluid discharge to any kind of environment will be prevented during the whole Project lifetime.
- The leak-proof well casings will be installed in the reinjection wells to the depth of the geological formation hosting the geothermal reservoir for minimization of the potential for contamination of the groundwater.
- H_2S emissions will be monitored regularly in order to determine compliance with the legislation requirements. H_2S will also be monitored at well heads through H_2S detectors.
- Drilling mud will be collected and treated by Drilling Mud Management System installed by drilling mud supplier and sent back to the system minimizing the generation of waste drilling mud. Remaining drilling mud will be collected in impermeable mud ponds and disposed after categorization of mud.
- An Emergency Response Plan has been developed for Project activities.

The Project is planned to be established on privately owned agricultural lands. Sis Enerji used voluntary purchase method for land take of the area required for the Project. There were no assets on the purchased lands and physical displacement did not occur for the Project. In terms of type of rights of the acquired land, all land that was acquired for each Project Component was through permanent land take method. There has been no temporary land take acquired by the Project Company. The Project Owner will continue land take for the Project purposes through negotiated land take approach. In case agreement cannot be achieved between the Project Owner and the land owner for a particular land, other alternatives within the licence area will be considered until reaching agreed prices. Although it is not planned, in case expropriation is not inevitable in the future, the Project Owner will prepare a Resettlement Action Plan/Abbreviated Resettlement Action Plan (RAP/ARAP) for land acquisition.

Sis Enerji has secured the geothermal resource operation license in January 2013 for a period of 30 years for an area of 2,385.08 hectares where 25 wells have been determined with potential. The Power Plant will cover an area of 44,536.42 square meters within the license area.

The legally protected and internationally recognized areas close to the Project area are Kula Fairy Chimneys Natural Monument, Gölcük Lake Wetland and Marmara Lake Wetland at distances of 25 km, 41 km and 43 km, respectively. The possible effects of the Project to these wildlife sanctuaries have been checked to prove that the Project area and the influence zone sufficiently far from the protected area network of Manisa.

The Project site and its vicinity are under intense human pressure due to the geothermal power plants, animal grazing and agricultural activities, and are occupied by the species which are known to exist in the habitats altered by anthropogenic activities. Although the Project area and its vicinity seem to possess a rich flora, the natural vegetation cover has been lost due to the agricultural fields and gardens. Certain fauna species have previously moved away from the region due to the abovementioned anthropogenic impacts. The existing fauna species are the ones that have adapted themselves to these impacts. Mitigation measures have been defined for the species which might occur at the Project area. Adverse impacts on terrestrial ecology and biodiversity imposed during the construction stage will disappear at the operation stage. No project-related adverse impacts on the ecology are anticipated for the operation stage.

Effective community engagement for the Project will be assured through the implementation of the Stakeholder Engagement Plan (SEP) prepared for the Project. The stakeholders of the Project will be informed and also be involved in identification of the important issues of the Project through implementation of the SEP.

2. INTRODUCTION

2.1 Objectives

2U1K has been appointed by Sis Enerji Üretim Ticaret A.Ş. (hereinafter the Project Company) for the Environmental and Social Impact Assessment (ESIA) of the Özmen - 3 Geothermal Power Plant Project (hereinafter The Project).

The objective of this ESIA is to identify potential impacts of the proposed project and to recommend appropriate mitigation measures to reduce adverse potential impacts. The ESIA study is conducted by 2U1K on behalf of the Project Company, to be submitted to TKB, the financial intermediary.

The ESIA process is comprised of baseline environmental and social assessment, environmental and social impact assessment, designation of mitigation measures, stakeholder consultations and cumulative impact assessment.

Baseline information in the Report is supported with field studies that include:

- Overall site observations of drilling wells, mud-pits, storage conditions of chemicals and fuels and waste management;
- Observations for the flora and fauna assessments;
- Sampling for air quality measurements, groundwater and surface water sampling, soil sampling and environmental noise measurements;
- Social surveys including focus group meetings and interviews with mukhtars;
- Consultations with key stakeholder groups.

A photo-log is available in Annex-1 to present pictures from field studies. Results of field tests and measurements are provided in Annex-2.

2.2 Scope of the Report

The Report is comprised of 10 Sections.

Section 1 is an introductory part that gives overall objectives of the ESIA Report, its contents and limitations in undertaking the associated studies.

Section 2 describes the Project components that are subject to assessment of environmental and social impacts.

Section 3 gives the legal framework including national and international legislative requirements as related with geothermal drilling and power generation. National frame compiles the Project-related laws and regulations on the basis of concerns of the environmental and social assessment. EHS, permits, energy generation, land use and

biodiversity conservation. International legal frame focuses on requirements of the World Bank operational procedures and the pertinent risk categorization for the specific Project.

Section 4 defines the methodology of data collection and impact assessment.

Section 5 gives environmental baseline situation to be considered in the long term monitoring process as well as the scoping of impact assessment process.

Section 6 gives social baseline situation to be considered in the long term monitoring process as well as the scoping of impact assessment process.

Section 7 is assessment of impacts on the environment. Focus is given on soil and groundwater contamination from discharge of geothermal drilling and operation stages, from mud pits opened during drilling stage, and H_2S emissions during operation.

Section 8 is assessment of impacts on the communities. Social and economic impact assessment is backed up by a Stakeholder Engagement Plan (SEP) and the Community Profile of Social Surveys. The SEP prepared by 2U1K is available in Annex-4 of the Report.

Section 9 discusses cumulative impacts of the Project in conjunction with other geothermal projects in the region.

Section 10 presents the mitigation plan and the monitoring plan for environmental and social aspects to be complied with during both construction and operation stages.

2.3 Limitations of the Study

Besides site observations performed by 2U1K, the ESIA Report is limited to the statements of Project Company representatives and former reports (PDRs for the drillings and the power plant and EMP for the power plant) prepared during the course of project planning and license applications. In this respect, no modeling studies are performed in relation to environmental and social parameters. The ESIA process builds upon the available reports and supports them with additional baseline measurements of critical parameters and social surveys.

Associated with the Project, the electricity transmission line (ETL) will be established following the approval of Turkish Electricity Transmission Corporation; TEIAS.. The power plant will be connected to the TEIAS transmission line of Kula 1 and 2 between the 34th and 35th electricity transmission towers. The transmission will be through a 34.5 kV line. The route and length of the transmission line as well as the coordinates of the transmission towers have not been finalized yet According to the national legislation requirements, necessary expropriation works for the lands where the ETL passes will be undertaken by TEIAS. The predictive route of the transmission line has been provided in the following sections. Potential impacts of the ETL and mitigation measures are provided in the impact assessment sectio

3. PROJECT DESCRIPTION

3.1 Purpose of the Project

The aim of the Project is to generate 19 MW electric power by means of utilizing the geothermal resources. The Project aims to produce approximately 166,440,000 kWh of electricity per year. The main components of the Project are the production wells, geothermal fluid transmission lines, reinjection wells and the power plant.

The Project is comprised of drilling and operation of geothermal wells in Tepeköy Neighborhood of Alaşehir District, Manisa. The operation license was secured in January 2013 for a period of 30 years from the Manisa Provincial Special Administration. The geothermal license area covers an area of 2,385.08 hectares where 25 wells have been determined with potential. 12 wells of 25 wells are planned to be utilized within the scope of the Project. 7 wells out of these 12 wells have been drilled until now. As of now 1 of the wells is determined as reinjection well, and 4 wells will be used as production wells. Remaining one will not be utilized for Project purposes. The coordinates of the wells to be used for Project are provided below in Table 3-1.

Table 3-1. Production and Reinjection Well Coordinates

Well no	Type of Use	Coordinates (UTM Zone:35S)	
		E	N
Özmen-1	Production	634739.44	4250354.99
Özmen-2	Production	634394.10	4250699.43
Özmen-3	Production	635059.78	4250567.17
Özmen-4	Production	635176.57	4250103.95
Özmen-5	Reinjection	635569.58	4250610.02
Özmen-24	Production	634486.54	4250648.31

The drilling works for the remaining 5 wells are planned to be started at the beginning of March 2018. With reference to the results of the well tests performed in 2017, the works associated with drilling of the reinjection wells will be completed at the beginning of February 2018. In February, the coordinates of 2 wells will be determined and the drilling works for these wells will be conducted in the first place. The drilling works for the remaining 3 wells out of the 5 wells will be planned according to the results of the drilling works for the 2 wells. It is planned that the 5 wells will be reinjection wells. The timeline for the 13 remaining wells out of 25 wells with geothermal potential within the license area is not certain yet. Therefore the impact assessment of the future planned wells is limited in the cumulative impacts assessment section. As the drilling process of the wells continues the functions of the wells

whether they are going to be production or reinjection wells will be determined considering the potential of the geothermal fluid.

The power generation process is based on the binary production technology called Organic Rankine Cycle (ORC) which makes 100% reinjection possible. Operation will include air-cooled condensers, hence no white plume will be emitted in contrast to flash power plants that use geothermal steam directly. The secondary fluid used for the binary power generation system is n-butane, a working fluid with a low boiling point. Environmental impacts of an ORC power plant are very low as compared to the flash technologies.

The site preparation activities are planned to be completed in 6 months in total. The construction activities of the Project are expected to be completed in 6 months. The operation period of the Project is estimated to be 30 years.

3.2 Project Location

The Project area provided on the map given in Figure 3-1 is located in the Tepeköy Neighborhood of the Alaşehir District of Manisa Province. Figure 3-1 further demonstrates the EIA area, license area and Area of Influence (AoI). The license area covers about 2,385.08 hectares of which the Power Plant area covers an area of 44,536.42 square meters. The map below includes the area which is subject to the national EIA process, the license area for which the Project Company secured geothermal operation license and the AoI within which the environmental and social impacts of the Project have been assessed in the following sections of this report. The AoI covers the EIA area, most of the license area of the Project, the closest sensitive receptors in respect of air quality, noise level and surface water quality in addition to the soil sampling points, ecological surveys and the settlements which are in the first and second impact zone in terms of social impacts which is explained later in Section 4.1.

Baklacı Neighborhood is determined as the closest settlement to the Project with a distance of 1.46 km to the Project Site. The second closest neighborhood to the Project is Tepeköy with the distance of 2.90 km and the third closest neighborhood is Işıklar at a distance of 3.65 km.

As it can be seen from the image below, the power plant and wells, which are all Project components, are located and surrounded by agricultural lands.

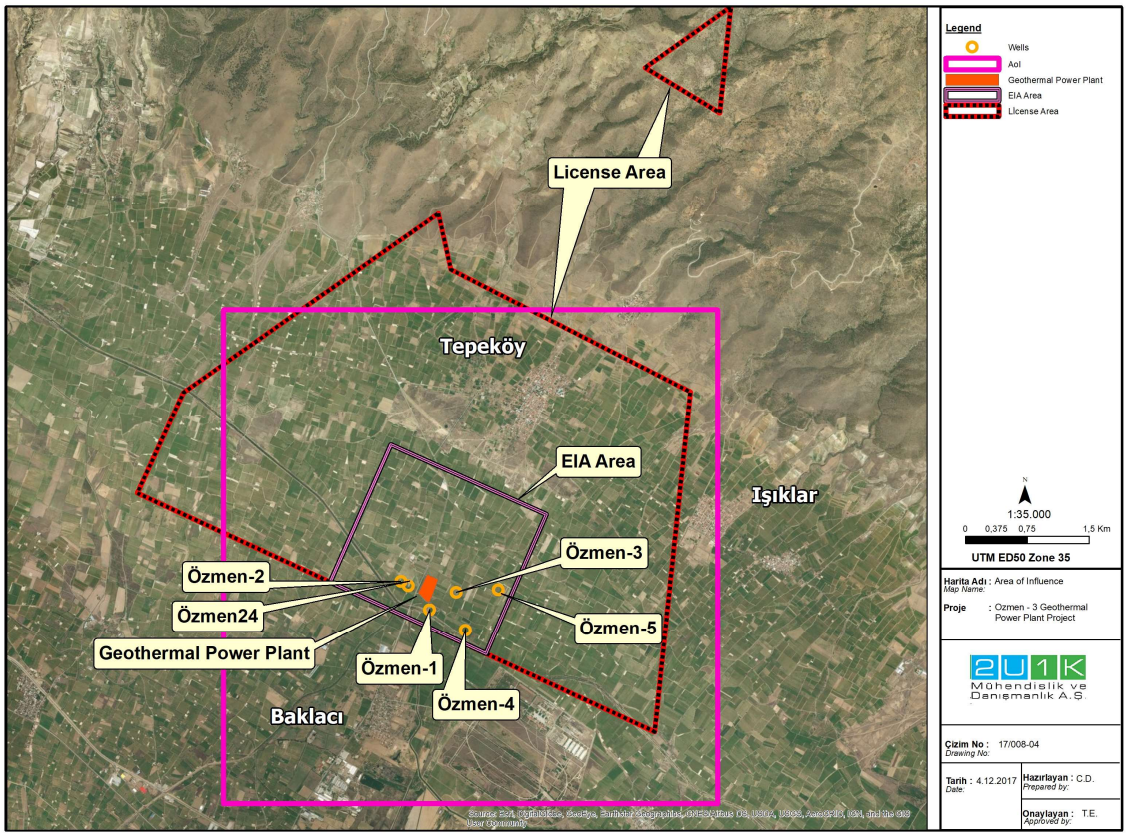


Figure 3-1. Project Area and its Vicinity

3.3 Project Components

3.3.1 Drilling of Geothermal Wells

The exploration and reservoir evaluation activities include geological, geophysical, and drilling surveys for exploratory drilling and reservoir testing.

The production field development involves drilling geothermal fluid production wells and reinjection wells, and processing the reservoir output for use in the power plant. As the drilling processes of the wells continue, the functions of the subject wells either as production or reinjection wells, will be periodically updated to support power generation requirements

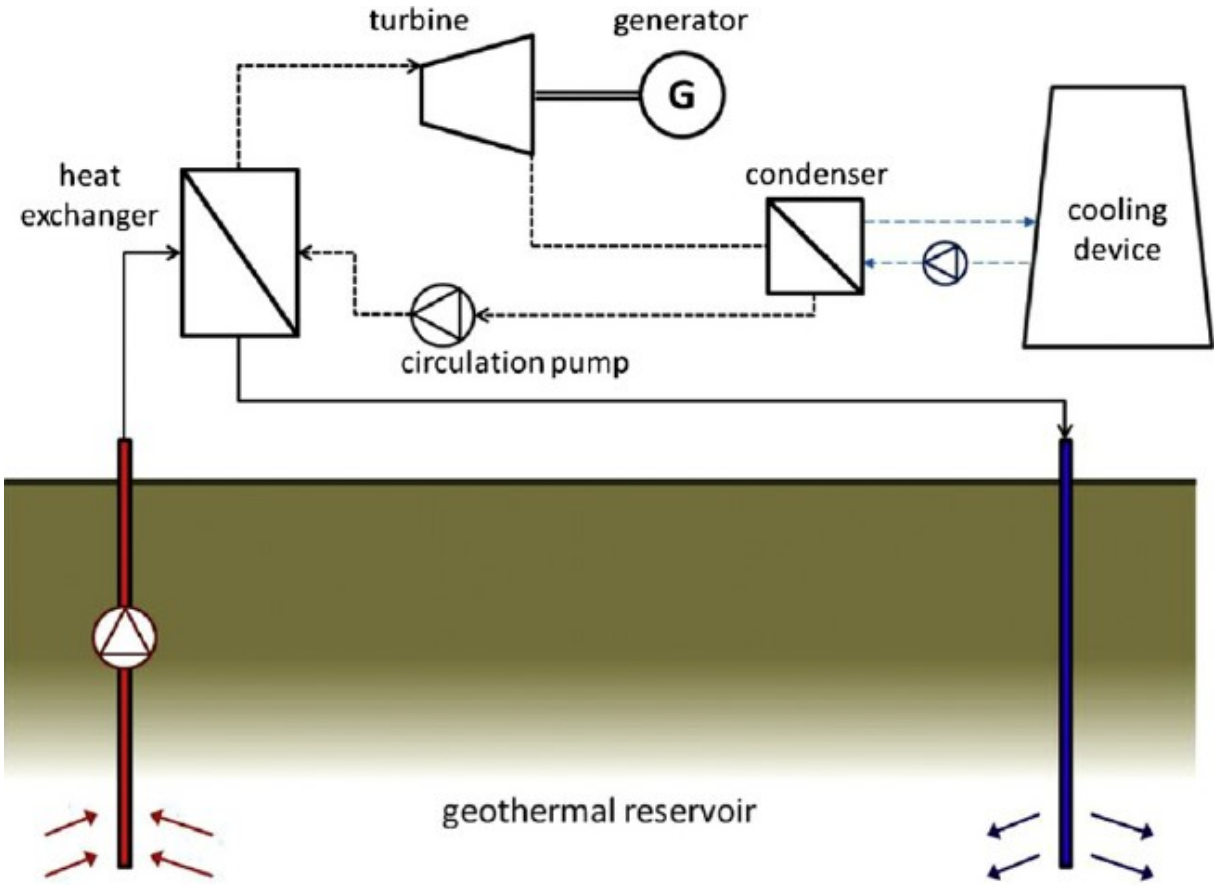
3.3.2 The Power Plant

The construction activities for the power plant include construction of the power plant facility and associated infrastructure, including pipelines, pumps, cooling towers and facilities for treatment and reinjection of geothermal fluid.

The Organic Rankine Cycle (ORC) technology is selected to be utilized in the plant. The units to be installed in the ORC system are boiler, turbine, generator, condenser, pump and

dry cooling tower. The working principle of the Organic Rankine Cycle is summarized as follows: the organic working fluid pumped to a boiler where it is evaporated via the geothermal fluid, passes through a turbine, and then through a condenser heat exchanger where it is finally re-condensed. In other words, the geothermal fluid yields heat to the working fluid through the heat exchangers, where the working fluid is heated and vaporized. The vapor produced drives the turbine, then is cooled and condensed, and the cycle continues. As an organic working fluid, n-butane will be used due to its low boiling point and high vapor pressure at low temperatures as compared to steam.

In order to avoid extensive water use and prevent wastewater generation, an air-cooled condenser will be employed, where the exhaust gas from the turbine flows through the tube bundles of an air-cooled condenser and is condensed through the air flow induced by the properly designed axial fans. The residual gas flows in counter current. In this way, with the use of an air-cooled condenser, water resources will not be consumed, no emissions will be generated, no hot water discharge will be made into the river. Furthermore, dry cooling systems require very low maintenance.



Source: (Alessandro Franco, 2011)

Figure 3-2. Process Flow Chart

3.3.3 Geothermal Fluid Transmission Lines

Geothermal fluid obtained from the production wells, will be transported to the plant with pressure-resistant and heat-insulated pipes.

3.3.4 Electricity Transmission Lines

Associated with the Project, the electricity transmission line will be established following the approval of TEIAS. The power plant will be connected to the TEIAS transmission line of Kula 1 and 2 between the 34th and 35th electricity transmission towers. The transmission will be through a 34.5 kV line. The route and length of the transmission line as well as the coordinates of the transmission towers have not been finalized yet. According to the national legislation requirements, necessary expropriation works for the lands where the ETL passes will be undertaken by TEIAS. The predictive route of the transmission line is presented below in Figure 3-3.

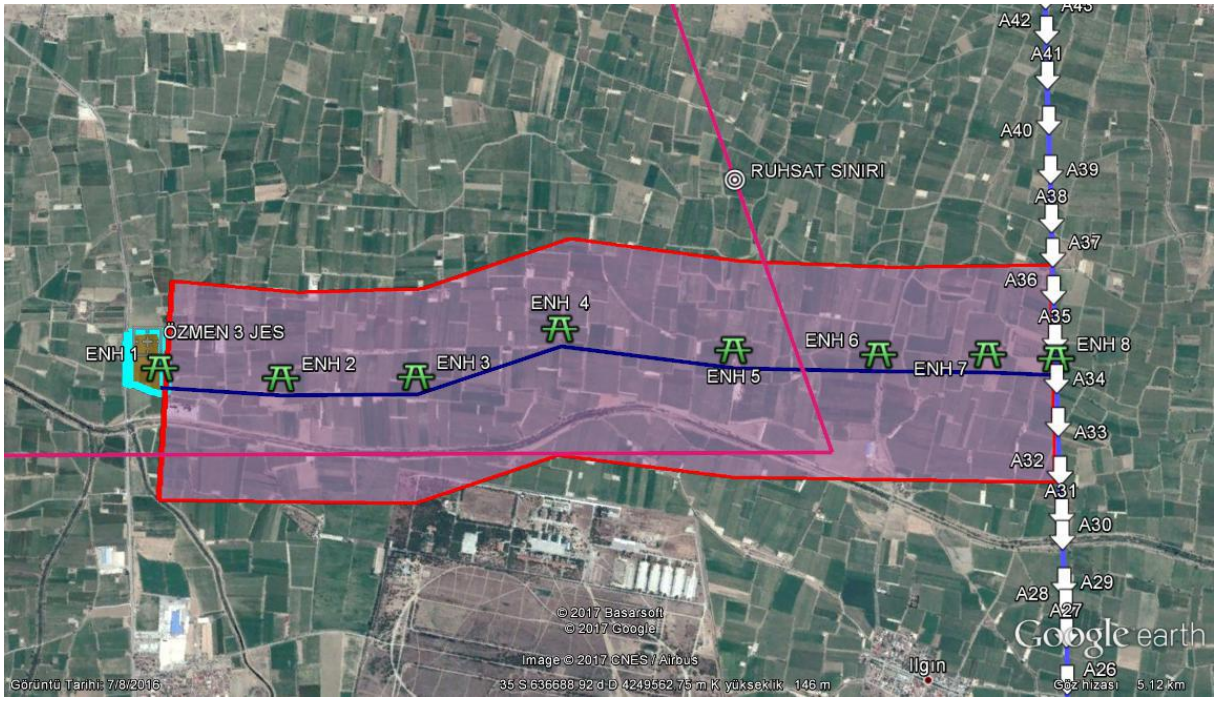


Figure 3-3 Predictive Route of the Electricity Transmission Line

3.3.5 Access Roads

The Project area can be accessed through the Alaşehir-Kula road. No new access roads have been constructed.

3.4 Project Proponents

Key proponents of the Project are:

- Project Company (Sis Enerji),
- Development Bank of Turkey,
- International Financing Institution (World Bank),
- Contractors.

3.5 Project Alternatives

The “no project” alternative would result in the continuation of the current situation, which would comprise of agricultural areas and unexploited geothermal water resources, and no development of the power plant planned in the Project. The Project is geared to meeting Turkey’s growing energy demand by means of renewable energy. Therefore, the “no project” alternative would result in a negative impact on national energy policies.

The Project is located within a rural agricultural area with no species of conservation status. The level of economic development in the area is poor, so without the Project, there would be no new source of employment for the local communities. As for the environmental and social impacts, the Project does have the potential to result in various environmental impacts without the mitigation measures.

Supposing that the Project Site is not situated on a geothermal reserve, a new power plant project could be located on the Project lands for developing a solar power or thermal power project. The site is not appropriate for wind power or hydropower development. Major points of comparison are land costs and environmental and social concerns. Comparisons are based on an assumption of equivalent power generation with the use of different resources. Comparative analysis is given in Table 3-2.

Table 3-2. Analysis of Alternatives

Alternatives	Description	Advantages	Disadvantages
"No Project"	• Agriculture continued as the only source of income. • No contribution to meeting national energy needs. • No exploitation of a valuable geothermal resource.	• No environmental impacts such as disturbance of surface waters and groundwaters. • No social impacts such as nuisance of odor and noise. • Protection of agriculture areas. • No costs encountered for environmental and social mitigation.	• Negative impact on national energy policies. • Negative impact on local economy by hindering employment opportunities.
Solar Power Plant in the same geographic location	Solar panels would be installed on a much broader land area to account for the equal power generation.	• Less environmental issues to manage. • Less social issues to manage. • Employment opportunities during construction and operation.	• Considerably high land acquisition costs. • Geothermal reserve unexploited, hence potential economic value lost. • Few personnel to be employed at construction and operation stages.
Coal fired Power Plant in the same geographic location	Coal fired power plant installed at the same geological location	• Employment opportunities during construction and operation.	• Several environmental issues: cooling water requirement, disposal of ash, emission control systems, etc. • High cost of coal supply • Land requirement for coal stockpiles and ash disposal
Geothermal Power Plant with Water-based Cooling vs air-cooled systems	Cooling with water would incorporate one or more cooling towers within the plant site	• Less expensive	• Extensive need for reliable, clean water supply • More environmental concerns with respect to air-cooled geothermal power plant • Dry air cooling is much

Alternatives	Description	Advantages	Disadvantages
			more practical.
Geothermal Power Plant with flash technology in contrast to binary technology of the Project	Hot water flows up through wells in the ground under its own pressure. As it flows upward, the pressure decreases and some of the hot water boils into steam.	• increases overall cycle efficiency • better utilizes the geothermal resources	• Larger emission of steam with fugitive gases including H_2S. • Overall increase in capital cost.

4. LEGAL FRAMEWORK

This ESIA study is carried out based on relevant national legislation as well as the lender's guidelines. The main legislation and guidelines are mentioned in the following sections together with their implications for the Project stages.

4.1 Turkish Legislation

The key national laws and regulations presented in this section include the legal requirements to reduce the potential environmental impacts that may arise from the construction and operational activities of the Project. Turkish Legislation related to the Project are presented in the following sections under relevant subtopics.

4.1.1 Turkish Environmental, Health and Safety (EHS) Legislation

"Environmental Law", which is ratified in August 1983 (amended with the Law dated May 29, 2013; No: 6486), is one of the principal legislation related to the Project. Several by-laws and decrees are enforced under the Environmental Law.

The "Regulation on Environmental Impact Assessment (dated November 25, 2014; No: 29186 and amended on February 9, 2016; No: 29619)" defines the administrative and technical procedures and principles to be followed throughout the EIA process. According to the EIA Regulation of 2014 of The Ministry of Environment and Urbanisation (MoEU), an EIA Report is compulsory for geothermal power plants with capacity above 20 MW. This Project falls into Appendix II of EIA Directive and that only required preparing Project Description Report (PDR) which was submitted on November 25, 2016. The "EIA Not Required" decision was made on July 24, 2017.

The rest of the national EHS legislation that the Project will comply with is presented as Table 4-1 below.

Table 4-1. Turkish EHS Legislation Related to the Project

Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Waste Management Regulation	02.04.2015	29314	• Disposal of wastes generated by construction staff during construction stage and by operation staff during the operation stage • Hazardous wastes generated at construction and operation stages
Water Pollution Control Regulation	31.12.2004 10.01.2016	25687 29589	• Discharge of wastewater generated by site staff at construction stage and by operation staff during the operation stage
Regulation on Landfill of Wastes	26.03.2010 11.03.2015	27533 29292	• Drilling mud generated during the construction stage
Waste Oil Control Regulation	30.07.2008 05.11.2013	26952 28812	• Waste oils generated at construction and operation stages
Waste Vegetable Oil Control Regulation	06.06.2015	29378	• Waste vegetable oils generated at construction and operation stages
Packaging Waste Control Regulation	24.08.2011	28035	• Packaging wastes generated at construction and operation stages
Medical Waste Control Regulation	25.01.2017	29959	• Medical wastes generated at construction and operation stages
Regulation on the Control of End-of-life Tires	25.11.2006 11.03.2015	26357 29292	• End-of-life tires generated at construction and operation stages
Regulation on the Control of Waste Batteries and Accumulators	31.08.2004 23.12.2014	25569 29214	• Waste batteries and accumulators generated at the construction and operation stages
Regulation on the Construction of Septic Tanks at Places Where Sewer Construction is Not Feasible	19.03.1971	25569	• Septic tanks for the collection of domestic wastewater generated at construction and operation stages
Regulation on the Noise Emission in the Environment from Equipment for Outdoor Use	30.12.2006	26392	• Noise levels caused by noise sources within the Project site at the construction and operation stages
Industrial Air Pollution Control Regulation	03.07.2009 20.12.2014	27277 29211	• Dust emissions at the construction stage and CO2 emissions at the operation stage
Regulation on Assessment and Management of Air Quality	06.06.2008	26898	• Emissions originating from the Facility during the operation stage
Regulation on the Control of Odorous Emissions	19.07.2013	28712	• Odorous emissions generated during the operation stage

Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Regulation on Assessment and Management of Environmental Noise	04.06.2010 18/11/2015	2760129536	• Noise emissions at construction and operation stages
Regulation on Soil Pollution Control and Point Source Polluted Areas	08.06.2010 11.07.2013	27605 28704	• Risks of soil contamination at construction and operation stages
Regulation on the Control of Excavation Soil, Construction and Debris Wastes	18.03.2004	25406	• Transportation and disposal of excavation waste and construction debris at the construction stage
Law on Occupational Health and Safety (6331)	20.06.2012	28339	• Health and safety measures to be taken during construction and operation stages
Regulation on Buildings to be Constructed within the Seismic Zones	06.03.2007 03.05.2007	26454 26511	• Construction works within the scope of the Project

4.1.2 Turkish Energy Legislation

Project-related Turkish energy legislation is presented below in Table 4-2.

Table 4-2. Turkish Energy Legislation Related to the Project

Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Electricity Market Law No. 6446 (as amended with the Law numbered 6639) and relevant regulations	30.03.2013 07.09.2016	28603	Rights and responsibilities of the Project Company regarding electricity production and transmission Expropriation of private properties
The Law No. 5346 on the Use of Renewable Resources for the Generation of Electrical Energy (as amended with the Law numbered 6446) and relevant regulations	18.05.2005 17.06.2016	25819	Procedures and principles of the conservation and utilization of renewable energy resource areas Certification of the energy generated from the utilization of these resources
Geothermal Resources and Natural Mineral Water Law No. 5686 (as amended with the Law numbered 6527) and relevant regulations	13.06.2007 01.03.2014	26551	Monitoring requirements regarding geothermal resource preservation and being the right-holder for these resources

4.1.3 Turkish Legislation on Land Use

According to the statement of Provincial Directorate of Food, Agriculture and Livestock (dated November 04, 2014), receiving the required Land-use permits is an obligation for the Project Company. Project-related Turkish Legislation on Land-use are presented in Table 4-3.

Table 4-3. Project-related Turkish Legislation on Land-use

Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Regulation on Geothermal Area Use for Electricity Generation	14.10.2008	27024	Land acquisition and use
Expropriation Law No. 2942 (as amended with the Law numbered 6645) and relevant regulations	08.11.1983 23.04.2015	18215	Expropriation of private properties
Pasture Law No. 4342 (as amended with the Law numbered 6552) and relevant regulations	28.02.1998 14.04.2016	23272	Permission(s) required for land use
Law on Soil Conservation and Land Use No. 5403 (as amended with the Law numbered 6537) and relevant regulations	19.07.2005 15.05.2014	25880	Permission(s) required for land use
Law on Aquaculture Resources No. 1380 (as amended with the Law numbered 5996) and relevant regulations	04.04.1971 13.12.2010	13799	Permission(s) required for land use
Law on Reclamation of Olive Cultivation and Inoculation No. 3573 (as amended with the Law numbered 4086) and relevant regulations	07.02.1939 28.02.1995	4126	Permission(s) required for land use

4.1.4 Turkish Legislation on Conservation of Nature and Wildlife

Project-related Turkish legislation on Conservation of Nature and Wildlife is presented below in Table 4-4.

Table 4-4. Project-related Turkish Legislation on Conservation of Nature and Wildlife

Legislation	Official Gazette Date	Official Gazette Issue	Implications for the Project Stages
Wetland Conservation Regulation	04.04.2014	28962	Conservation of the stream beds located within the boundaries of the project site
Regulation on the Management of Natural Assets, Natural Protected Areas, and State-Owned Lands Located on Environmental Conservation Lands	02.05.2013	28635	Measures to be taken during chance finds at the construction stage
Law on Conservation of Cultural and Natural Assets No. 2863 (as amended with the Law numbered 6552) and relevant regulations	23.07.1983 20.08.2016	18113	Measures to be taken during chance finds at the construction stage
Land Hunting Law No. 4915 and relevant regulations	11.07.2003	25165	Monitoring requirements regarding hunting and terrestrial wildlife

4.2 International Standards

Since the potential lender for the Project is Development Bank of Turkey (TKB), the Project must be in compliance with good international practice, including World Bank (WB) Safeguard Policies, guides, performance standards and best practices documents alongside the National EHS Legislation.

World Bank governs projects and activities by the Safeguard Policies in order to assure that they are conducted in an environmentally, financially and socially sound manner. Safeguard Policies include Environmental Assessments and other policies that define environmental and social adverse effects of the projects as well as their reduction and prevention. These policies are enlarged upon in “The World Bank Operations Manual”, which also provides guidance on compilation with the Operational Policies (OP), Bank Procedures (BP) and Good Practices (GP). OPS are defined as statements of policy objectives and operational principles including the roles and obligations of both the Borrower and the Bank, while BP are compulsory procedures to be followed by both the Borrower and the Bank and GP are non-compulsory advisory material. Specific policies and guidelines related to the Project are listed below:

- IFC/WB Environmental, Health, and Safety General Guidelines (2007),
- IFC/WB Environmental, Health, and Safety Guidelines for Geothermal Power Generation (2007)

Environmental Policies

- OP/BP 4.01 Environmental Assessment
- OP/BP 4.04 Natural Habitats

Social Policies

- OP/BP 4.11 Physical Cultural Resources

OP/BP 4.12 Involuntary Resettlement

- To avoid or minimize involuntary resettlement where feasible, exploring all viable alternative project designs;
- To assist displaced person in improving their former living standards; it encourages community participation in planning and implementing resettlement;
- To provide assistance to affected people, regardless of the legality of title of land.

BP 17.50 Bank Disclosure Policy

The main objectives and tasks of the Project-related WB Safeguard Policies are explained below:

OP/BP 4.01 Environmental Assessment

- To ensure the proposed projects' environmental and social sustainability and soundness
- To inform decision-makers about the environmental and social risks
- To increase transparency by providing stakeholder engagement in the decision-making process

OP/BP 4.04 Natural Habitats

- To conserve natural habitats and their biodiversity
- To avoid significant conversion/degradation of critical natural habitats
- To ensure the sustainability of services and products provided to human society by natural habitats

OP/BP 4.11 Physical Cultural Resources

- To ensure the identification and protection of Physical Cultural Resources (PCR), including archaeological and historical sites, historic urban areas, sacred sites, graveyards, burial sites and unique natural values
- To ensure the compliance with national legislation regarding the protection of physical cultural property

BP 17.50 Bank Disclosure Policy

- To support the decision-making process by allowing public access to information on environmental and social aspects of projects.

Under the Operational Policy for Environmental Assessment (OP 4.01), WB conducts an environmental scanning and classifies the proposed projects under Categories A, B and C, based on the level of their likely environmental impacts. Furthermore, Category B projects divide in two within its structure as B and B+, based on the special circumstances of the project in question.

4.3 Environmental and Social Risk Categorization

This ESIA Report proposes that the Project can be categorized as Category B+ based on a preliminary overview of potential environmental and social risks associated with the construction and operation of the project, with respect to WB criteria. The Category B is approached with due sensitivity on the social aspects, given the current public opposition on geothermal power projects in the region. Category B+ projects have relatively more impacts and mitigation measures as compared to Category B projects, which are, however, not significant enough to be recognized as Category A projects. The main difference of Category B+ from Category B is that Category B+ projects may require the preparation of a site-specific Environmental Assessment study.

5. METHODOLOGY

5.1 Area of Influence

The Area of Influence (AoI) is an important element in assessing environmental and social impacts of a proposed development since it lets us know the physical and/or social extent in which the assessment should be performed. According to the definition given in Performance Standard 1 of the IFC, the AoI encompasses, as appropriate:

- The area likely to be affected by: (i) the project[1] and the client's activities and facilities that are directly owned, operated or managed (including by contractors) and that are a component of the project; [2] (ii) impacts from unplanned but predictable developments caused by the project that may occur later or at a different location; or (iii) indirect project impacts on biodiversity or on ecosystem services upon which Affected Communities' livelihoods are dependent.
- Associated facilities, which are facilities that are not funded as part of the project and that would not have been constructed or expanded if the project did not exist and without which the project would not be viable.[3]
- Cumulative impacts[4] that result from the incremental impact, on areas or resources used or directly impacted by the project, from other existing, planned or reasonably defined developments at the time the risks and impacts identification process is conducted.

[1] *Examples include the project's sites, the immediate airshed and watershed, or transport corridors.*
[2] *Examples include power transmission corridors, pipelines, canals, tunnels, relocation and access roads, borrow and disposal areas, construction camps, and contaminated land (e.g., soil, groundwater, surface water, and sediments).*
[3] *Associated facilities may include railways, roads, captive power plants or transmission lines, pipelines, utilities, warehouses, and logistics terminals.*
[4] *Cumulative impacts are limited to those impacts generally recognized as important on the basis of scientific concerns and/or concerns from Affected Communities. Examples of cumulative impacts include: incremental contribution of gaseous emissions to an airshed; reduction of water flows in a watershed due to multiple withdrawals; increases in sediment loads to a watershed; interference with migratory routes or wildlife movement; or more traffic congestion and accidents due to increases in vehicular traffic on community roadways.*

AoI for Environmental Impacts

The AoI was intended to cover the operation license area of the Project, the footprint and the vicinity considering the environmental impacts considering mainly the air and noise impacts of the Project. In this respect a 6x6 km impact area was selected for air quality emissions assessment which also covers the area for the closest sensitive noise receptor. For the assessment of construction and operation noise levels due to the Project the closest sensitive receptor which is Baklacı neighbourhood at a distance of 1 km was included in the AoI. With regards to surface water quality, Alaşehir Brook which is the closest water body to the Project site was also included in AoI as well as soil sampling points and ecological surveys.

As mentioned in previous sections the geothermal license area covers an area of 2,385.08 hectares where 25 wells have been determined with potential. 12 wells out of 25 wells are planned to be utilized within the scope of the Project and are also included in the EIA area. The AoI covers the EIA area and most of the license area of the Project.

AoI for Social Impacts

The AoI for the social impacts is determined by considering the impacts sourced from land acquisition, workers' accommodation, noise during construction and operation phase, labour influx, changes on dust and air quality.

The settlement in which land take occurred due to Project activities and / or the closest settlement to the Project Site that may experience primarily environmental impacts of the Project will be considered as the first impact zone. In other words, the first impact zone may experience direct impacts of the Project. Therefore, Baklacı neighbourhood, being the closest settlement in which may experience direct environmental and social impacts and experienced all land acquisition for the Project, is considered within the first impact zone. Negotiations on prices of the lands with the landowners have been conducted by the Project Company and the lands were purchased through negotiated land take. All lands acquired for the Project purposes were privately owned land, therefore, no public land take cases acquired by the Project. There were no assets on the purchased lands and physical displacement did not occur for the Project. In terms of type of rights of the acquired land, all land that was acquired for each Project Component was through permanent land take method. There has been no temporary land take acquired by the Project Company. Further information on Project's land allocation can be found in Section 8.2 of this Report.

Second impact zone may cover majority of the indirect Project impacts such job opportunities, providing of goods and service. Therefore, the second impact zone will cover the settlements as Tepeköy and Işıklar.

5.2 Methodology for the Environmental Baseline Assessment

The baseline data have been compiled through available reports, literature review and onsite measurements performed by 2U1K. The onsite sampling and measurements include the following.

- Water sampling on the Alaşehir Brook on April 18, 2017 from a point downstream of the planned geothermal power plant site for the baseline surface water quality assessment,
- Groundwater sampling on April 18, 2017 at the Özmen-24 drilling location (O-24) for the baseline groundwater quality assessment,
- Soil sampling on April 18, 2017 at three locations including the planned site for the geothermal power plant, an agricultural land nearby the Özmen-24 drilling location (O-24) and a site nearby the Özmen-2 drilling location (O-2) in order to investigate the baseline soil conditions,
- Measurements of the weekday PM_{10} levels on April 18 and 19, 2017 and the weekend PM_{10} concentrations on April 29 and 30, 2017 at a location in the Baklacı Neighborhood,
- Measurements of the baseline H_2S concentrations through diffusion tubes installed at 9 different locations on April 18, 2017 to continue for 2 months,
- Measurements of the baseline noise levels on April 18 and 19, 2017 for weekdays and on April 29 and 30, 2017 for weekend days at the nearest settlement, the Baklacı Neighborhood.

The locations of the sampling and measurement points are demonstrated on the maps provided within the sub-sections of Chapter 5.

5.3 Methodology for the Social Baseline Assessment

Both quantitative and qualitative data collection techniques were used during social baseline assessment. Details of data collection are given below.

Collection of Primary Data

Community level assessments were conducted between 17 and 19 April 2017 for the purpose of gathering primary data, and include the following:

- 6 focus group meetings held with women and men separately;
- 6 in-depth interviews with the government agencies and non-governmental organizations in the district and the province.
- Survey with mukhtars for community level surveys.

Male and female participants have been separately involved in the focus group discussions so as to examine gender related concerns.

Secondary Data Collection Techniques

Secondary data was collected and prepared through regional and national statistics, newspaper archives and project documents. Secondary data holds an important role in reaching key stakeholders and project affected people before designing the field study. Information gathered from the secondary data increases the quality of field study and time efficiency during the field study.

Sources of information generally used for the SIA are:

- Data from Turkish Statistical Institute (TURKSTAT)
- Information from Alaşehir Municipality
- Evaluation reports of Non-Governmental Organizations
- Project Description Report for the Geothermal Power Project (dated November 2016)
- Information on social parameters, gathered during public participation meetings

Profile of the communities in the AoI can be seen in Annex-3, based on data collected through field surveys.

5.4 Methodology for the Impact Assessment

Identification and evaluation of impacts begin with the stage of scoping process. Impact assessment is a result of determining the possible impacts of project related activities within the aspects of physical, biological and social environment. During the impact assessment of the Project, possible interactions between the Project and surrounding environment have been defined, in order to provide the entire potential Project related impacts. In that aspect, impact is defined as changes originated from project and project related activities. In order to recognize impacts, the baseline study of the AoI has been established. General nature and types of the impacts categorized in Table 5-1 shown below.

Table 5-1. Impact Types and Definitions

Impact Type	Definition
Positive	Impacts that make positive changes over the current conditions.
Negative	Impacts that leads to new and undesirable changes over the current conditions.
Direct	Direct impacts occur through direct interaction of an activity with an environmental, social, or economic component.
Indirect	Impacts which are not a direct result of the project, often produced away from or as a result of a complex impact pathway.

Cumulative:	Impacts that consist of an impact that is created as a result of the combination of the project evaluated in the current project together with other projects causing related impacts.

As seen in Table 5-2, impacts may occur as positive, negative, direct, indirect and cumulative. Determination of the type of impact is the important step of the assessment process. The determination of the impact type is based on geographical size, duration, significance and likelihood of the impact. The table provides information regarding the process of determining impact significance, respectively.

Table 5-2. Impact Criteria

Impact Extent	***Project Area:*** potential impacts that only cover the borders within the construction site**.** ***Local:*** potential impacts area that covers 20 km within the construction activities of the project. ***Regional:*** potential impacts that cover the throughout the district level. ***National:*** potential impacts that expected to create changes in national level.
Impact Duration	***Temporary:*** extend of the impacts expected to be less than 6 months. ***Short-term:*** impacts that are expected to only occur during the construction phase of the project. ***Long-term:*** impacts that are expected to occur throughout the operation phase of the project. ***Permanent:*** impacts that are expected to be permanent to the project affected people.
Likelihood of Impact	***Not likely:*** impacts that are not likely to occur. ***Likely:*** impacts that are likely to occur in most circumstances. ***Certain:*** the outcome of impacts will certainly occur.
Impact Magnitude	***Negligible:*** There is perceptible change to people's lives ***Low****:* Communities are able to adapt with relative ease ***Medium****:* Communities are able to adapt with some difficulty ***High:*** Affected people/communities will not be able to adapt *to changes*

For the determination of impact significance, the matrix below is used:

Table 5-3. Significance Rating

Likelihood		Unlikely	Likely	Certain
Impact Magnitude	Negligible	Insignificant	Insignificant	Insignificant
	Low	Insignificant	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major

Impact reversibility is used in order to finalize overall impact assessment. Reversibility can be applied with the use of the matrix below:

Table 5-4. Overall Impact Rating

Impact Reversibility		High Reversibility	Medium Reversibility	Low Reversibility	Irreversible
Impact Significance	Insignificant	Insignificant	Insignificant	Insignificant	Insignificant
	Minor	Insignificant	Insignificant	Low	Medium
	Moderate	Low	Low	Medium	High
	Major	Low	Medium	High	Critical

6. ENVIRONMENTAL BASELINE

Baseline assessment is comprised of field studies and desk-top review of various sources of information. Baseline assessment is focused on a series of environmental components, as listed below:

- Geology and earthquake risks
- Climate
- Hydrology and surface water quality
- Groundwater quantity and quality
- Noise
- Air quality
- Soil quality
- Ecology

The site visit was conducted by the ESIA team composed of Tahir Çebi (Geological Engineer, M.S.), Turgay Eser (Environmental Engineer), Elçin Kaya (Sociologist) and Yasemin Çelikel (Social Impact Expert) from 17 to 19 April 2017.

Given that the Project is categorized as a Category B+ investment with limited significant impacts, a partial impact assessment is performed by 2U1K. In this respect, the ESIA Report is based on the onsite baseline measurements and social surveys, as well as environmental and social reports developed formerly for the Project.

Table 6-1. Scoping of Environmental Issues

Project Activities	Environmental Issue	Possible Impacts	Baseline Parameters
Drilling	Effluent discharge	• Discharge of drilling fluids including extracted water from exploration and operational wells during testing. • Discharge of extracted water during well testing. • Discharge of domestic wastewater from camp site.	• Groundwater quality. • Soil quality. • Surface water quality.
Drilling	Drilling mud	• Storage and disposal of drilling mud including cuttings.	• Groundwater quality. • Soil quality.
Drilling	Groundwater contamination	• Contamination of fresh groundwater resources in case of percolation of thermal groundwater during drilling and testing.	• Groundwater quality.
Drilling	Solid waste	• Storage and disposal of solid waste.	• Soil quality. • Groundwater quality.
Drilling	Noise	• Drilling rig, generators, traffic, etc.	• Environmental noise.

Project Activities	Environmental Issue	Possible Impacts	Baseline Parameters
Drilling and Construction	Air emissions	• Possible toxic gas emissions during drilling and well testing (hydrogen sulfide) • Dust emissions due to site activities, arrangement of drilling rig area, construction of access roads, traffic etc.	• Climate. • Air Quality (PM_{10}, H_2S).
Drilling and Construction	Ecosystem	• Disturbance of natural habitats from construction, e.g. dust, noise, un-seasonal working, poor siting of new works, disposal of untreated wastes, etc.	• Flora. • Fauna.
Drilling and Construction	Soil	• Loss of topsoil during preparation of rig sites, construction of access roads or disposal of excavated materials • Damage to soil structure due to material storage, traffic, etc. • Erosion due to uncontrolled surface run-off where vegetation is cleared.	• Soil quality.
Drilling	Emergency and environmental safety	• Well blowout during drilling.	-
Drilling and Operation	Water resources	• Possible over flow from mud pits. • Discharge of test water. • Contamination/pollution of resources due to drilling chemicals, fuel & oil, hazardous wastes, wastewater, etc.	• Surface water quality.

6.1 Geology and Earthquake Risks

The Project area and its environs is comprised of metamorphic massif rocks of Paleosoic Age and sedimentary rocks of Myosene, Pliosene and Quaternary and volcanic rocks of medium aged Myosene. Metamorphic rocks include stratigraphically gneiss, schist, marble, quarcide and various schists. See Figure 6-1 for regional geology.

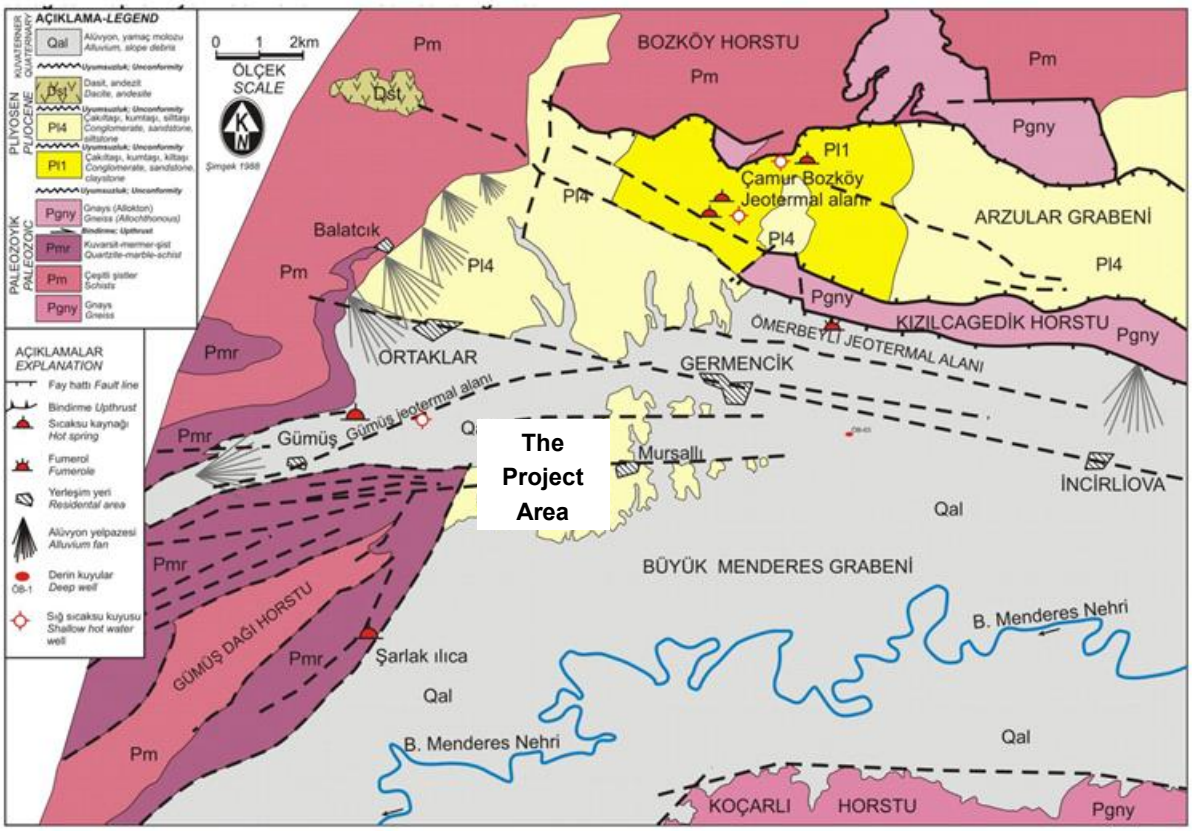
A geological survey was performed for the Project in 2016. According to the Geological Survey Report presented within the Project Description Report, majority of the Project area and close environs is made up of thick alluvial layer mostly more than 100 cm constituted by materials brought by Gediz River and its tributaries. The alluvial layer is of quaternary origin and contains gravel, sand, silt and clay.

The Project area is located mainly on a flat topography with a slope between 0 m and 30 m. The top vegetative soil layer is of about 0.20 m. The groundwater level is observed at about 3,000 m – 3,500 m.

The Project area is located in the 1st degree earthquake zone, hence the Project is required to comply with the Regulation on Buildings to be Constructed in Earthquake Zones (Official Journal Issue: 26454, dated 26.03.2007). The requirements of the regulation apply for the

power plant building but not for drilling wells, pipeline or the ETL. However the drillings of deep wells are performed based on critical geotechnical parameters.

The geologic map of the Project area and its vicinity presented in the Geological Survey Report is provided in Figure 6-1.



Source: The Project Description Report for the Özmen 3 GPP Project

Figure 6-1. The Geologic Map of the Project Area and its Vicinity

Project area is located within 1st degree earthquake zone according to the Earthquake Map of Turkey. The Earthquake Map of Manisa Province with the Project Area is given below Figure 6-2.

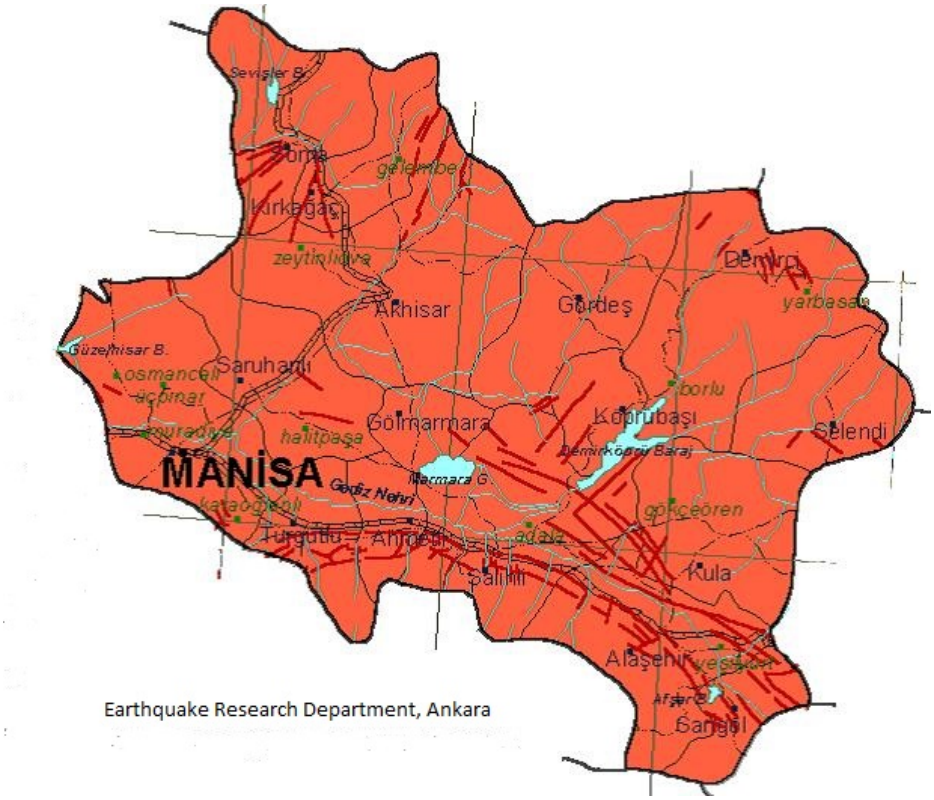


Figure 6-2. Earthquake Map of Manisa

The active faults around Manisa province are Simav fault zone at north-east between Bergama and Menemen and active faults at the east end of Büyük Menderes Graben at the southeast. The active faults within Manisa are active faults in Soma-Kırakağaç-Gölcük region and Gediz Graben.

Ege morphology is shaped by East-West oriented graben systems which generally show symmetrical features. These graben systems consist several thrust areas with parallel alignment which are Simav, Bakırçay, Gediz, Küçük Menderes and Büyük Menderes grabens from north to south. Gediz Graben is one of the most significant thrust areas with a length of almost 200 km within Ege Graben.

At the south of Salihli Neogene sediment consisting areas present a young and steep topography with deep streams and cliffs. This ridge structure reflecting rapid erosion shows graded structure probably formed by young active faults. The areas consisting metamorphic rocks of Menderes massive form Bozdağ chain of 2500 height with E-W extension.

The contact of clastic sediment with metamorphic rocks is mostly faulting. thickening, sloping of the layers, hot and cold water resources are expected at sections close to the fault sediment. This shows that the fault bordering Gediz Graben on the south is with low slope and active for sedimentation.

Carbonated facics is dominant at the northern part of the graben. The distinction between sediment facics at the northern and southern part of Gediz Graben shows the asymmetric development at the formation. Asymmetric behaviour of tectonics and subsidence causes the the slide of graben axis to the active southern side.

Soma-Kırkağaç-Gölcük Faults

There are many parallel faults between Soma, Akhisar and Bigadiç with NNE-SSW orientation and spreading within an area of 40 km. the faults area divided into two zones as Soma-Kırkağaç and Gölcük-Gelenbe. The faults in the two zones display a bunched image getting closer at north.

With limited data, it can be stated that the faults in the region consist strike-slip fault and normal fault components. It can be interpreted that the faults have vertical or close to vertical planes and with strike-slip alignment. The morphology of the basins between fault zones also supports strike-slip interpretation. The right oriented slip-strike characteristics of the faults between Bergama-Menemen which exist at the western part of the region are considered to be similar with the faults at Soma-Kırkağaç region.

Historical earthquakes in Manisa are provided below in Table 6-2.

Table 6-2. Earthquakes in the Region

Date	Earthquake impacts
17	Destruction in İzmir, Efes, Manisa, Alaşehir and Sart-N-S İzmir regionand Gediz and Büyük Menderes thrust. Epicentre was not determined.
44	Destruction in Manisa and Efes. Possible epicentre at N-S İzmir region.
688	Severe destruction in İzmir occurred.
23 February 1653	Destruction occurred from Ezine on the north to Mandayla Bay on the south, from İzmir on the west to Alaşehir and Denizli on the east. Epicentre is not definite.
10 July 1988	Severe destruction in İzmir and sliding on the shore occurred. Epicentre is estimated to be İzmir E-W fault zone.
09 October 1845	Destruction occurred in Midilli and Manisa. Epicentre is estimated to be at Midilli.
1850	Destruction occurred in İzmir, Manisa, Turgutlu, Bayındır, Ödemiş and Tire. Grike formation occurred in Kemalpaşa as well as damages in İzmir, Büyük and Küçük Menderes and Gediz Grabens.
10 June 1858	Impacted Manisa-Akhisar
28 July 1880	Damage occurred at İzmir and Gediz Grabens. Impacted Menemen, Bornova and Karşıkaya and less impacted İzmir, Turgutlu, Mnaisa

Date	Earthquake impacts
	and Alaşehir. Epicenter is estimated to be at İzmir N-S fault zone.
August 1885	Impacted Alaşehir
August 1887	Highly impacted Muğla Köyceğiz, Çİne, Denizli, Menemen, Gördes, Kula, Alaşehir.
26 July 1894	Slightly impacted Aydın, Alaşehir, Ayvalık and Bursa
16 April 1896	Destruction in Emet
June 1900	Slightly impacted Alaşehir
May 1902	Impacts in Manisa, Ödemiş and Bayındır
April 1903	Impacts Akhisar and Urla
December 1904	Impacts in Aydın, Kozpınar, Alaşehir, Dumlupınar, Sakız and Midilli
April 1908	Impacts in İzmir, Alaşehir and Ödemiş.
14 April 1924	Impacts in Akhisar
31 March1928	Destruction in Torbalı. Impacts in Tepeköy, İzmir, Manisa, Alaşehir, Uşak, Bayındır, Tire, Ödemiş. Epicenter is estimated to be in Torbalı intersection of Küçük Menderes and N-S faults. Magnitude of 6.5Ms
14 April 1934	Impacts around Akhisar.
05 February 1942	Impacts in İzmir, Akhisar, Bergama and Urla. Magnitude of 7.
12 August 1942	Impacts in Gelenbe. Epicenter is estimated to be in eastern extension of Bakırçay fault.
12 August 1942	Impacts in Kırkağaç, Balıkesir, Manisa, Turgutlu and Salihli.
10 May 1949	Impacts in Kula
16 July 1955	Epicenter is at Aegean Sea. Impacts in Bayındır, Muğla and Gördes. Flood occurred Gediz and Büyük Menderes Rivers. Magnitude of 6.8Ms
11 March 1963	Impacts in Sivaslı, Alaşehir, Söke, Fethiye and Kavaklıdere.
23 March 1969	Destruction in Demirci, Gördes and Sındırgı. Impacted West Anatolia and İstanbul. Magnitude of 5.9Ms.
28 March 1970	Destruction in Alaşehir and villages around. Caused a grike of 36 km which is a regular fault in N70-80W direction. Magnitude of 6.5Ms.

6.2 Surface Water and Groundwater Quality

The Project area is located within the Gediz catchment zone. There is the Alaşehir Brook flowing at about 125 m south of the Project area.

2U1K performed the surface water sampling on the Alaşehir Brook on April 18, 2017 from a point downstream of the planned geothermal power plant for the baseline surface water quality assessment. The geographical coordinates of the sampling point are provided below.

Table 6-3. The Geographical Coordinates of the Surface Water Sampling Point

Description	Coordinates	
	East	North
The Surface Water Sampling Point	634131	4250486

Source: Google Earth

Figure 6-3. The Location of the Surface Water Sampling Point

Results of water quality analysis are given in Table 6-4 below. Detailed laboratory reports are available in Annex-2.

Table 6-4. Results of Surface Water Quality Analysis

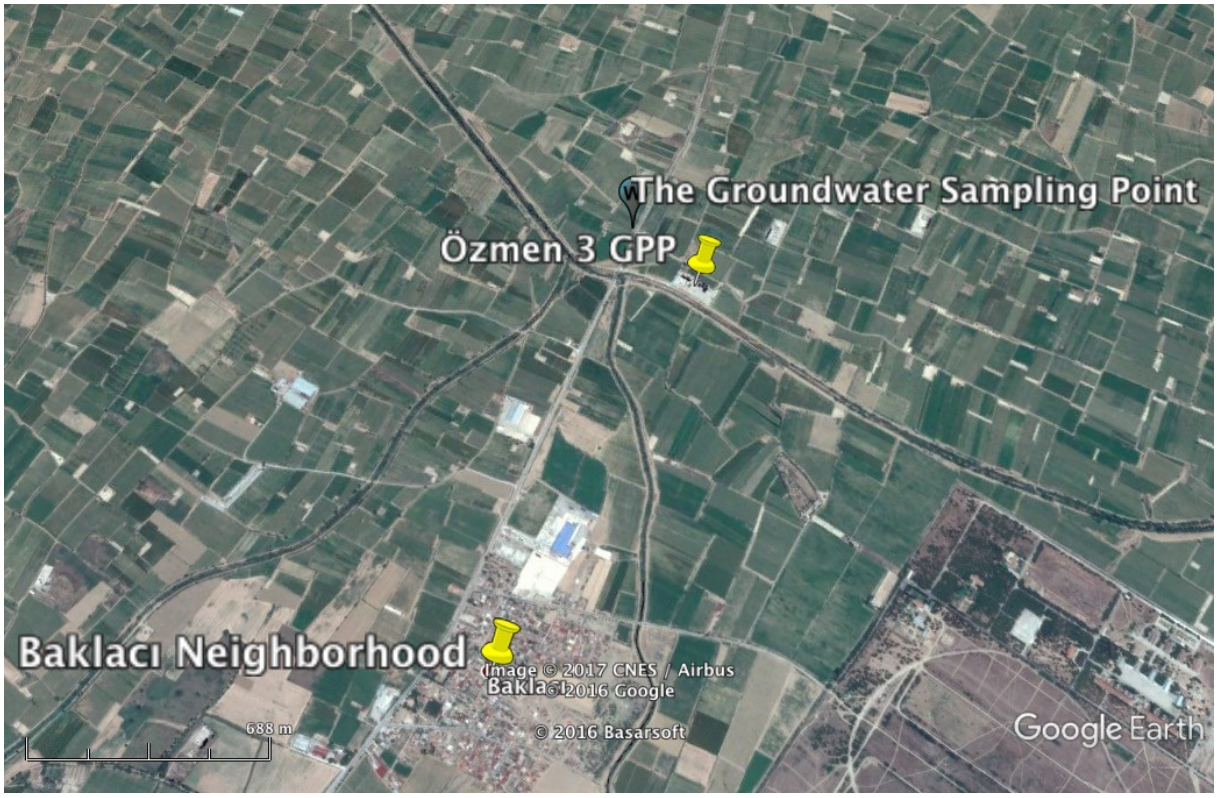
Parameter - Unit		Test Results	National Surface Water Quality Regulation Annex-5			
			Surface Water Quality Classes			
			Class I	Class II	Class III	Class IV
Colour	Wavelength 436 nm	4.1	≤1.5	3	4.3	>4.3
	Wavelength 525 nm	<0.5	≤1.2	2.4	3.7	>3.7
	Wavelength 620 nm	<0.5	≤0.8	1.7	2.5	>2.5
pH		7.49	6-9	6-9	6-9	6-9
Conductivity (µS/cm)		1,515	<400	1,000	3,000	>3,000
Dissolved Oxygen (mg/L)		2.5	>8	6	3	<3
Chemical Oxygen Demand (mg/L)		329	<25	50	70	>70
Biochemical Oxygen Demand (mg/L)		120	<4	8	20	>20
Ammonium Nitrogen (mg/L)		21.8	<0.2	1	2	>2
Nitrate Nitrogen (mg/L)		<0.1	<3	10	20	>20
Total Kjeldahl Nitrogen (mg/L)		33.6	<0.5	1.5	5	>5
Total Nitrogen (mg/L)		33.6	<3.5	11.5	25	>25
Phosphate Phosphorus (mg/L)		0.342	<0.05	0.16	0.65	>0.65
Total Phosphorus (mg/L)		2.03	<0.08	0.2	0.8	>0.8
Fluoride (µg/L)		650	≤1,000	1,500	2,000	>2,000
Manganese (µg/L)		129	≤100	500	3,000	>3,000
Selenium (µg/L)		5.3	≤10	15	20	>20
Sulphide (µg/L)		5,740	≤2	5	10	>10
Oil-Grease (mg/L)		<10	<0.2	0.3	10	>10

The surface water quality test results demonstrate that the downstream of the Alaşehir Brook from the planned geothermal power plant has Class IV surface water quality as per the national legislation. This is mainly due to the high COD, BOD, Nitrogen (N) and Phosphorus (P) concentrations. N and P concentrations can be interpreted as the indication of pollution originated from excessive fertilizer usage in the agricultural areas. These fertilizers might be brought to the brook by means of surface flow resulted from intense rainfalls.

As for the baseline groundwater quality assessment, sampling was performed by 2U1K on April 18, 2017 at the Özmen-24 drilling location (Ö-24) where the well is currently being drilled. The geographical coordinates of the groundwater sampling point are provided in Table 6-5. The location of the sampling point is shown on the map in Figure 6-4.

Table 6-5. The Geographical Coordinates of the Groundwater Sampling Point

Description	Coordinates	
	East	North
The Groundwater Sampling Point	634515	4250394



Source: Google Earth

Figure 6-4. The Location of the Surface Water Sampling Point

The results of the groundwater quality analysis are provided in Table 6-6 below, and the detailed laboratory report is given in Annex-2.

Table 6-6. Test Results for Groundwater

Parameter - Unit	Test Results
Ammonium (mg/L)	0.41
Arsenic (mg/L)	0.048
Mercury (mg/L)	<0.0005
Phosphorus from Phosphate (mg/L)	0.186
Conductivity (µS/cm)	1,929
Cadmium (mg/L)	<0.001
Chloride (mg/L)	44
Lead (mg/L)	<0.005
Nitrite (mg/L)	0.07

Parameter - Unit	Test Results
Total Pesticides (mg/L)	0.33
Sulphate (mg/L)	216
Tetrachloroethene (µg/L)	<0.07
Total Phosphorous (mg/L)	0.578
Trichloroethene (µg/L)	<0.09

The test results indicate that the groundwater has high conductivity associated with its high salt content. In terms of its high salt content, the groundwater is of low water quality according to Annex 1 of the Regulation on Protection of Groundwater Against Pollution and Deterioration. Furthermore, the total pesticides concentration of the groundwater is quite high with respect to the quality standard set for the total pesticides in Annex 2 of the Regulation.

6.3 Climate

A part of the Manisa Province is under the influence of the Mediterranean Climate, while a part of it is under the influence of the continental climate as a consequence of the mountain ranges blocking the sea effect (The Project Description Report, 2016).

According to the long-years meteorological data (between the years 1926 and 2016) for the Manisa Province, the average annual temperature is 16.9°C, while the average highest temperature is 34.9°C in July and August, and the average lowest temperature is 3.0°C in January. The highest temperature was measured in July 2007 as 45.5°C, and the lowest temperature was measured in January 1942 as -17.5°C. The maximum total daily precipitation was measured as 163.5 kg/m^2 in December 1986; the daily maximum wind speed as 153.0 km/hr in December 1966 (Republic of Turkey, Ministry of Forestry and Water Affairs, General Directorate of Meteorology, 2017). The dominant wind direction is East and the secondary dominant wind direction is East-Northeast depending on the seasonal changes (Republic of Turkey, Ministry of Forestry and Water Affairs, General Directorate of Meteorology).

6.4 Soil Quality

In order to investigate the baseline soil conditions to detect any soil contamination related with the mud pits, 2U1K performed the soil sampling on April 18, 2017, at three locations including the planned site for the geothermal power plant, an agricultural land nearby the Özmen-24 drilling location (O-24) where the well is currently being drilled and a site nearby the Özmen-2 drilling location (O-2). The geographical coordinates of the soil sampling points are provided in Table 6-7 below. The locations of the sampling points are also shown on the map in Figure 6-5.

Table 6-7 The Geographical Coordinates of the Soil Sampling Points

Description		Coordinates	
		East	North
The Soil Sampling Points	The planned site for the geothermal power plant	634615	4250370
	The Özmen-24 drilling location (O-24)	634437	4250512
	The Özmen-2 drilling location (O-2)	634379	4250510

Source: Google Earth

Figure 6-5. The Locations of the Soil Sampling Points

The analysis was conducted in order to determine the baseline soil quality at the Project Area according to the “Regulation on Soil Pollution Control and Point Source Polluted Areas” Annex-2: Potential Soil Pollutant Activities and Pollution Indicator Parameters for Specific Activities.

The results of the analysis of the soil samples are provided in below. The detailed laboratory report is given in Annex-2.

Table 6-8 The Results of the Analysis of the Soil Samples

Parameter - Unit	Test Results at the Özmen-2 drilling location (O-2)	Test Results at the Özmen-24 drilling location (O-24)	Test Results at the planned site for the geothermal power plant	Limit Values for Generic Pollutants-Transport of Pollutants to Groundwater and Ingestion of Groundwater	
Total Organic Halogens (TOX) (mg/kg)	83	73	49.78	-	
Antimony (mg/kg)	<1.25	1.29	1.64	2	
Arsenic (mg/kg)	14.38	24.06	28.1	3	
Copper (mg/kg)	21.57	269.81	30.24	514	
Barium (mg/kg)	116.73	125.67	124.05	288	
Boron (mg/kg)	47.22	53.48	53.57	3	
Mercury (mg/kg)	<0.25	<0.25	<0.25	3	
Zinc (mg/kg)	78.86	76.08	71.9	6811	
Cadmium (mg/kg)	<0.25	<0.25	<0.25	27	
Chromium (mg/kg)	73.83	89.45	89.29	900000	
Lead (mg/kg)	6.71	8.02	8.33	135	
Molybdenum (mg/kg)	<2.5	<2.5	<2.5	14	
Selenium (mg/kg)	<1.25	<1.25	<1.25	14	
Total Petroleum Hydrocarbons (mg/kg)	117	10.9	16.3	-	

According to the results arsenic and boron concentrations are higher than regulation limits values. Arsenic is a naturally occurring element in soil, on the other hand according to a number of researches conducted on soil quality for agricultural purposes, Boron concentrations are observed high at almost all sampled vineyards in Alaşehir. It can be concluded that boron levels are high in the region. It should also be noted that the results of analyses are the presentation of the baseline soil quality and cannot be attributed to any interpretation of Project impacts.

6.5 Air Quality

2U1K performed measurements of a number of air quality parameters for the purpose of assessment of the baseline conditions related with the parameters such as dust and H_2S.

The weekday PM_{10} levels in the Baklacı Neighborhood were measured on April 18 and 19, 2017 and the weekend PM_{10} concentrations were measured on April 29 and 30, 2017. The geographical coordinates of the PM_{10} measurement point are given in Table 6-9 below. The location of the PM_{10} measurement point is shown on the map in Figure 6-6.

Table 6-9 The Geographical Coordinates of the PM_{10} Measurement Point

Description	Coordinates	
	East	North
The PM10 Measurement Point	634787	4249058

Source: Google Earth

Figure 6-6 The Location of the PM_{10} Measurement Point

The test results for the PM_{10} concentrations are presented in Table 6-10 below, which indicate that the current dust emissions are below the limits designated for the year, 2017, in the Regulation on Control of Industrial Air Pollution (Table 2.2 of Annex-2 of the Regulation). The detailed laboratory report is provided in Annex-2.

Table 6-10 The Results of the PM_{10} Measurements

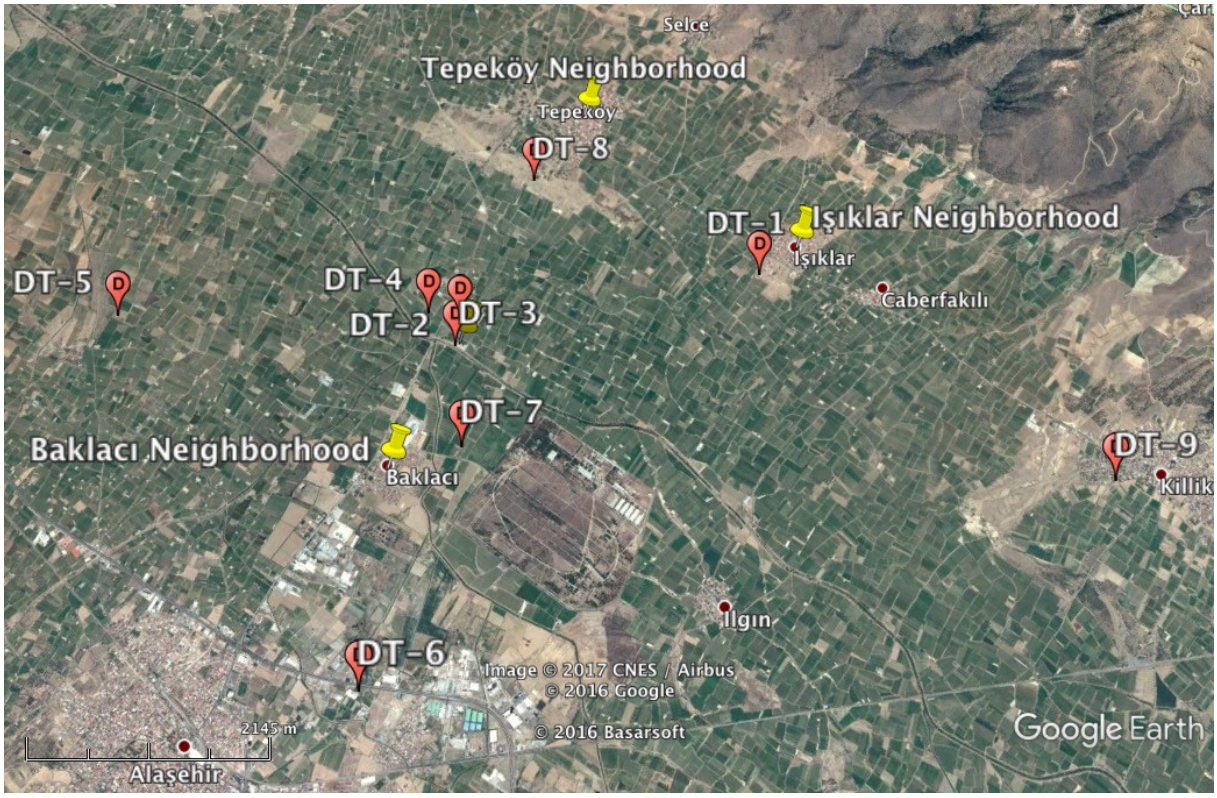
PM_{10} Measurement Location and Duration	Measured PM_{10} Concentration ($\mu g/m^3$)	Limit Values According to the National Regulation ($\mu g/m^3$)	
		24-hour value	Annual value
The Baklacı Neighborhood (a weekday)	14	70	48
The Baklacı Neighborhood (a weekend day)	56		

According to the WHO Ambient Air Quality Guidelines referred to in the IFC's General EHS Guidelines on Air Emissions and Ambient Air Quality, the 24-hour and 1-year average guideline values for PM_{10} are 50 $\mu g/m^3$ and 20$\mu g/m^3$, respectively. Despite compliance with the national standards, the weekend concentration of PM_{10} exceeds the 24-hour average guideline value. Exceeding concentration of PM10 can be due to the traffic increase on Alaşehir-Kula road which passes from the west of the measurement point during weekend.

For measurement of the baseline H_2S concentrations, diffusion tubes were installed on April 18, 2017 at 9 different locations, the geographical coordinates of which are given in Table 6-11 below. These locations are further demonstrated on the map provided in Figure 6-7.

Table 6-11 The Geographical Coordinates of the Points where the Diffusion Tubes have been installed

Description		Coordinates	
		East	North
The Points where the Diffusion Tubes have been installed	Işıklar Neighborhood	637775	4250968
	Özmen-1 Drilling Location	634684	4250146
	The GPP Site	634714	4250419
	Özmen-24 Drilling Location	634388	4250490
	Akkeçili Village Gülbahçe Neighbourhood	631223	4250398
	Alaşehir	634013	4246781
	Baklacı Neighborhood	634814	4249095
	Tepeköy Neighborhood	635406	4252017
	Killik	641177	4248875



Source: Google Earth

Figure 6-7 Diffusion Tubes Location

Sampling was conducted for two consecutive months, which are 18.04.2017 – 18.05.2017 and 18.05.2017 – 17.06.2017, respectively.

The baseline H_2S concentrations are presented below in Table 6-12 and Table 6-13.

Table 6-12. The Results of the Measurements of the Baseline H2S Concentrations for the First Period

Measurement Locations	Measurement Period	Measurement Duration	Total µg H_2S	µg H_2S (Blank)	µg/m^3	ppb
Işıklar Neighborhood	18.04.2017 – 18.05.2017	720 hours	0.12	0.09	0.20	0.14
Özmen-1 Drilling Location			0.21	0.18	0.39	0.28
The GPP Site			0.33	0.30	0.65	0.46
Özmen-24 Drilling Location			0.07	0.05	0.11	0.07
Akkeçili Village			0.06	0.03	0.07	0.05
Baklacı Neighborhood			0.17	0.15	0.32	0.22

Measurement Locations	Measurement Period	Measurement Duration	Total µg H_2S	µg H_2S (Blank)	µg/m^3	ppb
Tepeköy Neighborhood			0.12	0.10	0.21	0.15
Killik			0.11	0.09	0.18	0.13

Table 6-13. The Results of the Measurements of the Baseline H2S Concentrations for the Second Period

Measurement Locations	Measurement Period	Measurement Duration	Total µg H_2S	µg H_2S (Blank)	µg/m^3	ppb
Işıklar Neighborhood	18.05.2017 – 17.06.2017	720 hours	0.11	0.08	0.18	0.12
Özmen-1 Drilling Location			0.16	0.14	0.30	0.21
The GPP Site			0.17	0.14	0.31	0.22
Özmen-24 Drilling Location			0.17	0.14	0.31	0.22
Akkeçili Village			0.11	0.09	0.18	0.13
Baklacı Neighborhood			0.16	0.14	0.30	0.21
Tepeköy Neighborhood			0.14	0.12	0.25	0.18
Killik			0.16	0.13	0.29	0.20

The baseline concentrations of H_2S are below the limit values, which are 100 µg/m^3 as the 1-hour limit value and 20 µg/m^3 as the short term value defined by the Turkish Industrial Air Pollution Control Regulation No. 29211 dated 20.12.2014 which sets the ambient air quality standards for a number of pollutants, including H_2S (hydrogen sulphide).

6.6 Environmental Noise

2U1K performed measurements of the baseline noise levels on April 18-19, 2017 for weekdays at the nearest settlement, the Baklacı Neighborhood. The measurements for weekend days were conducted on April 29-30, 2017. The geographical coordinates of the noise measurement point are given in Table 6-14 below. The location of the noise measurement point is shown on the map in Figure 6-8.

Table 6-14 The Geographical Coordinates of the Noise Measurement Point

nDescriptio	Coordinates	
	East	North
The Noise Measurement Point	634789	4249069

Source: Google Earth

Figure 6-8 The Location of the Noise Measurement Point

The results of the measurements of the baseline noise levels are provided in Table 6-15 .

Table 6-15 The Results of the Measurements of the Baseline Noise Levels

Period	Hours	Date	Measured Noise Level L_{eq} (dBA)	Average Measured Noise Level L_{eq} (dBA)
Daytime (07:00-19:00)	07:00-08:00	18.04.2017 – 19.04.2017 (a weekday)	47	44.3
	08:00-09:00		43.7	
	09:00-10:00		42.2	
	10:00-11:00		46	
	11:00-12:00		42.2	
	12:00-13:00		44.9	
	13:00-14:00		44.1	
	14:00-15:00		44.2	
	15:00-16:00		42.8	
	16:00-17:00		42.9	
	17:00-18:00		44.4	
	18:00-19:00		44.6	
Evening time (19:00-23:00)	19:00-20:00		47.6	51.4
	20:00-21:00		53.1	
	21:00-22:00		55.5	
	22:00-23:00		45.9	
Nighttime (23:00-07:00)	23:00-00:00		45.5	50.6
	00:00-01:00		55	
	01:00-02:00		52.8	
	02:00-03:00		55	
	03:00-04:00		40.2	
	04:00-05:00		40.7	
	05:00-06:00		42.3	
	06:00-07:00		45.5	
Daytime (07:00-19:00)	07:00-08:00	29.04.2017 – 30.04.2017 (a weekend)	44.4	48.3
	08:00-09:00		39.7	
	09:00-10:00		37	
	10:00-11:00		36.7	
	11:00-12:00		37.3	
	12:00-13:00		43.8	
	13:00-14:00		43.7	
	14:00-15:00		47.5	
	15:00-16:00		56.3	

Period	Hours	Date	Measured Noise Level L_{eq} (dBA)	Average Measured Noise Level L_{eq} (dBA)
	16:00-17:00		53.2	
	17:00-18:00		39.3	
	18:00-19:00		44.8	
Evening time (19:00-23:00)	19:00-20:00		55.8	51.7
	20:00-21:00		51.5	
	21:00-22:00		48.5	
	22:00-23:00		37.7	
Nighttime (23:00-07:00)	23:00-00:00		42.4	45.6
	00:00-01:00		49.7	
	01:00-02:00		48.5	
	02:00-03:00		42.5	
	03:00-04:00		34.4	
	04:00-05:00		37.6	
	05:00-06:00		47.5	
	06:00-07:00		45	

According to the results, the measured baseline noise levels are under the limit values set in Table-5 in Annex VII of the Regulation on Assessment and Management of Environmental Noise.

According to the IFC Noise Management Guidelines, for residential receptors, the daytime and nighttime noise limits are 55 dBA and 45 dBA, respectively. Despite compliance with the national standards, the results of the noise measurements show that the current levels of noise during the construction stage (drilling, excavation, construction) exceed the nighttime noise limits of the IFC.

6.7 Ecology

Literature search and field surveys have been conducted for the determination of baseline flora-fauna characteristics of the Project area. Field surveys were conducted between 17 and 19 April 2017 at the Project area and its vicinity by 2U1K.

The bibliographic references used during the desktop study included:

- IUCN Red List Database;
- Turkish Red Data Book of plant species;
- Important Bird Areas for Turkey;
- CORINE Land Cover database;
- Documents and studies conducted by the Turkish Government, scientific Institutions and Associations;
- Satellite images and aerial photos; and

Scientific literature available in public databases and from Universities.

A thorough literature research was performed for endemic, restricted-range critically endangered, endangered, congregatory and migratory species (collectively referred to as species of conservation concern) identified.

The results of the analysis enabled to identify the presence of habitats with the potential for hosting species in the Study Area (i.e. site located within the species range and ecologically suitable to its habitat requirements). A set of species potentially present in the Study Area was identified for the different taxon (plants, mammals, birds, reptiles and amphibians).

The outputs of the field surveys were compared with literature references in order to make an inventory of flora-fauna species present in the Study Area.

The Flora list was prepared in accordance with the phylogenetic order in Turkish flora; ferns, open seed plants (*Gymnospermae*) and closed-seeded plants (*Angiospermae*). Families under each group were also listed according to the phylogenetic order in the Turkish flora. Species were listed with their Latin name, English name (if available), phytogeographic regions, endemism, threat categories for endemic and rare species, and their abundance in the region. Samples collected in the Project Areas were transformed into herbarium material and identified by using the “Flora of Turkey and the East Aegean Islands” by Davis, 1965-1988.

Threat status of endemic and rare flora species was determined according to the Red Data Book of Turkish Plants (Ekim et al., 2000), which had been prepared in accordance with the IUCN 1994 criteria.

Fauna surveys started early in the morning and continued until sunset.

Animal species and the existence of habitats apt for the choices of fauna have been determined through several indicators such as nest-youngster-vomit-footprint of these species (especially in the determination of the bird and large mammal species), faeces-food residues-burrow hole (especially in determination of mammals), skin-horn-shield and bone pieces. No hunting-capture-killing has occurred during the identification of species.

Observations of non-living material in nature (especially dead reptile individuals and/or skin, shield pieces found on site) are used particularly for reptile and small mammalian species and literature information on fauna elements of these areas, previously collected museum materials and locals contributed to the prepared species lists.

The general criteria and their explanations that are used while evaluating the status of the species are given below.

CITES

CITES is the Convention on International Trade in Endangered Species of Wild Fauna and Flora. CITES is an international agreement between 164 nations (including Turkey) and its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. CITES principles depend on the sustainable trade fundamental that is significant for protection of the ecologic resources (a vast array of wildlife products derived from a great quantity of live animals and plants, products additive to the food, exotic leather goods, etc.) in the future

Appendix I lists species that are the most endangered among CITES-listed animals and plants. They are threatened with extinction and CITES prohibits international trade in specimens of these species except when the purpose of the import is not commercial, for instance for scientific research. In these exceptional cases, trade may take place provided it is authorized by the granting of both an import permit and an export permit (or re-export certificate).

Appendix II lists species that are not necessarily now threatened with extinction but that may become so unless trade is closely controlled. It also includes so-called "look-alike species", i.e. species whose specimens in trade look like those of species listed for conservation reasons. International trade in specimens of Appendix-II species may be authorized by the granting of an export permit or re-export certificate. No import permit is necessary for these species under CITES. Permits or certificates should only be granted if the relevant authorities are satisfied that certain conditions are met, above all that trade will not be detrimental to the survival of the species in the wild.

Appendix III is a list of species included at the request of a Party that already regulates trade in the species and that needs the cooperation of other countries to prevent unsustainable or illegal exploitation. International trade in specimens of species listed in this Appendix is allowed only on presentation of the appropriate permits or certificates.

IUCN Red List of Threatened Species

International Union for Conservation of Nature (IUCN) Red List is published to draw attention to the species whose population is under risk or threatened. IUCN includes the species to the Red List after researching the reasons causing decrease in its population. IUCN Red List categories are given below:

EX: Extinct

EW: Extinct in the Wild

CR: Critically Endangered

EN: Endangered

VU: Vulnerable

NT: Near Threatened

LC: Least Concern

DD: Data Deficient

NE: Not Evaluated

EXTINCT (EX) A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

EXTINCT IN THE WILD (EW) A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR) A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered, and it is therefore considered to be facing an extremely high risk of extinction in the wild.

ENDANGERED (EN) A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered and it is therefore considered to be facing a very high risk of extinction in the wild.

VULNERABLE (VU) A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable and it is therefore considered to be facing a high risk of extinction in the wild.

NEAR THREATENED (NT) A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future.

LEAST CONCERN (LC) A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category.

DATA DEFICIENT (DD) A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE) A taxon is Not Evaluated when it has not yet been evaluated against the criteria.

5 different observation points were determined for the surveys of the Project area and its vicinity. Observation points were selected considering their proximity to the Project components, representation of the Project area, capability to create frequency, and ecological characteristics. The coordinates of the observation points are presented below in Table 6-16.

Table 6-16. Ecological Survey Points

Observation Points	UTM-ED50 (Zone 35)	
	X	Y
1	634744	4251900
2	634586	4250947
3	635208	4249985
4	633781	4251175
5	632512	4252505

Map showing the observation points for ecological survey is provided below in Figure 6-9.

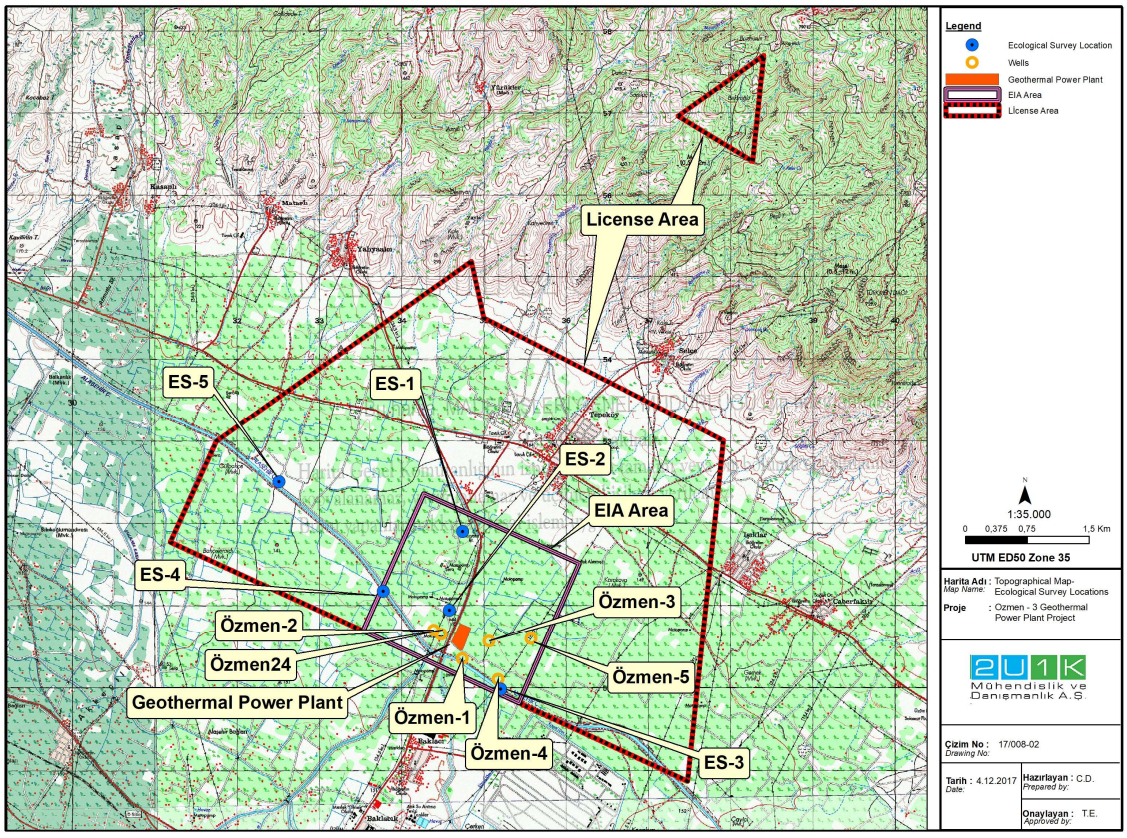


Figure 6-9. Ecological Survey Points

6.7.1 Flora

Vegetation and plant species of the Project site and its immediate environment have been assessed as a result of field studies and literature survey. The entire flora species of the region that is included in the resource “Flora of Turkey” have been reviewed in order to

eliminate any potential errors. Endemic species with possible existence due to their habitat characteristics have been considered in particular.

Field studies have been conducted in addition to previous studies for determining the plant species within the Project site, and the information obtained have been supported by literature data. Determination of flora species has been based on field investigations while studies in the literature have been made use of for undefined plant species.

The Project area is within the Mediterranean phyto-geographical region, and is located in B1 square according to Davis' Grid System. The Project area is dominated by agricultural lands and has the characteristics of a flat topography. See Photo 6-1.

Photo 6-1. Agricultural Areas Around the Project Site

The surroundings of the Project area are composed of highly modified habitats surrounded by road networks, residential buildings and agricultural lands.

Legally protected and internationally recognized areas in the region have been determined as a result of field surveys and literature review. In this context, the protected area network of the region has been examined and the possible effects of the Project to these wildlife sanctuaries have been checked to prove that the Project area and the influence zone sufficiently far from the protected area network of Manisa. Closest protected area to the

Project area is Kula Fairy Chimneys Natural Monument at a distance of 25 km at north-east direction. Other protected areas and their distance is provided below in Figure 6-10.

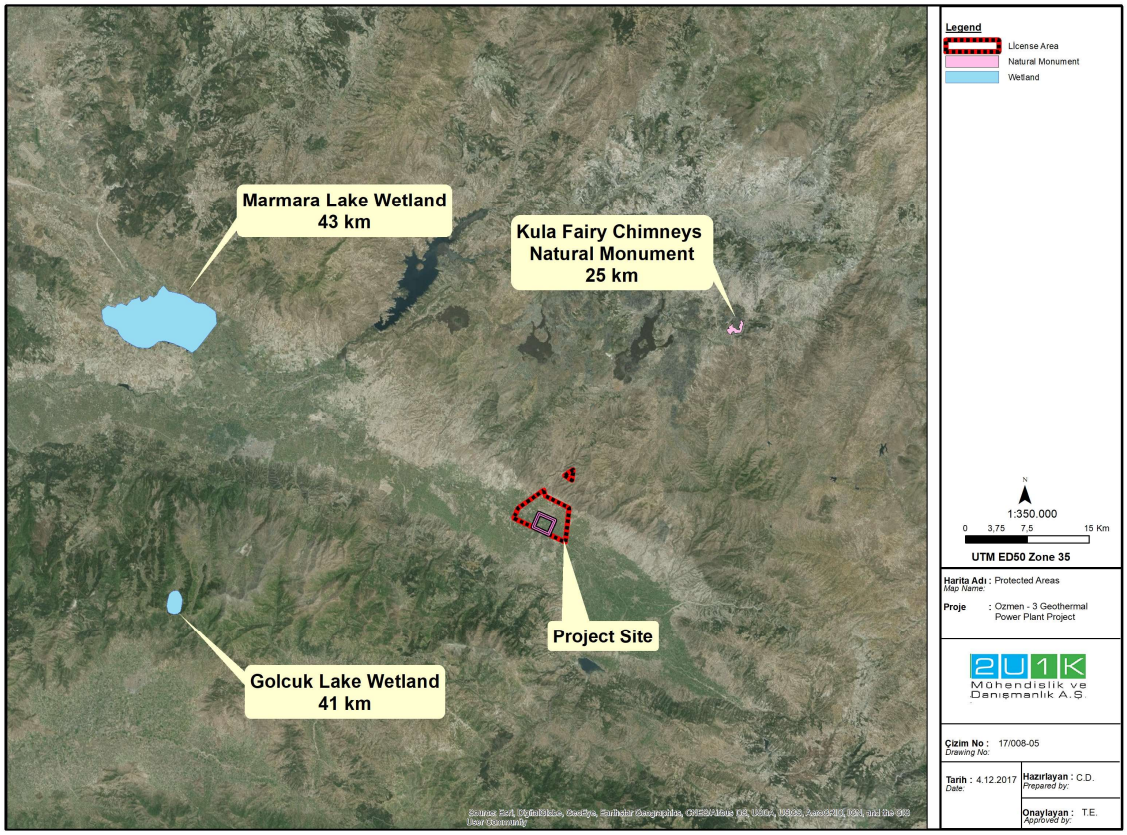


Figure 6-10. The Protected Areas Around the Project Area

The floristic structure of the project site and its immediate environment was determined by a detailed literature research and field surveys. According to the results of the surveys it can be seen that the area is covered with ruderal herbaceous plants and cultivated plants.

During flora studies, species were generally observed on the edge of the agricultural areas and on the roadsides. For this reason, studies were focused in these areas.

Table 6-17. lists possible flora in the project area and its environs as a result of the field observations and literature survey. Field surveys indicate that the natural vegetation has been destructed by anthropogenic impacts and has been replaced by cultivated plants. The herbaceous vegetation on the Project Site was not in good form, being quite degenerated.

As seen in Table 6-17. , no endemic taxa, nor significance in terms of categorizations of IUCN and the Bern Convention, are detected among the listed species.

Species identified during the studies are generally common species.

Due to intensive agricultural activities in the region, plant species can only grow on the edge of agricultural fields and roads.

There are a total of 390 plant species in the province of Manisa, whereas only 29 species were identified in the study area. For this reason, it is concluded that the area is poor in terms of plant diversity.

In the overall, the flora and the vegetation of the project area are not important in terms plant biodiversity.

Table 6-17. Flora in the Project Area and its Environs

Latin Name	Endemism	IUCN	Bern Convention	Source
FABACEAE	-	-	-	
Lens nigricans	-	-	-	**L**
Vicia grandiflora	-	-	-	**L**
Trifolium purpureum	-	-	-	**O**
APİACEAE	-	-	-	
Ammi majus	-	-	-	**L**
ASTERACEAE	-	-	-	
Filago eriocephala	-	-	-	**O**
Anthemis austriaca	-	-	-	**L**
Onopordum myriacanthum	-	-	-	**L**
Silybum marianum	-	-	-	**O**
Carthamus lanatus	-	-	-	**L**
Echinops ritro	-	-	-	**L**
LİLİACEAE	-	-	-	
Ornithogalum nutans	-	-	-	**O**
POACEAE	-	-	-	
Ventenata subenervis	-	-	-	**O**
Psilurus incurvus	-	-	-	**O**
Parapholis pycnantha	-	-	-	**L**
RANUNCULACEAE	-	-	-	
Nigella elata	-	-	-	**L**
BRASSİCACEAE	-	-	-	
Hutchinsia petraea	-	-	-	**O**
Alyssum umbellatum	-	-	-	*O*
CARYOPHYLLACEAE	-	-	-	

Latin Name	Endemism	IUCN	Bern Convention	Source
Petrorhagia dubia	-	-	-	**O**
Silene squamigera	-	-	-	**L**
Silene subconica	-	-	-	**L**
LAMİACEAE	-	-	-	
Marrubium vulgare	-	-	-	**L**
Salvia aethiopis	-	-	-	**L**
EUPHORBİACEAE	-	-	-	
Euphorbia platyphyllos	-	-	-	**O**

Trifolium purpureum

Silybum marianum

Hutchinsia petraea

Petrorhagia dubia

Figure 6-11. Some Flora Species Observed in the Project Area and its Environs

6.7.2 Fauna

Fauna inventory was prepared based on conducted fieldwork and a wide literature research. The status of the fauna in the region was evaluated according to the biological and ecological perspectives. Risk categories of fauna species were determined according to the IUCN red list categories which were published in Version 2016.3. In the fauna list that has been provided, species are written with the family names to which they belong.

Sixty-eight species and sub-species are known to exist in the Project Area and in its surrounding. A fauna inventory was prepared on a large scale so that it also includes many species not observed directly in the Project Area. Endemic species are sensitive in terms of risk status. However, during the site visits it was found that the immediate area of the facility and the close environs are not used by the target species which are known to be endemic.

The Project Site includes water courses and rocky areas which are suitable for reptiles and amphibians, which makes the area suitable habitat for both groups. Species, directly observed and likely to be seen in the Project Area are listed in Table 6-18.

Table 6-18. Species of Reptiles and Amphibians in the Project Region

Latin Name	Endemism	IUCN Red List	Bern Convention	Source
BUFONIDAE				
Bufotes variabilis		DD	ANN-III	L
Bufo viridis	-	LC	ANN-II	L
Bufo bufo	-	LC	ANN-III	O
TESTUDINIDAE				
Testudo graceae	-	VU	ANN-II	O
LACERTIDAE				
Ophisops elegans	-	NE	ANN-II	O
Lacerta trilineata	-	LC	ANN-II	L
COLUBRIDAE				
Elaphe sauromates	-	NE	ANN-III	L

Ophisops elegans

Testudo graceae

Figure 6-12 Some Reptiles and Amphibians Species Observed in the Project Area and its Environs

Regarding Table 6-18, the scale of IUCN risk category LC stands for “Least Concern”

For the fauna species taken under protection by Appendix – II and Appendix – III of the Bern Convention, measures stated in Article 6 and 7 of the Bern Convention have to be taken. In

particular, the following issues will be considered for the species listed in Appendix II in accordance with the 6th Article of the Bern Convention.

The species listed in Appendix II of the Bern Convention are strict. The species listed in Appendix III are periodically under protection.

Field data and literature research shows that the project area and surroundings are occupied by species which are known to exist in habitats altered by anthropogenic activities.

The bird species which were identified through literature and observed from field survey have been presented in Table 6-19. below.

Table 6-19. Bird Species in the Region

Latin Name	Endemism	IUCN Red List	Bern Convention	Source
Accipitridae				
Accipiter nisus	-	LC	ANN-II	L
Buteo buteo	-	LC	ANN-II	O
Buteo rufinus	-	LC	ANN-II	L
PHASIANIDAE				
Aletoris chukar	-	LC	ANN-III	L
COLUMBIDAE				
Columba livia	-	LC	ANN-III	O
Streptopelia decaocto	-	LC	ANN-III	L
STRIGIDAE				
Athene noctua	-	LC	ANN-II	L
APODİDAE				
Apus apus	-	LC	ANN-III	L
Apus melba	-	LC	ANN-II	L
MEROPIDAE				
Merops apiaster	-	LC	ANN-II	L
UPUPIDAE				
Upupa epops	-	LC	ANN-III	O
ALAUDIDAE				
Alauda arvensis	-	-	ANN-III	O
Galerida cristata	-	LC	ANN-III	O

Latin Name	Endemism	IUCN Red List	Bern Convention	Source
Lullula arborea	-	LC	ANN-III	
HIRUNDINIDAE				
Hirundo rustica	-	LC	ANN-II	L
MOTACILLIDAE				
Anthus campestris	-	LC	ANN-II	O
Anthus trivialis	-	LC	ANN-II	L
Anthus pratensis	-	LC	ANN-II	L
Motacilla alba	-	LC	ANN-II	L
MUSCICAPIDAE				
Muscicapa striata	-	LC	ANN-II	L
Erithacus rubecula	-	LC	ANN-II	O
Phoenicurus ochruros	-	LC	ANN-II	L
Saxicola rubetra	-	LC	ANN-II	L
Oenanthe isabellina	-	LC	ANN-II	L
Oenanthe oenanthe	-	LC	ANN-II	O
Oenanthe hispanica	-	LC	ANN-II	L
TURDIDAE				
Turdus merula	-	LC	ANN-III	O
Turdus philomelos	-	LC	ANN-III	L
Turdus viscivorus	-	LC	ANN-III	L
SYLVIIDAE				
Sylvia curruca	-	LC	ANN-II	L
Phylloscupus collybita	-	LC	ANN-II	L
Phylloscopus trochilus	-	LC	ANN-II	L
SITTIDAE				
Sitta neumayer	-	LC	ANN-II	L
LANIIDAE				
Lanius collurio	-	LC	ANN-II	L
Lanius minor	-	LC	ANN-II	O
Lanius senator	-	LC	ANN-II	L

Latin Name	Endemism	IUCN Red List	Bern Convention	Source
CORVIDAE				
Garrulus glandarius	-	LC	ANN-III	L
Corvus corone	-	LC	ANN-III	O
Corvus corax	-	LC	ANN-III	L
STURNIDAE				
Sturnus vulgaris	-	LC	ANN-III	O
PASSERIDAE				
Passer domesticus	-	LC	ANN-III	O
FRINGILLIDAE				
Fringilla coelebs	-	LC	ANN-III	L
Carduelis carduelis	-	LC	ANN-II	L
Carduelis chloris	-	LC	ANN-II	L
Carduelis spinus	-	LC	ANN-II	L
Carduelis cannabina	-	LC	ANN-II	L
EMBERIZIDAE				
Emberiza hortulana	-	LC	ANN-III	L
Emberiza caesia	-	LC	ANN-II	L
Emberiza melanocephala	-	LC	ANN-II	L
Miliaria calandra	-	LC	ANN-III	O

Buteo buteo

Oenanthe oenanthe

Lanius minor

Upupa epops

Figure 6-13 Some Bird Species Observed in the Project Area and its Environs

The project area is located on agricultural areas with low fertility and thus its anthropogenic impacts have made the area unsuitable for mammal species, especially larger mammals which require considerably wide ranges.

Table 6-20 Mammals in the Project Region

Latin Name	Endemism	IUCN Red List	Bern Convention	Source
ERINACEIDAE				
Erinaceus concolor	-	LC	-	L
VESPERTİLİONİDAE				
Pipistrellus pipistrellus	-	LC	ANN-III	L
LEPORIDAE				
Lepus europaeus	-	LC	ANN -III	L
CRİCETIDAE				
Cricetulus migratorius	-	LC	-	O
MURIDAE				
Mus musculus	-	LC	ANN -III	O
Rattus rattus	-	LC	-	L
Rattus norvegicus	-	LC	-	L
CANIDAE				
Vulpes vulpes	-	LC	ANN -III	L

Latin Name	Endemism	IUCN Red List	Bern Convention	Source
MUSTELLIDAE				
Mustela nivalis	-	LC	ANN -III	L
Martes foinea	-	LC	ANN -III	L
SUIDAE				
Sus scrofa scrofa	-	LC	ANN -III	O

Mammal species were not directly observed in field studies. Species was identified from the nests and tracks in the study area.

Figure 6-14 Some Mammal Tracks Observed in the Project Area and its Environs

7. SOCIAL BASELINE

In this section, baseline data for the socio-economic aspects of the Area of Influence (AoI) is presented in order to provide a current situation against which the impacts of the Project can be assessed. The baseline takes into account present conditions, as well changing conditions (i.e. population, education) apparent in the baseline.

The baseline description has the following main objectives to:

- focus on receptors that were identified during scoping as having the potential to be significantly affected by the Project,
- describe and, where possible, quantify their characteristics (demography, economy, education, health, etc.),
- provide data to aid the prediction and evaluation of possible impacts and,
- inform judgments about the sensitivity, vulnerability and/or importance of resources/receptors.

The aim of the socio-economic baseline study is to describe the socio-economic conditions and trends in the areas potentially affected by the Project to understand potential effects and to develop appropriate mitigation measures. The socio-economic baseline defines the socio-economic issues of importance of provincial and local communities and establishes a baseline of socio-economic data that can be used for monitoring changes in the affected communities after the Project.

The following variables were selected for the discussion of the socioeconomic indicators of the settlements area around the Project site:

- Demography and Population
- Livelihoods and Employment
- Education
- Health
- Infrastructure and Services
- Vulnerable Groups

As stated, socio-economic data was collected using a combination of research methods. The baseline section was conducted by collecting, reviewing, and analyzing a range of secondary data, including data originating from the Turkish Statistical agency (TURKSTAT), Alaşehir Municipality, local and provincial governorates.

In order to provide baseline information on the neighborhood level, national statistics are supported with information obtained from primary data collected from interviews with Mukhtars that were carried out between the 17th and 19th April 2017.

The AoI of the Project calls for Işıklar, Baklacı and Tepeköy neighbourhoods.

Table 7-1. Scoping of Social Issues

Project Activities	Social Issue	Possible Impacts	Baseline Parameters
Operation	National Economy	• The Project is expected to address the electricity needs of people nationally	• Annual national energy production
Drilling and Construction	Land Acquisition	• Loss of agricultural land	• Livelihood and employment • Number of lands that have been purchased • Number of affected people
Construction and Operation	Local Employment	• Employment opportunities	• Livelihood and employment • Number of the local employees
Construction	Labor influx	• Pressure on local infrastructure • Change in population	• Demography and population
Construction	Transportation / Traffic	• Safety concerns • Damage on existing roads • Increase in traffic • Dust	• Number of vehicles used for the construction phase • Air Quality
Drilling and Construction	Community Health and Safety	• Increase of noise and dust due to Project activities • Increase in traffic	• Noise level • Air quality
Construction and Operation	Occupational Health and Safety	• Potential for exposure to geothermal gases, confined spaces and heat • Noise exposure during well drilling, steam flashing and venting	• Air quality • Noise level
Drilling and Construction	Cultural Heritage	• Damage on cultural assets within or around the Project area.	Existing cultural heritage assets and archaeological areas in or around the Project area.

7.1 Demography and Population

This section presents general demographical information of Manisa Province and Alaşehir District respectively and move on to further details within the borders of the AoI.

Manisa, situated in Aegean Region of Turkey, covers an area of 13,810 km^2 and has been recorded as the 14th most populated city in Turkey with a population of 1,396,935 (Turkish Statistical Institute , 2016). Manisa holds the second place in terms of population density after Izmir within Aegean Region. The annual population growth rate in 2015 was 9.2 per thousand, whereas, the same indicator was 6.2 per thousand in 2014.

There are 17 districts within the Province borders and the majority of the population lives in the province and district centres, whereas, remaining population lives in towns and

neighbourhoods. The most populous district in Manisa is Yunusemre with 211,673 inhabitants, on the other hand the least populous district is Köprübaşı with 13,586 inhabitants. Alaşehir District on the other hand has a population of 101,313. (Turkish Statistical Institute , 2016).

As mentioned above, there are three neighborhoods within the limits of AoI (Tepeköy, Işıklar and Baklacı). Işıklar neighborhood has the lowest population figures, whereas, Tepeköy neighborhood has the highest figures. Further information regarding the population figures of the AoI can be found in Table 7-2.

Table 7-2 Population Figures of the Area of Impact

Neighborhood	Distance to Manisa Province	Distance to Alaşehir District	Neighborhood Population (2016)
Tepeköy	117 km	7 km	2,070
Işıklar	85 km	24 km	699
Baklacı	113 km	3 km	1,113

Majority of the population figures of the AoI have changed due to various reasons, the Table 7-3 below presents the population changes of the neighborhoods and its reasons within the five years respectively.

Table 7-3. Population Dynamics

Neighborhood	Population Change within the Last 5 Years	Reasons
Tepeköy	Increased	Self-employment opportunities
Işıklar	Remained Same	-
Baklacı	Decreased	Lack of market opportunities for the agricultural products

According to the filed study, majority of the population within the AoI is aged between 26-55, whereas, population aged 65 and over constitutes the minority of the general population of the AoI.

7.2 Livelihoods and Employment

According to information gathered from Manisa Provincial Culture and Tourism Directorate database, the economy of the Manisa is generally based on agriculture, in other words, 35% of the gross income is derived from agriculture.

Nearly all of the Province's population is involved in agriculture as Manisa having the largest vineyard area of Turkey with a viniculture area of 75.401 hectares. Furthermore, Manisa is the source of the grapes in Turkey by having 85% of the national grape production. The other

fruits growing in Manisa are peach, cherry, apricot, olive, almond, pear, walnut and pomegranate (Manisa Provincial Culture and Tourism Directorate).

Similarly, agriculture is the common economic activity in the three neighborhoods in the AoI of the Project, as well. The main sources of local income are viticulture and retirement pensions. In terms of livestock breeding, all three neighborhoods use animal husbandry mainly for household purposes.

Table 7-4 below presents the top three economic activities of each neighbourhood, respectively.

Table 7-4. Common Economic Activities within the AoI

Neighbourhood	Baklacı	Tepeköy	Işıklar
First Common Economic Activity	Retirement Pension	Viticulture	Viticulture
Second Common Economic Activity	Viticulture	Animal Husbandry	Animal Husbandry
Third Common Economic Activity	Paid Workforce	Tradesmen	Retirement Pension

Source: Field Study, 2017

Through the Community Level Surveys with the neighbourhood mukhtars, further information of lands within the neighbourhood was retrieved. Table 7-5 below presents the information gathered from the mukhtars on approximate size of the lands of each neighbourhood, respectively.

Table 7-5. Type of the Lands within the AoI

Neighborhood	Baklacı*	Tepeköy	Işıklar
Pasture land	N/A	300 decare	74 decare
Forest	N/A	-	1,900 decare-
Treasury	N/A	3000 decare	250 decare
Private	N/A	N/A	7,000 decare

Source: Field Study, 2017

*The Mukhtar of Baklacı neighbourhood did not have information on size and type of the lands.

The land to be used for the Project activities are agricultural lands, owned by private owners and were acquired by voluntary purchase method. Also, no public land take cases acquired by the Project Company. In terms of type of rights of the acquired land, all land that was acquired for each Project Component was through permanent land take method. There has been no temporary land take acquired by the Project Company. Further information on land acquired from Baklacı village, as well as result of the household interviews and Focus Group Meetings can be found in Section 8.2 of this Report.

According to interviews with Mukhtars of the AoI, Tepeköy neighborhood is observed to have higher economic standards, whereas, in terms of family income, Baklacı neighborhood has a decreasing trend of economic standards due to decreasing number of market opportunities for agricultural products.

7.3 Education

According to National Education Statistics Database of 2016 prepared by Turkish Statistical Institute, the literacy rate of Manisa has increased by 1.4% in 2016 which has resulted the Province to have 97.4% literacy rate in general. Continuing with the 2016 statistics, the highest literacy rate within the Province is located in Sarıgöl district, furthermore, the literacy rate of Alaşehir district is 96%.

In terms of comparing education conditions within the AoI, all three neighbourhoods have primary education facilities within their borders (1st through 8th grade), on the other hand, for high school education, students use means of transportation services to the closest high school located in Alaşehir District. According to the Mukhtar interviews, almost all portion of the AoI are literate.

7.4 Health

According to Manisa Provincial Health Directorate, there are 14 State hospitals, 8 private hospitals, 9 medicine centres, 4 oral and dental centres, 20 District Health Directorates, 17 Community Health Centres and 26 Emergency Health Services Station in Manisa (Manisa Provincial Health Directorate, 2017).

In terms of health services within the AoI, only Tepeköy local health clinic, which other neighbourhoods within the AoI prefers to access for minor health issues. For further health services, community members have access to hospitals within the District or Province.

7.5 Infrastructure and Services

Infrastructure and services within the AoI can be found in the given list below.

- Village rooms and coffee houses available in all of the three neighborhoods provide place for community gatherings.
- All the neighborhoods are connected to the national electricity grid.
- Drinking water is received mainly through groundwater and spring water.
- All three neighborhoods use septic tanks for wastewater discharge.
- Solid wastes are collected from the three neighborhoods by Alaşehir District Municipality.
- All three neighborhoods have access to tele-communication services including telephone, mobile communication and internet.

- Transportation is through either private vehicles or mass transportation by minibuses to the Alaşehir District center.
- In terms of the economic issues, all three neighborhoods experienced loss of market opportunities for the agriculture products which affected income of the families negatively.

7.6 Vulnerable Groups

Social baseline study also seeks to identify any potentially vulnerable or disadvantaged group or individuals in the local community. The social team conducted, through community level interviews, that there are number of vulnerable groups within the AoI and they include individuals depending on state aids, widows with no children, elderly people and mental or physical disabled persons.

Low income groups: In Turkey, the poverty line for a family of four in 2016 is set at about 4500 TL and about 7 million people are employed with a minimum wage of 1400 TL. According to information gathered from mukhtars of the AoI, approximately 220 households were defined in the area of influence living with the assistance of State aids.

Widows with no children: Widows may experience disadvantage in terms of loss of economic means that are conditional on marriage, including access to productive assets as well as the loss of protection and status previously derived from a husband**.** According to information gathered from mukhtars, approximately 54 widows resided in the AoI.

Mentally or physically disabled people: The social and economic impact of mental and psychosocial disabilities may lead to homelessness, poor educational and health outcomes and high unemployment rates. The exclusion of people with mental or physical disability from education leads to further marginalization of this vulnerable group. According to information gathered from mukhtars, approximately 14 individuals are known to either have mental or physical disability within the AoI.

Further information regarding the vulnerable groups is given in Table 7-6 below.

Table 7-6. Vulnerable Groups

Neighborhood	Individuals Depending on State Aids and Community Contributions	Mentally or Physically Disabled People	Elderly People Aged 70 and Over, Living Alone	Widows with no Children
Tepeköy	50 households	7 people	80 people	20 people
Işıklar	20 households	2 people	6 people	4 people
Baklacı	150 individuals	5 people	5 people	30 people

During the social field study, it has been obtained that the targeted vulnerable groups have not been affected by the Project or its activities. No impact on the identified vulnerable groups is anticipated for the future activities of the Project.

7.7 Project Information Level

Community Level Questionnaires and Focus Group Discussions

During the social field study conducted on 17 -19 April 2017, Focus Group Meetings have been conducted at Baklacı, Tepeköy and Işıklar Neighbourhoods. On each Focus Group Meetings, brief introduction of the Project's purpose and the Project Company has been presented to the attendees by the social team. Also, as stated, Community Level Questionnaire with the head of neighbourhoods was also conducted to attain public perspective of the community regarding the Project.

The result of social surveys related to Project information level is presented respectively for each settlements below.

- **Işıklar**: According to information gathered from the Mukhtar and the community level questionnaires; majority of the community are not familiar with the Project. Therefore, community members were suggesting to receive a meeting in their neighborhood for both female and male group separately and inform them regarding the purpose, benefit and the impacts of the Project. General perspective of the Mukhtar related with the Project to learn more about the technology and the impacts of the Project
- **Tepeköy**: According to the interview with the Mukhtar, majority of the community are aware of geothermal energy projects surrounding their Neighborhood, however, do not have detailed information regarding the project owners and further information of the projects. Especially considering the female community level meeting, women in the Neighborhood are not aware the purpose of drilling works surrounding their Neighborhood and suggested to inform women in Neighborhood regarding the Project in brief, through a separate meeting. General perspective of the Mukhtar

related with the Project is assessed positive however, concerned of the future of viticulture activities in his neighborhood due to growing number of geothermal energy projects within the Alaşehir District.

- **Baklacı**: The locals stated that unlike other project companies around the neighbourhood, the Project Company seek to settle voluntarily negotiation on land allocation. General perspective of the Mukhtar related with the Project is assessed neutral. However, other projects located close to the settlement created a prejudgment for geothermal projects in general. There was a common support on investments that could benefit the region. The locals also stated that Project Company representatives visit the neighbourhood to engage with the locals and ask for suggestions. Since land acquired for the Project was in Baklacı village, further information regarding the local's opinions on land acquisition can be found in Section 8.2 of this Report.

Respondents recommended following suggestions to raise their level of knowledge regarding the Project. Different expectations of each settlement and suggested grievance mechanism are presented below.

Table 7-7. Suggested Information Disclosure and Grievance Tools

Name of the Neighborhood	Information Disclosure Tool	Suggested Grievance Tool
Işıklar	• Project personnel should provide brief information in the neighborhood including the impacts and grievance mechanism for the Project. • Brochures can be used to inform phases of the Project.	• Phone –line • Project authorities should visit the settlement.
Tepeköy	• Project personnel should provide brief information in the neighborhood including the impacts and grievance mechanism for the Project. • Brochures can be used to inform phases of the Project.	• Project authorities should visit the settlement. • Phone –line
Baklacı	• Project personnel should provide brief information in the neighborhood including the impacts and grievance mechanism for the Project. • Brochures can be used to inform phases of the Project.	• Project authorities should visit the settlement. • Phone –line

Key Informant Interviews

On the other hand, during the baseline studies conducted in April 2017, the social team also conducted Key Informant Interviews with following institutions as:

- Alaşehir District Directorate of Agriculture;
- Alaşehir Irrigation Union and Alaşehir Chamber of Agriculture;

- Municipality of Alaşehir;
- Tepeköy Tradesmen and Craftsmen Credit Cooperatives; and,
- Tepeköy Agricultural Credit Cooperatives.

Most of the interviewees believed the Project will bring positive impact in national economy, however, there is a concern of the environmental side effects of the growing geothermal power plant projects within the region. The majority of the interviewees do not have high expectation regarding employment opportunities through the Project; however, interviewees believe that GPP within the District could help the region develop in terms of socially and economically through the project companies' support. In terms of interviewees comments and suggestions regarding the Project, further information can be found in SEP Report.

Public Participation Meeting

The Public Participation Meeting (PPM) was conducted on 27 October, 2017 at the village coffee house located in Baklacı neighborhood. The information regarding the date, place and scope of the meeting have been announced to the public via local newspaper named as '*5 Eylül*' on 21.10.2017. The Project officials also posted the PPM announcements at village coffee houses in the AoI. The Meeting included locals from the AoI, mainly locals from Baklacı neighborhood, and the Project officials. For detailed list of the attendees see Annex 3 of this Report. The local's opinions, suggestions and considerations about the Project have been taken under by the 2U1K experts and the Project officials during the meeting.

Before the meeting, the brochures about the Project have been distributed to the locals with a brief foreknowledge about the context of the Meeting. The location, importance, characteristics, national EIA and ESIA process, construction and operation stage impacts and foreseen mitigation measures of the impacts, socioeconomic benefits of the Project and grievance mechanism have been presented in non-technical terms throughout the meeting. The local people directed their main suggestions, questions and concerns at the end of the presentation as follows;

- Whether the Project will cause impacts in the future,
- Will there be any further drilling activities in the future,
- Further information on the reinjection system and,
- Potential odor impacts to the locals, if any.

The meeting was successful in terms of informing the locals about the Project and eliminating concerns regarding of the Project. This was also demanded by the locals during the baseline studies on April 2017, therefore, addressing questions and explaining the Project technology helped locals to acknowledge the purpose, benefits and potential impacts of the Project. Further information and photos of the PPM can be found in SEP Report.

8. ENVIRONMENTAL IMPACT ASSESSMENT

Based on an overview of baseline parameters, impact assessment is comprised of the following elements:

Assessment of impacts on surface waters and groundwaters:

- Degradation of surface water quality affecting local users
- Impacts on ecosystems from vegetation clearance and earth moving during construction;
- Pollution of surface water from drilling muds or water from testing wells;
- Surface and/or groundwater contamination from chemical spills and leaks from storage, transportation and use of chemicals and fuel on Project site;
- Cross-contamination of surface aquifer from drilling of new geothermal wells
- Surface water impacts from discharges of effluents from reinjection;

Assessment of noise impacts on communities:

- Noise from construction and drilling activities from site preparation, excavation and foundations, construction and drilling;

Assessment of impacts on soil:

- Degradation of soil by contamination from drilling mud and cuttings and other potential hazardous wastes,
- Degradation of land and soil by contamination from fuel or chemical storage facilities or spent oils, lubricants storage,
- Soil contamination from fuel or chemical storage facilities or spent oils, lubricants storage, etc.

Assessment of impacts on air quality:

- Odor impacts of hydrogen sulphide (H2S) on the surrounding communities because of the operational emissions of the Project,
- Release of CO_2 and other GHGs at the operation stage.

8.1 Construction Stage Impacts

8.1.1 Impacts on Ecology

Site observations clearly indicate that the flora has been largely deteriorated due to anthropogenic activities.

The Project area is located within the Mediterranean phyto-geographical region and therefore has the characteristics of diverse vegetation along its coastal region. There are numerous fields within the Project area and its immediate environment due to the flat topography and alluvial deposits. Within the Project site, there are ruderal plants along the roadsides and around the irrigation and drainage channels as well as the dominant vegetation of field crops. Although it seems as a rich flora, it has lost its natural vegetation cover due to agricultural fields and gardens.

A certain amount of biomass will be lost during excavation works at the construction site. Top soil that will be skimmed from the surface will be reserved and used in site restoration and redevelopment of flora. Up to 300 mm of topsoil will be stripped and stored in appropriate conditions providing loss and degradation. Mitigation measures for the preservation of topsoil are provided below and also in the ESMP.

A large amount of the geothermal fluid that is required for energy production will be passed above the ground; therefore, the biomass loss will be minimized during the operations along the pipeline route. The Project pipeline is a fully enclosed system which does not create any adverse effects on the existing vegetation during the transportation of geothermal fluid to the facility.

Cold water that will be generated as a result of the closed-circuit production will directly be pumped back to the thermal reservoir without being discharged to any receiving body.

The Project site and its vicinity are under intense human pressure due to the geothermal power plants, animal grazing and agricultural activities. Certain fauna species have previously moved away from the region due to such anthropogenic impacts. The existing fauna species are the ones that have adapted themselves to these impacts. Therefore, there are no species that may be damaged due to the facility construction.

Within this framework, noise-induced impact of the facility on the fauna is in question, because of which the faunal elements may abandon their nesting area. However, once the facility construction is over, faunal elements may use the region as their nesting area again. Mitigation measures which are provided below and the ESMP will be in place during construction works in order to avoid nuisance to species which may occur at the site.

Table 8-1: Impacts of Construction Stage on Ecology

Impact Type	Positive	**Negative**	**Direct**	**Indirect**	Cumulative
	Impacts of construction activities on the ecology is negative and both direct and indirect.				
Impact Duration	**Temporary**	Short Term	Long Term	Permanent	
	The impact is temporary as species will possibly adapt to post-construction conditions.				
Impact Extent	Project Area	**Local**	Regional	National	
	The impact is local, limited to the Project Site and environs.				
Impact Magnitude	**Negligible**	Low	Medium	High	
	Impact is negligible as there are no critical habitats or species and the existing species will be able to adapt to the changes.				
Likelihood of Impact	Unlikely	**Likely**	Certain		
	Impacts are likely as excavation works will remove some vegetation and top soil; and drilling activities will cause unfavorable conditions with dust and noise.				
Impact Significance	**Negligible**	Minor	Moderate	Major	
	Significance of impact is negligible as there are no critical habitats or species and the existing species will be able to adapt to the changes.				
Reversibility of Receptor	High	Medium	**Low**	Irreversible	
	General ecology will recover in time but it is evident that some species will move to new habitats.				
Final Impact Assessment	**Negligible**	Minor	Moderate	Major	
	Overall ecological impact is negligible.				

Indirect impacts on ecology through emissions of noise and air quality or through discharges of effluent will be mitigated in a large extent through the mitigation measures:

- Topsoil will be stripped up to 300 mm depth and stored in designated storage areas for further site restoration works.
- Storage areas will be prevented from the accumulation of storm water, provided with drainage.
- Weed growth in stockpiles of topsoil will be prevented and the stockpiles will be seeded if required.
- Existing access roads will be used for Project purposes and off-road driving will be prohibited.
- Project activities will be limited in the construction area and construction sites will be surrounded with fences to prevent wild animals intrusion to the site.
- Hunting or collection of animals and in particular of *Testudo graeca* (Common tortoise) will be strictly prohibited within the Project area.
- Awareness among all construction workers will be provided during the lifetime of the Project for especially the fauna species with limited mobility. If these species,

particularly *Testudo graeca* (Common tortoise) are observed, they will be translocated to undisturbed but similar areas.

The residual impacts will be negligible with the implementation of these mitigations.

8.1.2 Water Supply

During the construction stage, 15 workers will be employed, as stated in the PDR. The tap water demand of the personnel will be supplied through water tankers. The drinking water demand will be met through the procurement of 19 liter bottles of water from the licensed bottled water companies.

The water required for prevention of the dust emissions will be brought to the construction site with water tankers. Any surface water bodies or groundwater resources in the region will not be utilized during the construction works.

Water required for drilling activities will be supplied from the available wells near drilling locations. It is estimated that about 2,000 m^3 of water will be required for drilling of 60 days. “Dry Location” Drilling Monitoring System will be established for drilling wells and water and drilling mud will be recycled and therefore water consumption will be reduced through recycling.

8.1.3 Wastewater Generation

The construction stage activities will result in domestic wastewater only. Concrete curing water will not be required as ready-mixed concrete will be used.

Considering that the number of staff will be 15 and taking the value for the daily amount of wastewater generated per person as 122 liters/person-day according to the Turkish Statistical Institute’s data for the year, 2014 for the Manisa Province, the total amount of the domestic wastewater generated by the field staff will be 1.83 m^3/day during the construction stage. The domestic wastewater generated in the construction stage will be collected in an impermeable septic tank in compliance with the Regulation on Construction of Septic Tanks at Places Where Sewer Construction is not Possible. The wastewater collected in the septic tank will be disposed by the Alaşehir Municipality for a fee through Alaşehir Wastewater Treatment Plant.

The water required for prevention of the dust emissions will be brought to the construction site with water tankers which will regularly sprinkle water over the site. As the water used for this purpose will completely evaporate, no wastewater will be produced hereby.

8.1.4 Impacts of Geothermal Fluid from Well Testing

Test drillings are conducted in order to prove the commercial viability of the potential resources. Geothermal fluids are considerably hot and highly mineralized and, if released to any surface water, could cause thermal changes and changes in water quality.

During the drilling works, liquid drilling mud which is the mixture of different type of chemicals with water will be employed in order to carry rock cuttings to the surface and also lubricate and cool the drill equipment. Drilling mud will be collected and treated by Drilling Mud Management System installed by drilling mud supplier and sent back to the system minimizing the generation of waste drilling mud. Remaining mud will be collected in collection ponds covered with impermeable layer preventing any leakage to the environment.

The system basically comprises of Shale Shaker, Desander, Desilter, High Speed Centrifuge and Dewatering Unit. Instead of waste pits, metallic tanks are used to store, treat all cuttings, mud and residual water.

The cutting from Shale Shakers, Desanders, Desilters and High Speed Centrifuge is collected in half-moon tanks where it is stabilized.

Basic diagram of the system is provided below in Figure 8-2.

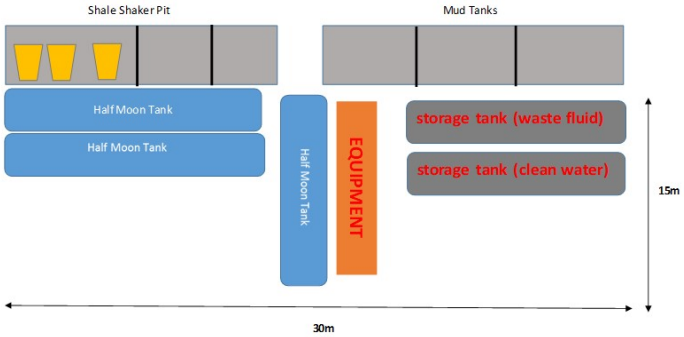


Figure 8-1 Drilling Mud Management Equipment

The Dewatering Unit together with High Speed Centrifuge are used to control the mud weight (drill solids content) and to avoid the necessary extra volume of mud which should be used to control the mud properties.

During the dewatering process, depending on the injection rate of flocculent solution, the separation of solids can be achieved up to 99.5% resulting in clean water as effluent.

The liquid phase (effluent) can return into the system if the dewatering is used to decrease the drill solid content below 4-10 %.

Test fluids will not be discharged to a receiving environment; generated test fluids will be re-injected. Rotary drilling has been used for the wells within the scope of the Project. Casings of three different diameters were employed during drilling of wells which were 20'' for 100m, 13 3/8'' for 1000m and 9 5/8'' for 2500 m. The largest casings will be located at a shallow depth to prevent loose near-surface material collapsing into the well. Casings with intermediate diameter will be employed to support successive wellheads and to contain drilling and formation liquids of relatively high temperature and pressure. The casings with smaller diameters will be employed at greater depths will be used to convey the geothermal fluid to the surface.

Well sides are also covered with concrete during the process. Casings and concrete wall at the sides of the well prevent groundwater and geothermal fluids intervene with each other. No discharge to aquifer will occur due to Project activities.

Although can vary according to each well, the total flow of the geothermal fluid is estimated to be about 780 ton/hour. Geothermal fluid extracted from the production wells will be reinjected to the original reservoir through reinjection wells. Currently 7 wells out of 12 wells have been drilled in the scope of the Project. Among the drilled 7 wells, Özmen-5 is planned to be reinjection well while the remaining 5 will be production wells. Moreover drilling for the remaining 5 wells, which are planned to be reinjections wells, is estimated to start at the beginning of March 2018.

Within the scope of the Project t is planned to construct an impermeable collection pond to be used in case of any failure during reinjection, operation of the power plant or during maintenance of the wells for a period of 1 hour for each well. The capacity of the collection pond is planned to be 1500 m^3 to be on the safe side with the estimation of use of about 150 tonnes/hour geothermal fluid for each well. Currently collection ponds for 6 drilling locations have been established. It is also possible to use more than one pond during testing by the use of pipeline between ponds. In case of any emergency the operation is stopped through installed automated system. The geothermal fluid collected in the pond will be reinjected back to the system by reinjection pump and geothermal fluid discharge to any kind of environment will be prevented during the whole Project lifetime.

Groundwater quality monitoring will be conducted at downstream of reinjection wells as well as geothermal fluid collection ponds will be conducted quarterly for temperature, EC, opacity, density, salinity, chlorophyll-a, PH, dissolved oxygen, hydrogen sulphide, alkalinity, copper, zinc mercury, lead, iron, manganese, cadmium, arsenic, total suspended solids, total organic carbon and petroleum hydrocarbons.

Upon DSİ approval two locations will be established within the license area and temperature and EC will be monitored in groundwater through installed automated monitoring systems.

Table 8-2 Impacts of Drilling Effluents

Impact Type	Positive	**Negative**	Direct	**Indirect**	Cumulative
	The impacts of the geothermal fluid discharge due to the test drillings into the drainage canals are indirect and negative on the environment.				
Impact Duration	**Temporary**	Short Term	Long Term	Permanent	
	The impact is temporary as limited to the construction stage.				
Impact Extent	Project Area	**Local**	Regional	National	
	The impact is limited to the impermeable collection pond, thereby local.				
Impact Magnitude	Negligible	**Low**	Medium	High	
	The magnitude of the impacts could be considered negligible in environmental terms given the polluted receiving media, and the temporary duration of the impacts.				
Likelihood of Impact	Unlikely	**Likely**	Certain		
	Impacts of geothermal fluid on soil and groundwater resources are likely at construction stage based on risks of mud-pit overflows or improper waste handling.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	Significance of impact is minor.				
Reversibility of Receptor	High	Medium	**Low**	Irreversible	
	The soil and groundwater quality can be reversed by restoration activities, at some cost.				
Final Impact Assessment	Negligible	**Minor**	Moderate	Major	
	Impact is minor. Mitigation measures are required in the form of impermeable collection pond.				

8.1.5 Impacts of Solid Wastes on Soil and Groundwater

Solid wastes expected to be generated during the construction stage are domestic solid wastes produced by the field staff, excavation debris, packaging wastes, hazardous wastes and waste oils, vegetative waste oils, end-of-life tires, waste batteries and accumulators, medical wastes from the camp site and drilling mud.

Non-hazardous Domestic Solid Waste

Domestic solid wastes are generated in the construction stage due to various consumptions of the field staff. Considering that the number of field staff will be 15 and taking the daily amount of domestic solid waste generated per person as 1.25 kg/person-day, according to the Turkish Statistical Institute's data for the year, 2014 for the Manisa Province, the total amount of the domestic solid waste generated by the field staff will be 18.75 kg/day during the construction stage.

The domestic solid waste generated during the construction stage will be collected in leak proof garbage containers and stored properly on the site in line with the Regulation on Waste Management published in the Official Gazette No. 29314 and dated 02.04.2015. The collected domestic solid wastes will be transferred to the solid waste disposal area of the Alaşehir Municipality and ultimately disposed of in line with the subject Regulation. Recyclable waste (i.e. glass, plastics, glass) will be collected separately at source in order to be reintegrated into the economy.

Excavation Debris

A part of the topsoil and surplus excavated materials generated through the site preparation activities will be utilized in backfilling the foundation. The remaining part will be temporarily stored in the designated areas and then used in land leveling and landscaping works. The amount of stripped topsoil is estimated to be 8,900 m^3 in total. The amount of excavated material is estimated to be 3,000 m^3 in total. Excavated material will temporarily be stored at designated storage areas near Özmen-3 and Özmen-5 wells and will not be transported outside the Project area. The height of the stored material will not exceed 5 m and the material will not be stored for more than 6 months. The excavation material will be stored avoiding the generation of drainage pathways to underlying aquifers. The stockpiles will be dampened especially during dry and windy weather in order to prevent dust emissions.

In case excess excavation material is generated the Regulation on the Control of Excavation, Construction and Demolition Wastes published in the Official Gazette No. 25406 and dated 18.03.2004 will be complied within the scope of the Project.

Packaging Waste

The packaging wastes generated during the construction stage will be composed of recyclable materials such as metal, paper, plastics and glass. The recyclable wastes (i.e. glass, plastics) will be collected separately at source as indicated in Section 2, Article 5 of the Regulation on Waste Management, in order to be reintegrated into the economy without being subject to any chemical or biological processes. In addition, compliance with the Packaging Waste Control Regulation will be ensured for their management during the construction stage.

Hazardous Wastes

Hazardous wastes can possibly comprise of the drilling muds if they contain oil-based inputs. The muds are generated at the drilling wells as a result of injection of mixture of water, bentonite and emulsifiers to support the well, cool the drill bit and remove cuttings. The muds are currently collected in the mud-pits. Any failure of the mud-pits has the potential to cause pollution of the adjacent surface water bodies which is of particular concern with oil-based muds as they are likely to contain oil-related contaminants.

Waste Oils

Waste oils are expected to be generated from maintenance of the vehicles to be used during the construction stage.

Waste oils will be managed by authorized technical services, and oil change of the vehicles will be conducted by machine experts or service staff on leak-proof surface within the construction site, therefore a possible soil contamination will be prevented. In case of waste oil generation during an oil change, it will be stored and disposed of in accordance with the Waste Oil Control Regulation. Vehicle maintenance will be conducted periodically on daily, weekly and monthly bases, and oil leakage will be avoided by using drip pans.

Waste Vegetable Oils

Waste vegetable oils will be generated from the cafeteria, where the food service will be provided for 15 field personnel. Waste vegetable oils will be collected separately to be sent to the licensed firms in compliance with the Waste Vegetable Oil Control Regulation.

End-Of-Life Tires

Maintenance of the vehicles to be used during the construction stage will be managed by authorized technical services. However, end-of-life tires may be generated in case of mandatory tire changes. In such cases, tires will be sent to the licensed firms in accordance with the Regulation on Control of End-of-Life Tires.

Waste Batteries and Accumulators

Waste batteries generated during the construction stage will be separately collected in the waste battery containers placed at the Project site.

The waste batteries will be sent to a Waste Battery Recycling Plant as stated in Section 2, Article 13 of the Regulation on Control of Waste Batteries and Accumulators. In addition, temporary storage of the waste batteries within the facility will be managed according to Section 4, Article 20 of the same regulation.

There will be no accumulator replacement within the construction site. However, empty accumulators generated in compulsory cases will be sent to the firms to be replaced with full ones as stated in the Regulation on Control of Waste Batteries and Accumulators. In addition, temporary storage of the waste accumulators within the facility will be managed according to

Section 4, Articles 18 and 19 of the same regulation.

Medical Wastes

Nearest hospitals will be used for possible injuries and health problems of 15 construction stage personnel. As a result of on-site first aid applications for injuries, medical waste will be generated; and they will be collected, transferred, stored and disposed of in compliance with the Medical Waste Control Regulation.

Drilling Mud

The drilling muds generated as a result of the drillings, will be readily collected and treated by Drilling Mud Management System installed by drilling mud supplier and sent back to the system minimizing the generation of waste drilling mud. The system decreases the generated waste during drilling of about 3500 m by 80%. After treatment of the chemicals and water, remaining content is collected in waste ponds of 300-400 tonnes capacity at each drilling location. The ponds will be covered with impermeable layers geomembrane in order to prevent any intervention with groundwater. The mud will be analysed and categorized according to the requirements of the Circular on the Disposal of Drilling Mud and Wastes Generated from the Physical Treatment of Chromium Minery (dated 2012/15) and the Regulation on Landfill of Wastes (Official Gazette dated 26.03.2010, no: 27533).

If the waste mud is determined as inert and/or non-hazardous waste then the mud ponds will be covered with impermeable structure after evaporation.

If the waste is deemed hazardous waste, it will be disposed according to the requirements of the Regulation on Landfill of Wastes.

Table 8-3: Impacts of Waste Storage

Impact Type	Positive	**Negative**	**Direct**	Indirect	Cumulative
	Impacts of mud-pits and hazardous waste storage are negative and direct. Improper storage of hazardous waste would cause infiltration of hazardous components into sub-layers of soil and the shallow aquifers.				
Impact Duration	Temporary	Short Term	**Long Term**	Permanent	
	The impact will be long-term if the impact is not detected on-time and cleaning procedures are not applied.				
Impact Extent	Project Area	**Local**	Regional	National	
	The impact is limited to local soils and the shallow aquifer.				
Impact Magnitude	Negligible	Low	**Medium**	High	
	Groundwater in the shallow aquifer is not used by local people. Still any contamination is not allowed by regulations.				
Likelihood of Impact	Unlikely	**Likely**	Certain		
	Impacts of waste storage on soil and groundwater resources are likely at construction stage based on risks of mud-pit overflows or improper waste handling.				
Impact	Negligible	Minor	**Moderate**	Major	

Significance	The significance of the impacts is moderate as oil contamination can cause long term or permanent changes.			
Reversibility of Receptor	High	Medium	**Low**	Irreversible
	Soil and groundwater quality can be reversed by restoration activities, at certain costs.			
Final Impact Assessment	Negligible	Minor	**Moderate**	Major
	Impact is moderate and requires mitigation measures.			

8.1.6 Impacts on Air Quality

The emissions during the construction stage will be associated with the dust and exhaust gas resulting from the operation of onsite diesel vehicles, skimming of topsoil layers, and excavation of mud pits and transportation of the ready-mixed concrete for the power plant construction and H_2S emissions during drilling although in low concentrations due to the use of binary technology. According to the baseline H_2S measurements in the AoI of the Project it was observed that H_2S concentrations are below the Regulation on Control of Industrial Air Pollution limits. Air quality measurements will be conducted in terms of H_2S concentrations during drilling works and operation phase in order to prove compliance to the regulation requirements. H_2S detectors will also be placed at well heads for monitoring H_2S levels.

Dust Emissions

Dust emissions generated during site preparation and construction phase of the Project have been calculated in the PDR using the controlled dust emission factors given in Turkish IAPCR Table 12.6. Controlled dust emission factors are given in Table 8-4.

Table 8-4. Controlled Dust Emission Factors according to Turkish IAPCR

Activity	Controlled Dust Emission Factors (kg/ton)
Excavation	0.0125
Loading	0.005
Transportation	0.35
Unloading	0.005
Storage	2.9

Calculated dust emissions regarding site preparation and construction phase activities using the emission factors as provided below in respectively:

Table 8-5. Controlled Dust Emissions During Site Preparation

Activity	Emissions (kg/hour)
Excavation	0.14
Loading	0.05
Transportation	0.07
Unloading	0.05
Storage	0.0002

Table 8-6. Controlled Dust Emissions During Construction

Activity	Emissions (kg/hour)
Excavation	0.28
Loading	0.11
Transportation	0.15
Unloading	0.11
Storage	0.0005

Total dust emission is estimated to be 0.31 kg/hour during site preparation activities and 0.06 kg/hour during construction phase of the Project under controlled conditions. According to Turkish IAPCR, it is stated that if total dust emission from fugitive sources is higher than 1 kg/hr, air quality dispersion modeling should be performed for both total suspended particles and PM_{10}. As seen in the table below dust emissions calculated for construction phase of the proposed project, do not exceed the limit value of 1 kg/hr. Therefore, no dispersion modeling was performed as it is stated in the Turkish IAPCR.

Exhaust Gas Emissions

Another major source of air emissions during the construction phase of the Project is the construction equipment engines at the construction site due to the use of diesel fuel for the heavy construction machinery. Carbon monoxide (CO), sulfur oxides (SO_2), hydrocarbons (HC), nitrogen oxides (NO_x) and particulate matter (PM) emissions will be generated due to the use of diesel fuel by construction equipment.

The exhaust emissions from the construction equipment are calculated using the U.S. Environmental Protection Agency's (EPA) Report No. NR-009A on Exhaust Emission Factors for Nonroad Engine Modeling -- Compression-Ignition published on February 13, 1998 and revised on June 15, 1998 which describes and documents exhaust emission factors used for compression ignition (CI) engines and covers factors for all diesel-fueled engines (Megan Beardsley, 1998). Table 1 in this document provides steady-state emission factors for CI engines in the Nonroad Model according to the power and model year ranges of the engines.

For determination of the emission factors, the power outputs of the engines of the construction equipment their respective model years are estimated.

The power outputs of the construction equipment and corresponding exhaust emission factors are given below Table 8-7.

Table 8-7. Power Outputs and Emission Factors for the Construction Equipment

Equipment	Number of Equipment	Engine Power* (hp)	Emission Factors (g/hp-hr)			
			HC	CO	NO_x	PM
Loader	1	180	0.2	1.0	2.8	0.4
Excavator	1	270	0.2	1.0	2.8	0.4
Truck	2	280	0.2	1.0	2.8	0.4
Compressor	1	80	0.2	1.0	3.3	0.72
Generator	1	130	0.2	1.0	2.8	0.4
Drilling Rig	1	380	0.2	1.0	2.8	0.4

According to the above list, the exhaust emissions of the construction equipment, which are calculated through multiplying the number of equipment and engine power with emission factors, are provided in Table 8-8.

Table 8-8. Exhaust Emissions of the Construction Equipment

Equipment	Emission Amounts (kg/hr)			
	HC	CO	NO_x	PM
Loader	0.036	0.180	0.504	0.072
Excavator	0.054	0.270	0.756	0.108
Truck	0.112	0.560	1.568	0.224
Compressor	0.016	0.080	0.264	0.0576
Generator	0.026	0.130	0.364	0.052
Drilling Rig	0.076	0.380	1.064	0.152

The impacts will be temporary and limited to the construction period. The mitigation measures are currently in place to suppress the dust emissions by means of water spraying and improvement of the road conditions. Regarding the increase of PM10 concentrations during weekend, good working practices will be implemented particularly during weekend especially during dry and windy weather conditions. Loading and unloading of construction materials will be performed in a proper way to prevent dust generation. Vehicles loaded with dust generating materials will be covered during transportation. Speed limits will be applied

for the drivers. Materials stored within the project area will be monitored for dust emissions and covered or damped if required.

Maintenance of construction vehicles will be conducted periodically in order to control the exhaust emissions generated. With the measures taken to minimize nuisance on the communities, the impacts of dust emissions and exhaust will be negligible.

Table 8-9. Impacts of Construction Activities on Air Quality

Impact Type	Positive	**Negative**	**Direct**	Indirect	Cumulative
	The impacts of dust , H_2S and exhaust emissions during the construction stage are direct and negative.				
Impact Duration	**Temporary**	Short Term	Long Term	Permanent	
	The impact is limited to the construction stage.				
Impact Extent	Project Area	**Local**	Regional	National	
	The impact is limited to nearby settlements, thereby local.				
Impact Magnitude	Negligible	**Low**	Medium	High	
	The impacts are low as there will be some perceptible changes in people's livelihoods, but they will adapt with some relative ease.				
Likelihood of Impact	Unlikely	Likely	**Certain**		
	Dust and exhaust emissions during construction stage is certain due to operation of construction vehicles and drilling equipment.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	Significance of impact is minor as the impact is temporary and mitigation measures are in place.				
Reversibility of Receptor	**High**	Medium	Low	Irreversible	
	Communities will be free from dust exposure once the construction stage is complete.				
Final Impact Assessment	**Negligible**	Minor	Moderate	Major	
	Impact is negligible, thereby there is no need for additional mitigation measures.				

8.1.7 Noise Impact

Noise will be emitted from the onsite vehicles and machinery during the construction stage. However, construction noise is temporary and transient in the environment. Noise impact during construction on 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.

According to the PDR sound levels of construction equipment are provided as follows in Table 8-10:

Table 8-10. Sound Level of Construction Equipment

Noise Source	Number	Sound Level (Lw (dB))
Loader	1	99.5
Excavator	1	104.5
Truck	2	103.5
Compressor	1	99.5
Generator	1	102.5
Drilling Rig	1	101.5

Environmental noise measurements have been conducted for the Project within the scope of ESIA studies while construction activities were on-going for which the details are provided in Section 5.6. According to the measurement results noise levels are below RAMEN limit value of 70 dBA for construction activities.

The IFC/WB noise guideline provides limits for daytime (07:00-22:00) and nighttime (22:00-07:00) 55 dBA, and 45 dBA respectively. According to the measurement results IFC/WB noise guideline limits are exceeded during night time. Construction activities are not performed during nighttime therefore adverse impact on the receptors is not expected. Moreover construction noise is temporary and can be controlled through good site working practices and limiting working hours.

Table 8-11. Noise Impacts of the Construction Stage

Impact Type	Positive	**Negative**	**Direct**	Indirect	Cumulative
	Noise impact during construction is direct and negative.				
Impact Duration	**Temporary**	Short Term	Long Term	Permanent	
	The impact is limited to the construction stage.				
Impact Extent	Project Area	**Local**	Regional	National	
	The impact is limited to nearby settlements, thereby local.				
Impact Magnitude	Negligible	**Low**	Medium	High	
	Impact is low considering the noise levels comply with both RAMEN and IFC/WB guideline requirements.				
Likelihood of Impact	Unlikely	Likely	**Certain**		
	Noise during construction stage is certain due to operation of construction vehicles and drilling equipment.				
Impact Significance	Negligible	**Minor**	Moderate	Major	
	Significance of impact is minor as the impact is temporary and mitigation measures are in place.				
Reversibility of Receptor	**High**	Medium	Low	Irreversible	
	Communities will be free from noise once the construction stage is complete.				

Final Impact Assessment	**Negligible**	Minor	Moderate	Major
	Impact is expected to be negligible, still mitigation measures for decreasing noise levels by means of good practices and proper scheduling of construction activities will be in place.			

8.2 Operation Stage Impacts

Operational activities basically include routine operation and maintenance of the geothermal power plant, well field monitoring and maintenance, periodically drilling of production and injection wells, geothermal fluid processing and pipeline maintenance (IFC, 2007). Before the detailed discussion of the potential operation stage impacts in the following sub-sections, here is a summary of the environmental issues associated with the operational activities for the geothermal power generation within the scope of the Project:

- **Generation of wastewater:** As the power plant is designed as air-cooled, water will not be used in the power generation process. Accordingly, the power plant will not produce any industrial wastewater. In this regard, the operation stage will result in domestic wastewater only.
- **Generation of spent geothermal fluids:** The ORC system will return the spent geothermal fluid (effluent) via the reinjection wells back to the geothermal reservoir. With the use of the reinjection system, the residual impact associated with the operational discharges of the brine geothermal fluid is assessed to have negligible significance.
- **Generation of air emissions:** As indicated in the IFC's Environmental, Health and Safety Guidelines for Geothermal Power Generation (2007), geothermal power plant emissions are negligible compared to those of fossil fuel combustion-based power plants. The binary technology even has close to zero emissions of hydrogen sulfide or mercury to the atmosphere because of reinjection of all geothermal fluids and gases. However H_2S levels will be monitored by H_2S detectors at each well head as well as ambient air quality measurements.
- **Generation of solid wastes:** Geothermal technologies do not produce a substantial amount of solid waste (IFC, 2007).
- **Generation of noise:** The PDR estimates that the operation stage noise levels will be within the limits defined in the Regulation on Assessment and Management of Environmental Noise.

8.2.1 Impacts on Ecology

Adverse impacts on terrestrial ecology and biodiversity imposed during the construction stage will disappear at the operation stage. No project-related adverse impacts on the ecology are anticipated for the operation stage.

8.2.2 Impacts of Domestic Wastewater on Surface Waters

As the power plant is designed as air-cooled, water will not be used in the power generation process. Accordingly, the power plant will not produce any industrial wastewater. In this regard, the operation stage will result in domestic wastewater only.

During the operation stage, 25 staff will be employed as stated in the PDR. The tap water demand of the personnel will be supplied through water tankers. The drinking water demand will be met through the procurement of 19 liter bottles of water from the licensed bottled water companies. Considering that the number of staff will be 25 and taking the value for the daily amount of wastewater generated per person as 122 liters/person-day according to the Turkish Statistical Institute's data for the year, 2014 for the Manisa Province, the total amount of the domestic wastewater generated by the field staff will be 3.05 m^3/day during the operation stage. The domestic wastewater generated in the operation stage will be collected in an impermeable septic tank in compliance with the Regulation on Construction of Septic Tanks at Places Where Sewer Construction is not Possible. The wastewater collected in the septic tank will be disposed by the Alaşehir Municipality for a fee. Hence, there will be no direct discharge of wastewater into any nearby surface water bodies.

8.2.3 Impacts of Spent Geothermal Fluid on Surface Waters

The ORC system will return the spent geothermal fluid (effluent) via the reinjection wells back to the geothermal reservoir. With the use of the reinjection system, the residual impact associated with the operational discharges of the brine geothermal fluid is assessed to have negligible significance. It is planned to construct an impermeable collection pond of 1,500 m^3 to be used in case of any failure during reinjection, operation of the power plant or during maintenance of the wells. Currently collection ponds for 6 drilling locations have been established. In case of any emergency the operation is stopped through installed automated system.. Geothermal fluid discharge to any kind of environment will be prevented during the whole Project lifetime. The geothermal fluid collected in the pond will be reinjected back to the system by reinjection pump and geothermal fluid discharge to any kind of environment will be prevented during the whole Project lifetime.

Groundwater quality monitoring will be conducted at downstream of reinjection wells as well as geothermal fluid collection quarterly for temperature, EC, opacity, density, salinity, chlorophyll-a, PH, dissolved oxygen, hydrogen sulphide, alkalinity, copper, zinc mercury, lead, iron, manganese, cadmium, arsenic, total suspended solids, total organic carbon and petroleum hydrocarbons.

Table 8-12. Impacts of Spent Geothermal Fluid

Impact Type	Positive	**Negative**	**Direct**	Indirect	Cumulative
	Impact of reinjection failure is direct and negative.				
Impact Duration	**Temporary**	Short Term	Long Term	Permanent	
	The impacts are temporary.				
Impact Extent	Project Area	**Local**	Regional	National	
	Failure of a surface pipeline would lead to contamination of a limited area, including soil and groundwater.				
Impact Magnitude	Negligible	Low	Medium	**High**	
	According to the Regulation on Control of Soil Contamination, it is compulsory to restore contaminated soil. Furthermore, communities have a tendency to fear that spillage from the reinjection system may harm their crops and react to the Project Company.				
Likelihood of Impact	**Unlikely**	Likely	Certain		
	Critical failure of the pipeline is unlikely with a good design and good operation practices including system monitoring. Yet it can happen at any time as an out-of-control aspect.				
Impact Significance	Negligible	Minor	**Moderate**	Major	
	Significance of impact is moderate.				
Reversibility of Receptor	High	Medium	Low	**Irreversible**	
	In case of a temporary discharge into the Alaşehir Brook, local community distress would rise. The discharge of the geothermal fluid would destroy the aquatic life in the brook.				
Final Impact Assessment	Negligible	Minor	**Medium**	Major	
	Impact is medium and requires mitigation measures for preventing impacts on soil and groundwater.				

The spent geothermal fluids generated during the operation stage will be re-injected to the host rock formation, resulting in minor effluent volumes involving reject waters. Potential contaminants in the geothermal effluents will vary according to the mineralogy of the host geological formation, temperature of the geothermal water, and site-specific facility processes (IFC EHS Guidelines for Geothermal Power Generation).

The potential for contamination of the groundwater will be minimized by installation of leak-proof well casings in the injection wells to the depth of the geological formation hosting the geothermal reservoir.

In case of the failure of the reinjection line, the system will be shut down. The Project Company will develop an effluent management plan to minimize the risk of effluent discharges before the start of operation. In the event of unavoidable discharge of the geothermal fluid into the surface waters, the geothermal fluid will be retained in a thermal pond, where the temperature of the fluid will drop to the allowable limits set by the Water Pollution Control Regulation. The storage pond will be lined and of sufficient size to allow for

storage and for the required cooling to be realized for the potential duration of the reinjection failure.

The impacts of any potential failure of the reinjection system within the Project area can be effectively managed through a good design, regular monitoring and development of the appropriate emergency responses. Given that the critical failure of the pipeline is extremely unlikely and with a well-prepared management and monitoring plan in place, the residual impacts can be assessed as low.

8.2.4 Impacts of Solid Wastes

Solid wastes expected to be generated during the operation stage are domestic solid wastes produced by the operation staff, packaging wastes, hazardous wastes and waste oils, *waste vegetable oils*, end-of-life tires, waste batteries and accumulators and medical wastes from the camp site. A Waste Management Plan will be required for different types of waste as described below.

Domestic Solid Waste

Domestic solid wastes will be generated in the operation stage due to various consumptions of the operation staff. Considering that the number of staff will be 25 and taking the daily amount of domestic solid waste generated per person as 1.25 kg/person-day, according to the Turkish Statistical Institute's data for the year, 2014 for the Manisa Province, the total amount of the domestic solid waste generated by the operation staff will be 31.25 kg/day.

The domestic solid waste generated during the operation stage will be collected in garbage containers and stored properly on the site in line with the Regulation on Waste Management published in the Official Gazette No. 29314 and dated 02.04.2015. The collected domestic solid wastes will be transferred to the solid waste disposal area of the Alaşehir Municipality and ultimately disposed of in line with the subject Regulation.

Packaging Waste

The packaging wastes generated during the operation stage will be composed of recyclable materials such as metal, paper, plastics and glass. The recyclable wastes will be collected separately at source as indicated in Section 2, Article 5 of the Regulation on Waste Management, in order to be reintegrated into the economy without being subject to any chemical or biological processes. In addition, compliance with the Packaging Waste Control Regulation will be ensured for their management during the operation stage.

Waste Oils

Waste oils will be generated as a result of maintenance of the vehicles and equipment to be used during the operation stage. Waste oils will be managed by the authorized technical services, and oil change of the vehicles will be conducted by the machine experts or service staff on the leak-proof surfaces within the site, therefore possible soil contamination will be prevented. In case of generation of waste oils through oil changes, they will be stored and disposed of in accordance with the Waste Oil Control Regulation. Vehicle maintenance will be conducted periodically on daily, weekly and monthly bases, and oil leakage will be avoided by using drip pans.

Waste Vegetable Oils

Waste vegetable oils will be generated from the cafeteria, where the food service will be provided for 25 operation stage personnel. Waste vegetable oils will be collected separately to be sent to the licensed firms in compliance with the Waste Vegetable Oil Control Regulation.

End-of-Life Tires

Maintenance of the vehicles to be used during the operation stage will be managed by authorized technical services. Nevertheless, end-of-life tires may be generated in case of mandatory tire changes. In such cases, tires will be sent to the licensed firms in accordance with the Regulation on Control of End-of-Life Tires.

Waste Batteries and Accumulators

Waste batteries generated during the operation stage will be separately collected in the waste battery containers placed at the Project site and will be periodically sent to a Waste Battery Recycling Plant as stated in Section 2, Article 13 of the Regulation on Control of Waste Batteries and Accumulators. In addition, temporary storage of the waste batteries within the facility will be managed according to Section 4, Article 20 of the same regulation.

There will be no accumulator replacement within the site. However, the empty accumulators generated in compulsory cases will be sent to the firms to be replaced with the full ones as stated in the Regulation on Control of Waste Batteries and Accumulators. In addition, temporary storage of the waste accumulators within the facility will be managed according to Section 4, Articles 18 and 19 of the same regulation.

Medical Wastes

The nearest hospitals will be used for possible injuries and health problems of 25 operation stage personnel. However, as a result of on-site first aid applications for injuries, medical wastes will be generated; and they will be collected, transferred, stored and disposed of in compliance with the Medical Waste Control Regulation.

A Waste Management Plan will be prepared by the Project Company before operation phase in order to mitigate impacts from storage of different streams of waste. The Waste Management Plan will comprise of mitigation measures on the basis of different lines of waste generation, and emergency response measures against possible emergency conditions associated with hazardous wastes particularly.

Table 8-13. Impacts of Waste Generation and Storage at Operation Stage

Impact Type	Positive	**Negative**	**Direct**	Indirect	Cumulative
	Impact of waste generation without waste management is direct and negative on soil and groundwater.				
Impact Duration	Temporary	Short Term	**Long Term**	Permanent	
	The impact is long term.				
Impact Extent	Project Area	**Local**	Regional	National	
	The extent of impact is local.				
Impact Magnitude	Negligible	Low	Medium	**High**	
	Impact will be high if no mitigation measures are taken and direct contact with ground would cause soil and groundwater contamination.				
Likelihood of Impact	Unlikely	**Likely**	Certain		
	Impacts are likely if no waste management is implemented.				
Impact Significance	Insignificant	Minor	Moderate	**Major**	
	Significance of impact is major as lack of waste management practices would cause contamination of soil and groundwater.				
Reversibility of Receptor	High	Medium	**Low**	Irreversible	
	Soil and groundwater has low reversibility (depending on the contents of waste).				
Final Impact Assessment	Negligible	Minor	Moderate	**Major**	
	The impacts are major and require mitigation measures.				

Without any mitigation measures, risks of particularly hazardous waste storage would be high. Given the possible impacts, it is significant to implement a well established waste management practices mainly for proper storage of hazardous wastes. With a well established waste management plan, the impact level will be lowered to minor. Hence, it will be necessary to set monitoring procedures for groundwater and soil at critical locations, downstream and upstream of waste storage locations.

8.2.5 Impacts of Storage of Chemicals

During the operation stage; the fuels, lubricants and other chemicals may pose risks of soil contamination due to poor storage conditions and practices. The magnitude of any potential

change in the groundwater quality is assessed to be moderate, because the impact would cause a significant change in the water chemistry but would be short-lived and highly localized. This could have impacts on the water abstraction close to the site for the local residents. The impact of this risk is therefore assessed to be of adverse major significance without any mitigation measures. N-butane which is a flammable chemical will be used as working fluid during energy generation. Total volume of n-butane will be 150 tonnes including the portion in the operating cycle and the stored amount. The requirements of Law on Occupational Health and Safety will be complied with during the use, storage, or handle of n-butane. Safe working principles for butane have been defined in the PDR of the Project. All operators who will be employed with n-butane involving activities will be provided with both Safe working principles and Material Safety Data Sheet.

IFC/World Bank EHS General 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. The Project will implement hazardous materials management 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 in accordance with the guideline.

Table 8-14. Impacts of Chemicals Storage

Impact Type	Positive	**Negative**	**Direct**	Indirect	Cumulative
	Impact of improper chemicals storage, use and handle is direct and negative on soil and groundwater as well as workers.				
Impact Duration	Temporary	Short Term	**Long Term**	Permanent	
	The impact is long term.				
Impact Extent	Project Area	**Local**	Regional	National	
	Impact will on the project area and environs.				
Impact Magnitude	Negligible	Low	Medium	**High**	
	Impact is high if no mitigation measures are taken as leakages and spills would cause soil and groundwater contamination as well as risk for workers and locals.				
Likelihood of Impact	Unlikely	**Likely**	Certain		
	Impacts are likely if no measures are taken.				
Impact Significance	Insignificant	Minor	Moderate	**Major**	
	Significance of impact is major.				
Reversibility of Receptor	High	Medium	**Low**	Irreversible	
	Reversibility of receptor is low (depending on the chemicals spilled or leaked).				
Final Impact Assessment	Negligible	Minor	Moderate	**Major**	
	Impact will be major if no mitigations are taken.				

The Project Company will prepare and implement a Hazardous Chemicals Management Plan, supported with a Spill Response Plan. Appropriate containers will be used for segregation and permanent storage of the chemicals and fuels on the site. Suitable sized storage and well-maintained containers with appropriate labeling will be ensured.

With a well-established Hazardous Chemicals Management Plan, the impact level will be lowered to minor. It will be necessary to set monitoring procedures for the groundwater and soil at the critical locations, downstream and upstream of the chemicals use and storage locations.

8.2.6 Impacts on Air Quality and Odor Impacts

The major gases emitted from the geothermal power generation processes are CO_2 and H_2S. The site will be required to comply with the limits indicated in the Regulation on Control of Industrial Air Pollution. The release of the H_2S gases during drilling and the operation stage usually accompanies the severe odor problems in the settlements close to the geothermal plants. Given the binary process of the geothermal power generation, the H_2S emissions will be minimal as compared to the other technologies. Still, the Project Company will conduct regular air quality measurements for H_2S emissions and commit to taking additional measures if the measurements indicate high levels of H_2S concentrations. There will be also be H_2S detectors at well heads.

Table 8-15. Air Quality and Odor Impacts During Operation Stage

Impact Type	Positive	**Negative**	**Direct**	Indirect	Cumulative
	H_2S and odor impacts on communities are direct and negative				
Impact Duration	Temporary	Short Term	**Long Term**	Permanent	
	The impact is long-term throughout operation stage.				
Impact Extent	Project Area	Local	**Regional**	National	
	Impact can be regional together with cumulative impacts from other projects in the region.				
Impact Magnitude	Negligible	Low	**Medium**	High	
	The impacts are medium given that the communities in the Area of Influence will have to adapt to the exposure to the nuisance. The communities are sensitive about the odor issue, as it also gives them an indication for their crops exposed to air pollution caused by the geothermal power generation.				
Likelihood of Impact	**Unlikely**	Likely	Certain		
	The impacts are unlikely as the Project will employ a closed-circuit system which will minimize the odor emissions, except for the temporary odor releases at the times of maintenance and testing. H_2S will also be regularly monitored.				
Impact Significance	Insignificant	**Minor**	Moderate	Major	
	Significance of impact is minor.				
Reversibility of Receptor	Insignificant	Low	Medium	**High**	
	Reversibility of impact is high as odor/H_2S emissions will diminish once the source is closed				

	down.			
Final Impact Assessment	**Negligible**	Minor	Moderate	Major
	The overall impacts are negligible and do not require any additional mitigation measures.			

8.2.7 Environmental Noise Impacts

The major sources of noise pollution during the operation phase are the air-cooled condenser fans (ACC fans), turbine generators, pumps, vents for non-condensable gases and feed pumps. Noise sources during operation phase of the Project and their sound level are provided below in Table 8-16.

Table 8-16. Sound Power Level of the Power Plant Equipment

Equipment Description	Number of Equipment	Sound Power Level (dBA)*
Air-Cooled Condenser Fans (ACC Fans)	58	85
Turbine	1	85
Generator	1	85
Pumps	4	80
Vent for Non-Condensable Gases	1	85
Feed Pump	3	82

* The sound power levels of the Power Plant equipment are measured at a distance of 3 m.

The total sound power level from the Power Plant equipment is calculated using Formula (1) below:

$$L_{eq} = 10 \times \log \sum_{i=1}^{n} 10^{L_i/10} \qquad (1)$$

where,

n = the no. of the noise sources,

L_i = the sound power level (dB(A)) of the noise sources,

L_{eq} = the total equivalent sound power level.

Accordingly, the total sound power level of the Power Plant equipment is calculated as 103.05 dBA.

The next step is to calculate the change of the total sound power level with distance from the source. This is to estimate the sound power level reaching the sensitive receptors. For this purpose, Formula (2) below is used:

$$L_P = L_{eq} + 10 \times \log\left(\frac{Q}{4.\pi.r^2}\right) \quad (2)$$

where

L_p = the sound power level,

L_{eq} = the equivalent sound power level,

Q = the directional coefficient (taken as 3 due to the fact that the Project area is considerably flat),

r: the distance from the source.

Here, atmospheric absorbance and geographical and artificial barriers (buildings etc.) are omitted to consider the worst-case. Also, it is assumed that all the machinery is working at the same point and at the same time.

The sound power level resulting from the Power Plant with respect to the distance from the source is presented below in Table 8-17.

Table 8-17. Sound Power Level with Respect to Distance

Distance (m)	Sound Power Level (L_p) (dBA)
0	103.05
50	62.85
100	56.83
200	50.81
300	47.29
400	44.79
500	42.85
550	42.02
600	41.27
700	39.93
800	38.77
900	37.74
1000	**36.83**
1250	34.89
1500	33.31
1750	31.97
2000	30,81
2300	29.59
2750	28.04

Distance (m)	Sound Power Level (L_p) (dBA)
3000	27.29
3250	26.59
3500	25.95
4000	24.79

RAMEN sets limit noise levels according to the location of the facility and the type of structures at the vicinity of the facility. Limits applicable for the Project are 60 dBA, 55 dBA and 50 dBA for daytime, eveningtime and nighttime respectively.

IFC/WB Guidelines noise levels at the noise sensitive receptor which should not be exceeded are given in Table 8-18.

Table 8-18. IFC/WB 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

Closest sensitive receptor is Baklacı Neighbourhood at 1 km to the Power Plant. as seen in the table above, noise level decreases below 36.8 dBA after 1 km. Therefore operation phase noise levels are expected to comply with both RAMEN and IFC/WB Guideline requirements.

Table 8-19. Noise Impact of the Operation Stage

Impact Type	Positive	**Negative**	**Direct**	Indirect	**Cumulative**
	Noise impacts on communities are direct and negative and cumulative.				
Impact Duration	Temporary	Short Term	**Long Term**	Permanent	
	The impact is long-term throughout operation stage.				
Impact Extent	Project Area	Local	**Regional**	National	
	Impact is local, limited to the settlements in the Area of Influence.				
Impact Magnitude	Negligible	**Low**	Medium	High	
	Impact is low since noise levels are expected to comply with both RAMEN and IFC/WB Guideline limits.				
Likelihood of Impact	Unlikely	**Likely**	Certain		
	The impact is likely.				
Impact Significance	Insignificant	**Minor**	Moderate	Major	
	Significance of impact is minor.				
Reversibility of	Insignificant	Low	Medium	**High**	

Receptor	Reversibility of impact is high as noise will diminish once the source is closed down.			
Final Impact Assessment	**Negligible**	Minor	Moderate	Major
	Overall impact is negligible and does not require additional mitigation measures.			

8.2.8 Climate Change Impacts

Release of non-condensable gases from geothermal reservoirs raises the issue of impacts that cause climate change. Non-condensable gases (NGCs) are mainly composed of CO_2, which has no direct impact on local air quality.

As a greenhouse gas (GHG), CO_2 is associated with combustion of fossil fuels. The Project will lead to releases of the greenhouse gases. During the tests, but mostly during the operation stage, CO_2 and methane (CH_4) will be released.

The worldwide calculations show that the total amount of CO_2 avoided by utilization of geothermal resources in place of coal proves that a beneficial impact of major significance is gained from geothermal power plants.

It should be recalled that binary power plants retain non-condensable gases in closed loop systems. The geothermal fluid is re-injected after utilizing its heat at the heat exchanger resulting in near-zero emissions during the power generation process as the non-condensable gases are never released to the atmosphere. However, if gas separation occurs within the circulation loop, some minor gas extractions and emissions are likely to occur.

Sis Enerji aims to decrease the CO_2 emissions generated from Özmen-3 GPP and has therefore conducted a study for CO_2 emissions assessment based on the outputs from their other GPP Project namely Özmen-1. According to the study CO_2 will reduce naturally and gradually. Besides Sis Enerji is in the progress of developing a study in collaboration with Middle East Technical University on the reduction of CO_2 emissions by reinjection.

In the scope of the study, NCG content during short term well testing was compared with the operation phase measurement results after 2 years for Özmen-1 GPP. It was observed that almost 50% difference occurred between two values.

Measurements were conducted at well no Özmen-1 of Özmen-3 GPP Project in order to make a projection on NCG content in the next 4 years. Estimated NCG decrease at Özmen-1 is presented below in Figure 8-2.

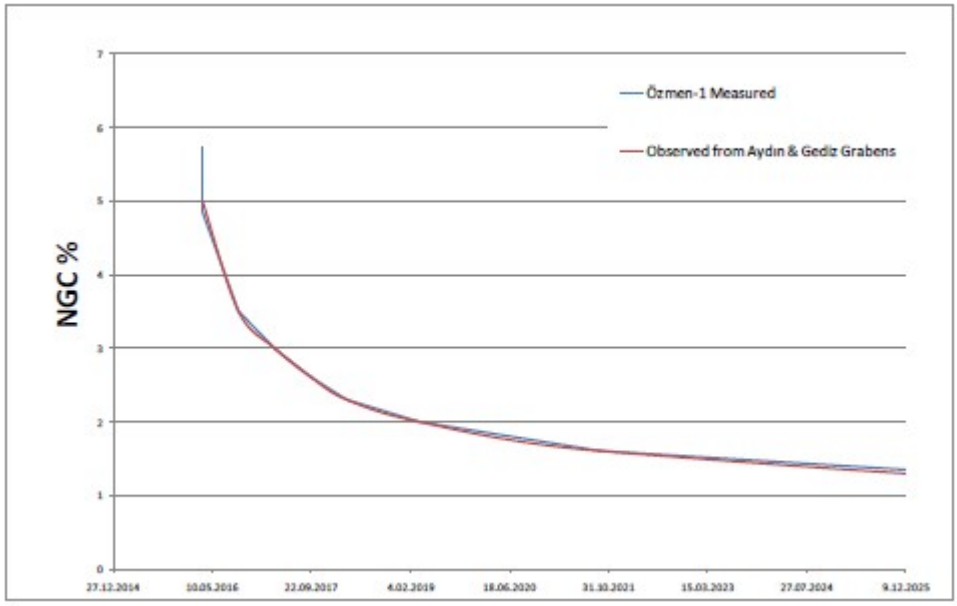


Figure 8-2 Time dependent NCG Decrease Projection at Özmen-1 Well of Özmen-3 GPP Project

It is expected that the NCG content will decrease by 53% in 4 years.

In the study report CO_2 distribution map which had been prepared in 2010 was presented. It was stated that Gediz Graben, one the most high geothermal field in Western Anatolia has a high potential of natural CO_2 release in regional scale due to numerous active faults those control the graben tectonically and morphologically. According to CO_2 flow from Gediz Graben, natural CO_2 emission is 11.6 kg/m^{2}d. Within the scope of the study, natural CO_2 emission was calculated as 40.4 kg/m^{2}d and geothermal CO_2 emission due to Özmen-3 GPP operations was expected to be 0.55 kg/m^{2}d which is below the natural CO_2 emissions of 11.6 kg/m^{2}d for Gediz Graben.

Moreover Gediz graben similar to Menderes graben is known to have high GHG emission values which can be restricted to high temperature geothermal reservoirs located in carbonate rich rocks (Energy Sector Managament Assistance Program, 2016).

CO_2 emissions distribution map for Özmen-3 GPP is provided below in Figure 8-3.

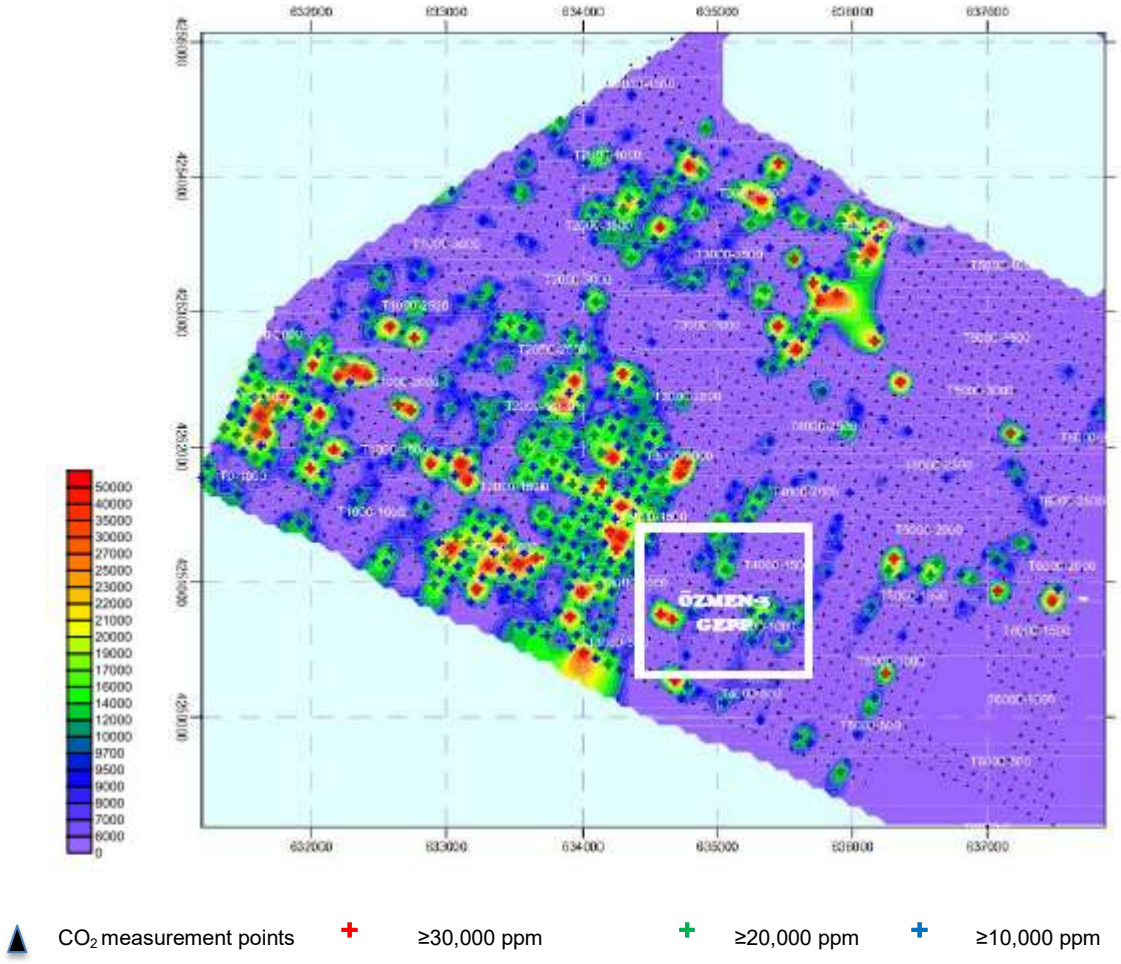


Figure 8-3 CO_2 Emission Distribution Map

CO_2 release during operation phase of the Project is calculated according to the information below;

Geothermal fluid of 780 tons/hour will be used during operation of 8,760 hours in one year for 166,440,000 kWh of annual electricity production. Regarding that the geothermal fluid consists 3% NCG of 97% of which is CO_2, CO_2 generation per year will be 22.70 tons. Then the CO_2 emissions at the beginning of the operation will be 1,194.73 grams/kWh according to the following calculation.

780 tons/hour * 3/100 (NCG percentage) * 97/100 (CO_2 percentage) = 22.70 tons CO_2/hour

22.70 tons CO_2/hour * 1,000,000 grams/ton * 8,760 hours/year * 1 year/166,440,000 kWh = 1,194.73 grams/kWh.

It is projected that the NCG content will decrease to 1.6% in 5 years, then the CO_2 emissions

will be as follows:

780 tons/hour * 1.6/100 (NCG percentage) * 97/100 (CO_2 percentage) = 12.10721 tons CO2/hour

12.10721 tons CO_2/hour * 1,000,000 grams/ton * 8,760 hours/year * 1 year/166,440,000 kWh = 637.22164 grams/kWh

8.3 Closure Stage Impacts

Operation period of the Project is planned to be 30 years at this stage however the duration can be extended based on maintenance and rehabilitation of the equipment and the system. Therefore closure phase impacts can be altered in the future at the end of the operation phase of the Project. Yet estimated impacts are as follows:

8.3.1 Impacts on Ecology

Impacts on Ecology during closure phase activities would be similar to that would occur during construction, but at a reduced magnitude.

Noise from machineries and demolition can affect animals, disturb them or scare them which could have impact on results from nesting season. Noise generation during closure phase will be temporary and transient in nature and will be controlled through good site working practices, limited working hours and decommissioning will be planned outside breeding season. Therefore noise impact during closure phase of the Project is expected to be insignificant.

Closure activities can temporary cause trapping or accidents for wildlife. Entrance of the animals will be prevented by fences surrounding the Project area. Decommissioning will be planned so it will be continuous and surface finish will not leave hazards of abandoned structures for wildlife. Therefore impact on wildlife during closure phase of the Project is expected to be insignificant.

8.3.2 Water Supply

Impact regarding water supply during closure phase will be similar to construction phase. Water will be used for dust suppression and domestic uses. It is expected that the impact will be insignificant during closure phase.

8.3.3 Wastewater Generation

Wastewater will be generated due to domestic uses of the workers. Domestic wastewater will be collected in septic tanks and discharged by the Municipality. Impact due to wastewater generation during closure phase is expected to be insignificant.

8.3.4 Impacts of Geothermal Fluid

Geothermal fluid will be reinjected to the reservoir during the operation phase of the Project. The wells will be closed after the operation phase is over and there will be no use of geothermal fluid during closure phase.

8.3.5 Impacts of Solid Wastes on Soil and Groundwater

Impacts of solid waste will be similar to the construction phase of the Project. There will be non-hazardous solid waste generation by the workers and also waste oil and drilling mud. The requirements of Regulation on Waste Management, Packaging Waste Control Regulation, Regulation on the Control of End-of-life Tires, Regulation on the Control of Waste Batteries and Accumulators will be complied with during closure phase and the impacts are expected to be low after mitigation measures.

8.3.6 Impacts on Air Quality

Potential impacts on air quality are expected to be similar to the construction phase of the Project however with a smaller extent. There will be limited earth moving activities and less vehicle movement and demolition of Project components will be conducted minimizing the generation of dust. Therefore impact on air quality during closure phase of the Project is expected to be insignificant.

8.3.7 Noise Impact

Noise generation during closure phase will be temporary and transient in nature and will be controlled through good site working practices, limited working hours. Therefore noise impact during closure phase of the Project is expected to be insignificant.

8.4 Impacts of Energy Transmission Line

Although the ETL route is not finalized yet, it is expected to be of about 1.5 km and connected to the national grid through TEIAS transmission line of Kula 1 and 2 between the 34th and 35th electricity transmission towers. It is expected that there will be 8 towers through the route located on an area of 2mx2m with a height of 3m. The proposed route passes entirely from agricultural lands. There are no areas with significant ecological value on the route. Land use of the area is given below in Figure 8-4. According to the map the area on the route is classified with “Complex Cultivation Patterns”. This class includes by definition; parcels of arable crops (occupying < 75% of the area), permanent crops such as vineyards, fruit orchards, olives (each type occupying < 50% of the area), permanent grasslands (pastures, meadows), kitchen gardens, regular buildings, huts (occupying < 50% of the area), sealed or non-sealed (dirt or tar macadam) roads.

The closest protected area to the route is Kula Fairy Chimneys Natural Monument at about 25 km. Other protected areas close to the route are Marmara Lake Wetland and Gölcük Lake Wetland at about 43km and 41km respectively..

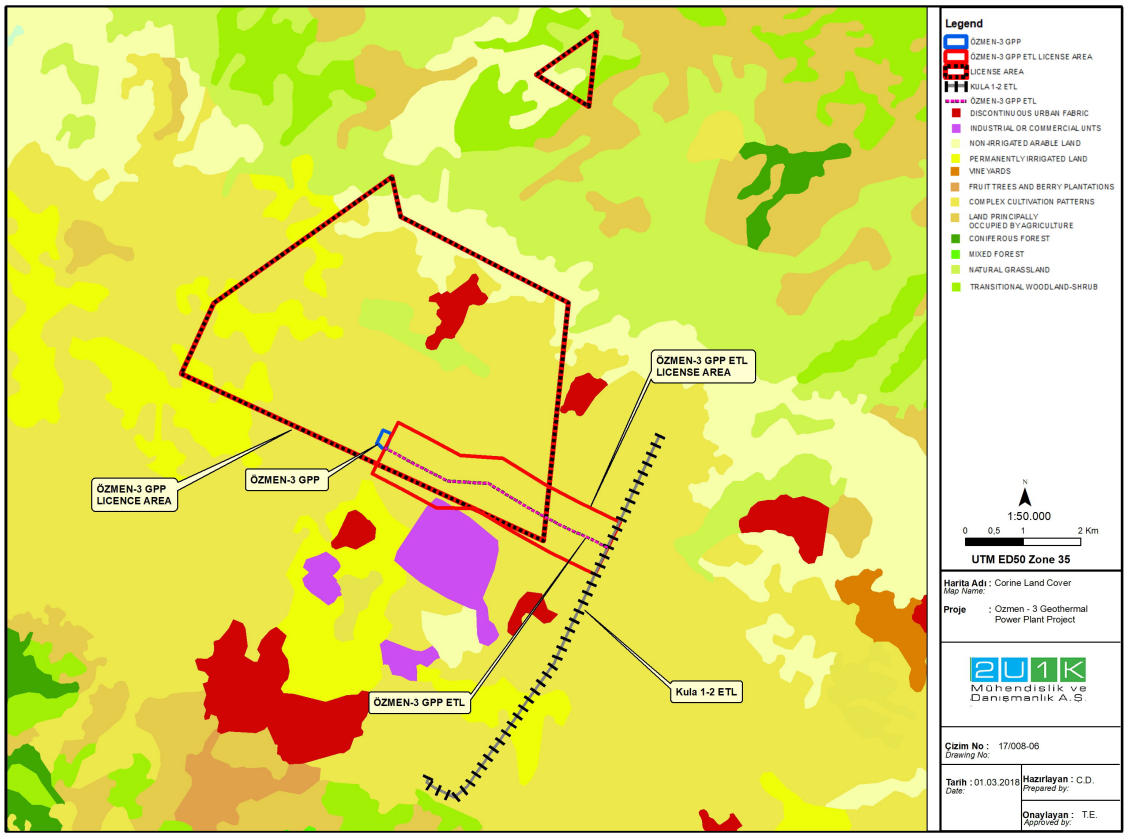


Figure 8-4 Corine Land Cover Map

The potential impacts of ETL during construction phase are expected to be mainly on land use, air quality, noise, soil and groundwater and occupational health and safety.

The expropriation procedure for the lands on the ETL route which could be required will be undertaken by TEİAŞ, however through obtaining of easement rights, agricultural lands can continue around the ETL components during operation. It is also important to inform the land owners close to the route in advance of the construction of the electricity transmission line and transmission towers in order to avoid any grievances due to construction activities.

The emissions during construction phase will be associated with the dust and exhaust gas resulting from the operation of onsite diesel vehicles, skimming of topsoil layers, and excavation for the electricity transmission towers and transportation of the necessary material and equipment for the construction of the electricity transmission line and transmission towers. Existing access roads will be used if possible and unnecessary traffic will be restricted. Excavated material storage will be minimized and will be covered if

required. Construction impacts will be limited in duration and extend therefore are expected to be negligible.

Improper use or handling and spills of hazardous materials such as insulating oils, paints or fuel can lead to soil and groundwater contamination. In case of storage of hazardous material at the site, the materials will be kept in leak proof containments on designated areas with impermeable floor, spill kits will be available at working site. Maintenance of construction vehicles will not occur at site. The impact on soil and groundwater is expected to be negligible.

Noise generation due to the vehicle movement and construction equipment will occur during construction activities however will be temporary and transient in the environment. Also working hours will be limited in order to prevent nuisance. Therefore noise impact is expected to be negligible.

Occupational health and safety hazards during construction activities are primarily due to live power lines and working at height. Risk of hazard will be minimized by employing only trained and certified workers and providing required PPEs along with providing fall protection systems.

During operation phase potential impacts are expected to be mainly due to electromagnetic field (EMF) and corona effect. Although the site will be visited regularly by TEİAŞ for maintenance there will be no domestic or hazardous waste generation, air emission or noise generation. During the operation of the ETL plants and trees will be cleared to protect the electric wires if necessary.

ETLs are the source of the high electricity and magnetic fields because of the high voltage and currents. Although there is no proven adverse impact of electromagnetic field on human health, there are still some potential risks depending on the frequency and intensity of the fields. Therefore, some limits were developed for exposure to electrical and magnetic fields. “IFC EHS Guidelines for Electric Power Transmission and Distribution” presents exposure limits for general public exposure to 50/60 Hz electric and magnetic fields published by the International Commission on Non-Ionizing Radiation Protection (ICNIRP) which are provided below in Table 8-20.

Table 8-20. ICNIRP Exposure Limits for General Public Exposure to Electric and Magnetic Fields

Frequency	Electric Field (V/m)	Magnetic Field (μT)
50 Hz	5000	100
60 Hz	4150	83

Although there are no limits regarding electrical and magnetic field exposure in national legislation Turkish Standards Institute has defined limit values at Exposure of Human to the Electromagnetic Field-Low Frequencies (0 Hz-10 kHz) (given in the standard of TS ENV 5016-1/April 1996 publication and numbered 29020). Accordingly, public exposure limit to electric field is 10 kV/m and magnetic field is 6.4 Gauss (=640 µT).

Frequency value for the ETLs operated by alternating current is 50 Hz. According to the study carried out by TEAŞ (former Turkish Electricity Generation and Transmission Incorporation) and TUBİTAK (The Scientific and Technological Research Council of Turkey) National Metrology Institute in 2001, electric and magnetic fields of some high voltage energy transmission lines were determined. According to this study, electric and magnetic fields of high voltage 154 kV overhead ETLs are in the range of 0.3-1 kV/m and 9-14 mG (= 0.9-1.4 µT), respectively. Since the voltage of the proposed ETL is 154 kV, it can be concluded that electric and magnetic fields of the ETL will be significantly below the limit values presented above.

The effect of electromagnetic field decreases when the distance increases. Therefore, negative impact of EMF of the ETL is not expected at the residential areas close to the predicted ETL route.

Regulation on Electric Power Installations (issued in the Official Gazette dated November 30, 2000 and numbered 24246) defines limitations for the distance between energy transmission lines and settlement areas, roads and other structures. The route of the ETL should be finalized considering these limitations.

The minimum distance between the ETLs and the settlements considering electric and magnetic field effects and safety issues such as collapse of pylons and lines will be 4 m in accordance with the Regulation on Electric Power Installations. In addition, the width of the ETL corridor (right-of-way) which will be cleared from trees and be expropriated as well will be 50 m.

Also minimum vertical and horizontal distances s safety zones are defined by the Regulation on Electric Power Installations. Article 44 of the regulation states that the horizontal distances given in Table 8-21 below must exist between the overhead line conductors and the most projected sections of the buildings, near which they pass, with maximum oscillation.

Table 8-21. Minimum Horizontal Distances of the Overhead Line Conductors to the Structures with Maximum Oscillation

Permitted Highest continuous operation voltage of the line (kV)	Horizontal distance (m)
0 – 1 (1 included)	1
1 – 36 (36 included)	2
36 – 72,5 (72.5 included)	3
72,5 – 170 (170 included)	4
170 – 420 (420 included)	5

The regulation also states that that all trees violating conductor stringing and line safety must be trimmed or cut. Minimum horizontal distances of the line conductors to trees in maximum oscillation condition are given in Table 8-22.

Table 8-22. Minimum Horizontal Distances of Overhead Line Conductors to Trees

Permitted highest operational voltage of the line (kV)	Horizontal distance (m)
0 – 1 (1 included)	1
1 – 170 (170 excluded)	2.5
170	3
170 – 420 (420 included)	4.5

The minimum vertical distances of the conductors to the locations and objects over which they pass calculated in accordance with Article 46 of this regulation with maximum sag are given in Table 8-23.

Table 8-23. Minimum Vertical Distances of Overhead Line Conductors to the Places Over Which They Pass with Maximum Sag

Locations	Maximum continuous operational voltage of the line (kV)					
	0-1 (1 included)	1-17.5	36	72.5	170	420
	Minimum vertical distances (m)					
Water with no traffic (in accordance with the highest surface of the water)	4.5*	5	5	5	6	8.5
Pastures, fields, grassland etc. suitable for passage of vehicles	5*	6	6	6	7	9.5
Village and city roads suitable for the passage of vehicles	5.5*	7	7	7	8	12
Intercity highways	7	7	7	7	9	12

Locations	Maximum continuous operational voltage of the line (kV)					
	0-1 (1 included)	1-17.5	36	72.5	170	420
	Minimum vertical distances (m)					
Trees	1.5	2.5	2.5	3	3	5
Flat roofs that can be climbed by everybody	2.5	3.5	3.5	4	5	8.7
Sloped roofs that cannot be climbed by everybody	2	3	3	3.5	5	8.7
Electric lines	2	2	2	2	2.5	4.5
Petroleum and natural gas pipelines	9	9	9	9	9	9
Water and canals with traffic (these distances must be measured from the highest point of the vehicles that may pass on the highest surface of the waters)	4.5	4.5	5	5	6	9
Communication lines	1	2.5	2.5	2.5	3.5	4.5
Railways without electricity (measured from the rail)	7	7	7	7	8	10.5
Motorways	14	14	14	14	14	14

(*) The heights shall be decreased 0.5 m when insulated overhead line cables are used.

High electric fields on the lines with very small radiuses causing ionization of the air around conductor and relative discharge is called corona. Corona occurs on all types of transmission lines, but it becomes more noticeable at higher voltages. It causes electrical losses, a crackling or humming sound, light, ozone production, acid impacts with the moisture, interferences in the radio and TVs.

According to the “IFC EHS Guidelines for Electric Power Transmission and Distribution” this effect is greater with high voltage power lines of 400-800 kV. Since the proposed ETL will have a voltage of 154 kV, it is anticipated that the corona effect will be limited. Hence a potential corona effect such as a sound will not be perceived by the communities.

In addition maintenance of the ETL will be done regularly and contamination in the conductors increasing the corona effect will be cleaned at specific periods.

9. SOCIAL IMPACT ASSESSMENT

Although there have been innovations in national environmental legislation regarding the social aspects within the framework of the European Union adaptation process, the lack of social impact assessment process still continues. Turkish EIA legislation does not cover social environment and only limited its scope to the physical and ecological environment. The social environment topics that are included in national legislation are limited to stakeholder engagement and resettlement processes. Therefore, in order to cover the national gaps, the international financial institutions are taken into a consideration for investment projects to minimize environmental and social risks and take actions in equitable and transparent forms.

This section of the Report assesses the direct and indirect potential socio-economic impacts of the Project. For this section, impacts likely to have the same receptor and similar mitigation measures for both construction and operation phase are presented in the same section. Major social issues subject to assessment are:

- National Economy
- Land Acquisition
- Local Economy And Livelihood
- Labour Influx
- Transportation and Traffic
- Community Health and Safety
- Occupational Health and Safety
- Cultural Heritage

Both quantitative and qualitative data collection techniques were used during social impact assessment.

9.1 National Economy

Operation Phase

There are powerful connections between energy provision and socioeconomic development. Energy is an important factor of socioeconomic development. Turkey's energy demand has grown rapidly almost every year and it will continue to grow. One of the main consequences of the Project is the provision of energy. This will create beneficial effect on the wider community.

Table 9-1. Impacts on National Economy

Impact Type	**Positive**	Negative	**Direct**	Indirect	Cumulative
	The impact of energy provision is a positive impact. The Project is expected to address the electricity needs of people nationally.				
Impact Duration	Temporary	Short-Term	**Long Term**	Permanent	
	Operation phase of the project is planned for 30 years.				
Impact Extent	Project Area	Local	Regional	**National**	
	Extent of the impact will be National level. Produced energy will be connected to national grid.				
Impact Magnitude	Negligible	Low	Medium	**High**	
	Impact magnitude is high.				
Likelihood of Impact	Unlikely	Likely	**Certain**		
	Likelihood of occurrence of impact will be certain.				
Impact Significance	Insignificant	Low	**Moderate**	Major	
	Impact will be moderate.				
Final Impact Assessment	Insignificant	Low	Medium	High/Critical	
	The impact of the Energy Provision is a positive impact.				

Enhancement Measures

The Project will address the energy needs of Turkey, contribute to national development, and help improve efficiency and quality of infrastructure services.

The impact will be positive.

9.2 Land Acquisition

Construction and Operation Phase

The Project is planned to be established on privately owned agricultural lands. Until now, a total area of 92,002.3 m^2 have been purchased within the scope of the Project for 7 wells and the Power Plant area. Negotiations on prices of the lands with the landowners have been conducted by the Project Company and the lands were purchased through negotiated land take. There were no assets on the purchased lands and physical displacement did not occur for the Project. The Project did not and will not cause any public land take cases.

Information on the purchased lands is presented in Table 9-2 below. The Project Owner will continue land take for Project purposes through negotiated land take approach. In case agreement cannot be achieved between the Project Owner and the land owner for a particular land, other alternatives within the licence area will be considered until reaching agreed prices. Although it is not planned, in case expropriation is not inevitable in the future,

the Project Owner will prepare a Resettlement Action Plan/Abbreviated Resettlement Action Plan (RAP/ARAP) for land acquisition.

As mentioned previously, the electricity transmission line will be established following the approval of Turkish Electricity Transmission Corporation; TEIAS. The power plant will be connected to the TEIAS transmission line of Kula 1 and 2 between the 34th and 35th electricity transmission towers. The transmission will be through a 34.5 kV line. However, the route and length of the transmission line as well as the coordinates of the transmission towers have not been definitively established yet. Necessary expropriation works will be undertaken by TEIAS.

Table 9-2. Land Take for the Project Activities

Name of Quarter	Block No.	Parcel No.	Former Parcel No.	Project Component	Total Parcel Area (m^2)	Purchased Area (m^2)	Type of Right
Baklacı	118	8		O-2 and O-24 Wells	5,963.33	5,963.33	Permanent land take
Baklacı	118	9			5,557.42	5,557.42	Permanent land take
Baklacı	118	10			5,922.95	5,922.95	Permanent land take
Baklacı	118	11			5,447.52	5,447.52	Permanent land take
Baklacı	120	10	575	O-5 and O-25 Wells	30,000.00	10,324.81	Permanent land take
Baklacı	120	76		Power Plant Site	12,934.9	12,934.9	Permanent land take
Baklacı	120	77		Power Plant Site	12,851.11	12,851.11	Permanent land take
Baklacı	120	78		Power Plant Site	10,850.11	10,850.11	Permanent land take
Baklacı	120	79		Power Plant Site	7,900.3	7,900.3	Permanent land take
Baklacı	120	132		O-3 Well	34,313.10	6,180.00	Permanent land take
Baklacı	121	97		O-4 Well	13,437.44	5,039.00	Permanent land take
Baklacı	121	116	1001	O-1 Well	3,195.00	3,030.85	Permanent land take
Total Area (m^2)					**148,373.18**	**92,002.30**	

As of now, all of the purchased lands for the wells and Power Plant are in Baklacı Neighborhood. Thereby, as stated in the Social Area of Influence, it can be stated that Baklacı is the most affected settlement in terms of land acquisition. As presented in the Table above, in terms of type of rights of the acquired land, all land that was acquired for each

Project Component was through permanent land take method. There has been no temporary land take acquired by the Project Company.

During the baseline studies, the social team conducted interviews with two different households from Baklacı Neighbourhood who sold their land to the Project Company. Both households stated that, they were informed regarding the Project's land requirements more than year prior to actual acquisition. Both households stated their satisfaction on negotiation prices. According to their statements, usually land price of a decare in the neighbourhood approximately values for 25.000 Turkish Lira, whereas, the Project Company offered 46.500 Turkish Lira for a decare. In terms of drilling phase, both interviewees stated that the Project did not cause any harm on the borders of the acquired lands. Furthermore, both households assumed since the land acquisition was realized with the high market values, now they have opportunities for different investments such as buying alternative agricultural lands in the area.

During the Focus Group Discussion in Baklacı Neighbourhood, all of the locals who sold their land were satisfied with the land acquisition of the Project. According to their statements, usually land price of a decare in the village will approximately values between 28.000 to 30.000 Turkish Lira, whereas, the Project Company offered between 45.000 – 50.000 Turkish Lira for a decare. They stated that there were no pressure by the Project Company in terms of acquiring land from the locals, as the locals were willing to sell their land higher than the market value.

Land acquisition process was also discussed during the PPM which was held on 27.11.2017 in Baklacı neighbourhood. The Meeting included locals from the AoI, mainly locals from Baklacı neighborhood, and the Project officials. The PPM meeting was announced in the local newspaper and was also posted on the billboard of the coffee houses in the AoI. It has been observed that there was no concern or prejudgment regarding to land acquisition process of the Project from the locals. The locals specifically stated that the Project Company is highly involved in terms of locals' concerns and development of the affected neighborhoods. Detailed information on the previous stakeholder engagement activities are provided in SEP document.

Table 9-3. Impacts of Land Acquisition on Local Communities

Impact Type	Positive	Negative	**Direct**	Indirect	Cumulative
	Land-take is a direct impact as land acquisition is performed by means of land purchase. It can be considered positive as it is made upon willingness of land-owners and at reasonable prices. It can be considered negative indirectly, if land-owners can not invest in sustainable businesses.				
Impact Duration	Temporary	Short Term	Long Term	**Permanent**	
	The impact is permanent.				
Impact Extent	Project Area	**Local**	Regional	National	
	Impact is local, limited to the Project area.				
Impact Magnitude	Negligible	**Low**	Medium	High	
	Impact is rated low, as the amount of land acquisition is not high, and former land-owners are now able to adapt with relative ease as presumed. No major workforce living on agricultural lands acquired.				
Likelihood of Impact	Unlikely	Likely	**Certain**		
	The impact is certain as land is acquired for the purpose of the Project.				
Impact Significance	Insignificant	**Minor**	Moderate	Major	
	Significance of impact is minor.				
Reversibility of Receptor	**Irreversible**	Low	Medium	High	
	Once the land is occupied for the Project, no further agricultural use will be possible.				
Final Impact Assessment	Negligible	Minor	**Moderate**	Major	
	Overall impact will be moderate.				

Mitigation Measures

- The land acquisition process was handled by setting prices higher than the market value considering the long-term income from agriculture is lost permanently. Project Company will guide farmers through community engagement (mainly by organization of trainings with the collaboration of NGOs) toward investing in sustainable income sources.

- Grievance mechanism will be disclosed to the affected community and will be provided as a means of encouraging affected people to state their grievances about the land acquisition process.

Residual Impacts

Majority of the project-affected individuals have already purchased new lands for investment purposes or invested in their existed lands, with their compensation for acquisition of land. Providing assistance when needed and establishing good monitoring system will make the land acquisition process more efficient and will eliminate the possible negative outlook for the Project Company.

9.3 Local Economy and Livelihood

9.3.1 Employment

Construction and Operation Phase

It is estimated that a maximum of 15 workers will be required for the construction and 25 for the operation phases of the Project. Workers from the region will be given priority for employment opportunities. In addition, it was stated that temporary employment opportunities were created within AoI.

According to the participants from AoI stated that they were pleased with the employment opportunities created within the quarter but also that the number should be increased.

Table 9-4. Impacts on Local Employment

Impact Type	**Positive**	Negative	**Direct**	Indirect	**Cumulative**
	Employment opportunities will create a positive impact directly from the Project. All geothermal projects will contribute to increased local employment and may reverse out-migration in cumulative terms.				
Impact Duration	Temporary	Short-Term	**Long Term**	Permanent	
	Impact is long-term.				
Impact Extent	Project Area	**Local**	Regional	National	
	Impact will provide benefit particularly to Alaşehir District.				
Impact Magnitude	Negligible	Low	**Medium**	High	
	Impact magnitude is positive and medium.				
Likelihood of Impact	Unlikely	Likely	**Certain**		
	Employment opportunities within the region and the associated improvement of the local economy are certain impacts of the Project.				
Impact Significance	Insignificant	Low	**Moderate**	Major	
	Impact will be moderate.				
Final Impact Assessment	Negligible	Minor	Moderate	Major	
	The Project will contribute to problems of unemployment as a positive impact.				

The Project Company will be responsible for human resources for the drilling, construction and operation periods. Turkey is currently in the middle of a harmonization process with the European Union and labor laws are being reviewed to ensure alignment. The Project will comply with national labor, social security and occupational health and safety laws as well as the principles and standards of ILO convention. Based on the national principles embodied in the ILO convention, the Project Company will take measures by:

- not employing children under the age of 18,

- eliminating forced labor and ensuring a Human Resources Policy compatible with the European Convention on Human Rights and the Turkish Constitution,
- eliminating discrimination based on language, race, sex, political opinion, philosophical beliefs and religion in the employment relationships,
- ensuring workers' access to the right of collective bargaining (Act of Collective Bargaining Agreement on Trade Unions Act No. 6356 and 4857 Labor Law)
- ensuring access to the Project grievance mechanism that is functional effectively

Labor Law (4857) applies to all establishments and to their employers, employees, employer's representatives and employee representatives, irrespective of the subject matter of their activities. The Project Company is yet to develop a formal grievance procedure for workers although an informal procedure is in place. The Project Company Human Resources Policy will have provisions for age, wages, working hours, disabled employees, non-employee workers (i.e. sub-contractors), health and safety; and workers camps.

Enhancement Measures

- Project Company will ensure that its HR Policy will maintain that all workers will have contracts that clearly state the terms and conditions of their employment and their legal rights.
- The Project Company will have a Human Resources policy which observes wage standards, working hour regulation, freedom of association and staff encouragement. The policy will also eliminate child and forced labor, discrimination on the basis of religion, language, gender or social status, bullying and harassment. This policy will be developed by the Project Company to cover local employment and training of local people.
- Workers will be provided with information including, but not be limited to, entitlement to wages, hours of work, overtime arrangements and overtime compensation, and any benefits (such as leave for illness, maternity / paternity or holiday).
- All workers will be able to join trade unions of their choice and have the right to collective bargaining.
- Contracts will be verbally explained to all workers where this is necessary to ensure that workers understand their rights prior to any employment contract to be signed.
- Wages, benefits and conditions of work offered will be comparable to those offered by equivalent employers in Manisa.
- The Project and all contractors will put in place a formal worker grievance mechanism.

Positive impacts will be enhanced with the implementation of the enhancement measures described.

9.3.2 Local Economy

Construction and Operation

The Project will be beneficial for the economic growth in the Region. In addition, the Project may create in-direct employment opportunities during the construction and operation period to provide service for the Project Company. According to Focus Group Discussions, the locals are pleased to provide services and have opportunities to increase their economic income for the Project activities.

Table 9-5. Impacts on Local Economy

Impact Type	**Positive**	Negative	**Direct**	Indirect	**Cumulative**
	The Project will provide benefit to the local business and services, in which will create a positive impact directly from the Project.				
Impact Duration	Temporary	Short-Term	**Long Term**	Permanent	
	Impact is long-term..				
Impact Extent	Project Area	**Local**	**Regional**	National	
	Impact will provide benefit particularly to Alaşehir District.				
Impact Magnitude	Negligible	Low	**Medium**	High	
	Impact magnitude is positive and medium.				
Likelihood of Impact	Unlikely	Likely	**Certain**		
	Economic opportunities within the region and the associated improvement of the local businesses are certain impacts of the Project.				
Impact Significance	Insignificant	Low	**Moderate**	Major	
	Impact will be moderate.				
Final Impact Assessment	Insignificant	Low	Medium	High/Critical	
	The Project will contribute to problems of unemployment as a positive impact.				

Mitigation Measures

- The Project will have a Business Ethics Policy/Good Neighbour Policy that commits the Project to 'Buy Local'.

Positive impacts will be enhanced with the implementation of the enhancement measures described.

9.3.3 Labour Influx

Participants of the household survey stated that there have currently been no impacts of the Project regarding the magnitude of population. No impacts are anticipated for the future as well. Considering that employees would be from the local people during drilling works, the

total employment for construction phase is 15 and operation phases is 25 people, which would not account for a considerable population increase.

Table 9-6. Impacts on Labour Influx

Impact Type	Positive	**Negative**	Direct	**Indirect**	Cumulative
	Labour influx is direct negative impact, however, due to low number of construction workers, no significant concern have been stated from the locals.				
Impact Duration	Temporary	**Short Term**	Long Term	Permanent	
	It is evaluated as an impact during the construction period of the Project at the site.				
Impact Extent	**Project Area**	Local	Regional	National	
	Population influx was not a concern of the local resident.				
Impact Magnitude	Negligible	**Low**	Medium	High	
	Impact magnitude is evaluated as low level.				
Likelihood of Impact	**Unlikely**	Likely	Certain		
	Occurrence of the impact is considered unlikely.				
Impact Significance	**Insignificant**	Minor	Moderate	Major	
	Significance of impact is insignificant.				
Reversibility of Receptor	Insignificant	Low	Medium	**High**	
	Local people will be employed for construction phase as to an extent possible. Furthermore, due to low number of Project workers and there is no concern of local community, the reversibility is high.				
Final Impact Assessment	**Insignificants**	Minor	Moderate	Major	
	The impact is considered as insignificant, with the implementation of below mitigation measures				

Mitigation Measures

- The Project Company will establish a grievance mechanism, which will support the information disclosure process.
- The Project will provide job opportunities for the residents of nearby settlements to the extent possible.
- A code of conduct should be developed and implemented for workers, outlining expected behaviour with respect to their daily interactions with local residents and users of public amenities. This will be part of the labour force management plan to be developed for the Project
- The locals are willing to contribute for the Project activities once they feel their opinions matter and received sufficient information regarding the Project activities and potential impacts.

- The Project Company will establish a grievance mechanism, which will support the information disclosure process.

Residual Impacts

No residual impacts are anticipated.

9.4 Transportation / Traffic

Construction Phase

Majority of participants from AoI assumed that this is a cumulative impact related with the other geothermal projects in the region. Furthermore, communities may be concerned that gaseous emissions and dust from heavy vehicles may cause community health issues and may pose safety issues especially on children.

Table 9-7. Impacts of Project Transportation Activities

Impact Type	Positive	**Negative**	**Direct**	Indirect	**Cumulative**
	Traffic load caused by heavy vehicles is a direct and negative impact arising from the Projects are operating in the region.				
Impact Duration	Temporary	**Short Term**	Long Term	Permanent	
	Since the heavy machineries will be used for the drilling and construction period of the Project, it is going to be a short term impact.				
Impact Extent	Project Area	**Local**	Regional	National	
	Impacts related to transportation and traffic load is expected to be local.				
Impact Magnitude	Negligible	Low	**Medium**	High	
	Given the public nuisance expressed during surveys, traffic and transportation are assumed to pose a medium level impact.				
Likelihood of Impact	**Unlikely**	Likely	Certain		
	Impacts of transportation operations on community health and safety is unlikely with measures taken.				
Impact Significance	Insignificant	**Minor**	Medium	High	
	Level of impact significance is minor.				
Reversibility of Impact	Irreversible	Low	Moderate	**High**	
	Health and safety risks associated with traffic loads from heavy vehicles will disappear once the construction stage is over.				
Final Impact Assessment	**Negligible**	Minor	Moderate	Major	
	Given the high reversibility and measures taken, the impact is considered negligible.				

Mitigation Measures

- The Project Company will prepare and implement a site specific Traffic Management Plan so as to adequately manage traffic in the access roads used by communities. In

case of disturbing access roads, the Project Company and its contractors will be responsible to improve the roads back to their original status. Communities will be informed about schedules of transportation and also on safety and security measures to be taken at the level of individuals.

- The Project will implement an awareness raising information disclosure with local stakeholders regarding the risks related to the movement of heavy vehicles and increased traffic in the area. The main focus of this campaign will be during the construction phase and will focus on local residents and children. It will be implemented in coordination with local community groups such as Mukhtars.
- An Emergency Response Plan will be developed for the Project. This will provide details of what will happen in the case of a major traffic related incident and define roles and responsibilities. This plan will also be disclosed as part of the stakeholder engagement activities.
- Warning signs will be placed at entrances and exits of site vehicles.
- 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.
- Coordination with emergency responders to ensure that appropriate first aid is provided in the event of accidents.
- Using locally sourced materials, whenever possible, to minimize transport distances. Locating associated facilities such as worker camps close to project sites and arranging worker bus transport to minimizing external traffic.

Residual Impacts

Strict health and safety standards will be implemented including traffic management plan to reduce the road related accidents. With the implementation of above mitigation measures the residual impact of the Project are considered to be negligible.

9.5 Community Health and Safety

Construction and Operation

Community health and safety issues are associated with pollution factors that may arise from drilling, construction and operation period of the Project. Local people have expressed their concerns and worries during surveys that the geothermal projects in the region may cause climate change, agricultural activities may be negatively affected from sulfide emissions, grazing lands may shrink due to soil contamination, and that groundwater resources may get polluted. These concerns are mainly rooted in speculative information from other geothermal projects in the region.

Focus group participants stated project staff has contributed positively to the local economy by means of shopping in the quarters in the AoI. Some of the household survey participants

from the three quarters expressed their concerns regarding lack of information on environmental and health impacts of the Project. Either based on their experience or misinformation about other geothermal projects in the region, they fear that there would be an increase in environmental pollution and health risks.

According to Focus Group Meeting in Baklacı village, most severe impact raised as the nuisance caused by noise from other geothermal activities, especially near by the neighbourhood school at nighttime .

Communities around the Project area may be exposed to physical hazards associated with the Project components such as wells and pipeline. Besides, confined spaces or falling hazards may occur due to unattended infrastructure.

Table 9-8. Impacts on Community Health and Safety

Impact Type	Positive	**Negative**	**Direct**	Indirect	Cumulative
	Increase of, dust emissions and noise due to Project activities are a direct and negative impact arising from the Project. Based on misinformation, local people have concerns over investment projects, especially for the construction phase.				
Impact Duration	Temporary	**Short Term**	Long Term	Permanent	
	Since most of dust and noise emissions will occur during construction period of the Project, it is going to be a short term impact.				
Impact Extent	Project Area	**Local**	Regional	National	
	Impacts related to transportation and traffic load is expected to be local.				
Impact Magnitude	Negligible	Low	**Medium**	High	
	Given the public nuisance expressed during surveys, traffic and transportation are assumed to pose a medium level impact.				
Likelihood of Impact	Unlikely	**Likely**	Certain		
	Impacts on community health and safety are likely to occur if no mitigation measure is taken.				
Impact Significance	Insignificant	Minor	**Medium**	High	
	Level of impact significance is medium.				
Reversibility of Impact	Irreversible	Low	Moderate	**High**	
	Community Health and safety risks are mainly associated with construction phase and expected to disappear once the construction stage is over.				
Final Impact Assessment	Insignificant	**Low**	Medium	High/Critical	
	Given the high reversibility and measures taken, the impact is considered low.				

Mitigation Measures

- The Project area and wells will be surrounded by security fence in order to prevent unauthorized entrance. Health protection strip has also been established for the Project which is 15 m. Warning signs will be in place around the Project area, the wells and pipeline in order to inform the locals for Project site associated risks.
- The Project will operate on a closed system and the Project Company will take measures for lowering emissions that cause nuisance. Inclusion of buffer strips or other methods of physical separation around project sites to protect the public from major hazards associated with hazardous materials incidents or process failure, as well as nuisance issues related to noise, odors, or other emissions.
- Training and licensing industrial vehicle operators in the safe operation of specialized vehicles such as forklifts, including safe loading/unloading, load limits.
- The Project Company will monitor H_2S emissions and take immediate measures where necessary. A well-structured stakeholder engagement will minimize public concerns by clearly explaining the project operations, mitigation measures and possible residual impacts.
- The Project Company will perform effective public consultation and stakeholder engagement in order to provide correct and unbiased information on possible environmental and health impacts of the Project as well as the mitigation measures that will be taken.
- Construction activities will not be performed at night-time in order to prevent nuisance for the locals.
- Emergency Response Plan including fire, accidents and spills will be implemented.
- Information boards about public safety hazards and emergency contact information will be available in the Project site.

Residual Impacts

With the mitigation measures mentioned under respective environmental impact assessment sections, the impacts will be minimized to limits set by regulations.

9.6 Occupational Health and Safety

Construction and Operation Phase

Specific health and safety issues in geothermal power projects include the potential for exposure to geothermal gases, confined spaces, heat and noise.

Occupational exposure to geothermal gases, mainly hydrogen sulfide gas, may occur during non-routine release of geothermal fluids (for example, pipeline failures) and maintenance work in confined spaces such as pipelines, turbines, and condensers. The significance of the

hydrogen sulfide hazard may vary depending on the location and geological formation particular to the facility.

Noise is mainly related to well drilling, steam flashing and venting. Other sources include equipment related to pumping facilities, turbines, and temporary pipe flushing activities. Noise abatement technology includes the use of rock mufflers, sound insulation, and barriers during drilling, in addition to silencers on equipment in the steam processing facility.

Table 9-9. Impacts on Occupational Health and Safety

Impact Type	Positive	**Negative**	**Direct**	Indirect	Cumulative
	OHS risks are direct and negative.				
Impact Duration	Temporary	Short Term	**Long Term**		Permanent
	Impacts related with OHS issues may occur during the construction and operation phase				
Impact Extent	**Project Area**	Local	Regional	National	
	Risks are expected to be local as limited with the Project employees				
Impact Magnitude	Negligible	Low	Medium	**High**	
	OHS impacts in terms of magnitude can be considered as high.				
Likelihood of Impact	Unlikely	**Likely**	Certain		
	Risks are likely in case of not implementing appropriate OHS management system throughout the Project phases.				
Impact Significance	Insignificant	Minor	Medium	**High**	
	OHS risks may cause high significance.				
Reversibility of Impact	Irreversible	**Low**	Moderate	High	
	Reversibility of OHS related incidents may be resulted as low.				
Final Impact Assessment	Insignificant	Low	Medium	**High**/Critical	
	Occupational health and safety impacts can be high if no mitigation measures taken.				

Mitigation Measures

- Workers will be provided with contracts which clearly state the terms and conditions of their employment and their legal rights. The Project Company will ensure the workers are aware of the OHS risks of the Project activities and the mitigations to be taken through OHS trainings.
- The Project Company will take reasonable precautions in order to prevent occupational accidents, injuries and diseases on site, including measures to reduce and prevent the risk of exposure to harmful levels of ambient factors and chemicals, as well as the risk of injury or disease that may arise from the use of equipment and machinery.

- There will be H2S detectors on each well head in order to monitor hazardous levels of hydrogen sulphide. The Emergency Response Plan will include contingency plan for hydrogen sulfide release events, establishing facility emergency response teams, providing adequate ventilation of occupied buildings to avoid accumulation of hydrogen sulfide gas, development and implementation of a confined space entry program, and providing workers with a fact sheet about the chemical composition of liquid and gaseous phases with an explanation of potential implications for human health and safety.
- The Project Company will require all employees and contractors to adhere to local and international health and safety legislation and guidelines. This will include the use of suitable personal protective equipment (PPE), hearing protection, and implementation of and adherence to a management system for activities associated with health and safety risks. These would include such aspects of construction such as working at heights and working in confined spaces.
- In order to mitigate occupational exposure to heat occurring during construction activities as well as operation and maintenance, the Project Company will ensure that time required for work in elevated temperature environments is reduced, drinking water is accessible; surfaces where workers come in close contact with hot equipment are shielded.
- An occupational health and safety management plan will be developed by the Project Company which includes response measures for the situations of accidents, sabotages, fire and electricity shocks, commutable diseases, hydrogen sulfide releases, well blowouts, earthquake, floods, storms and chemical spills.

Residual Impacts

The overall residual impact on occupational health and safety of the labour force will be low to medium when an OHS management system is fully in place and measures are taken.

9.7 Cultural Heritage

There are no cultural assets known in the AoI that need to be protected with respect to the definitions of the Law on “Conservation of Cultural and Natural Assets” (Law No. 2863, amended with the Law No. 5226).

Table 9-10. Impacts on Cultural Heritage

Impact Type	Positive	**Negative**	**Direct**	Indirect	Cumulative
	Risks related to cultural heritage are direct and negative.				
Impact Duration	Temporary	**Short Term**		Long Term	Permanent
	The impact is short-term.				
Impact Extent	**Project Area**	Local		Regional	National
	The impact is limited to the Project Site.				
Impact Magnitude	Negligible	**Low**		Medium	High
	The magnitude of the impact is low.				
Likelihood of Impact	**Unlikely**	Likely			Certain
	Archaeological findings are unlikely to be found within the site borders.				
Impact Significance	**Insignificant**	Minor		Moderate	Major
	Impact is insignificant as there are no archaeological findings.				
Reversibility of Impact	Irreversible	Low		Medium	**High**
	In the case of finding archaeological features, findings will be protected and necessary steps will be applied according to national and international regulations and standards.				
Final Impact Assessment	**Negligible**	Minor		Moderate	Major
	Overall impact is negligible.				

Mitigation Measures

The Project Company will ensure that the Chance Find Procedure is effectively applied. Currently, the Project Company employs two archaeologists.

Residual Impacts

With the implementation of a chance finds procedure, the residual impact of the Project is considered to be negligible.

9.8 Closure Phase Impacts

Potential social impacts from closure activities are generally similar to those during the construction phase. Following decommissioning, the site would be restored to approximate its original condition or to some standard that results in stable social and environmental conditions.

Impacts would be similar to those addressed for the construction above; however, many of these impacts would be reduced by implementing already established good practices. Restoration during this phase would also ensure that impacts beyond the life of the geothermal energy development are avoided or minimized.

9.8.1 Economy and Employment

Closure of the Project will result in retrenchment of Project workers of the operation phase over a number of years, which may lead to an increase in unemployment at the local level. The Project will implement the Retrenchment Procedure in line with IFC PS2. Impacts related to Project closure will be assessed in detail during the operation phase, 5 years before the Project closure.

On the other hand, the creation of temporary employment opportunities for locals during decommissioning activities may arise as well as local businesses may benefit by providing necessary materials during the closure phase.

9.8.2 Land Use

Land use impacts resulting from drilling and construction could be largely reversed by closure activities, depending on the further purpose selected for the Project Site. Impacts related to land use and further decision on the post-Project use of the site will be assessed in detail during the operation phase, in advance of closure phase.

9.8.3 Visual and Landscape

At the closure phase, the removal of Project components will be planned so that no signs will be left of the abandoned power plant where possible. The Project area will be restored to its natural and pre-Project state as much as possible.

9.8.4 Community Health and Safety

Potential community health and safety impacts during closure are expected to be similar to those during the exploration/ drilling and construction phases of the Project. These impacts may be caused due to earthmoving, use of large equipment, dismantling of industrial components, and transportation of overweight and oversized materials. These activities will prevent direct negative impact to the local community if same mitigation measures (See Section 8.5) will be applied as the construction phase of the Project. Besides the wells will be closed and sealed with cement in order to prevent generation of confined space or falling hazard. The area will be surrounded with fence

Given the high reversibility and measures taken, the closure impact is considered insignificant.

9.8.5 Occupational Health and Safety

Site decommissioning will involve closure and removal of facilities and wells, including linear infrastructures and finally vegetation restoration and landscaping. These activities may not

cause direct negative impact to the Project workers if same mitigation measures (See Section 8.6) will be applied as the construction phase of the Project. Given the high reversibility and measures taken, the closure impact is considered insignificant.

9.8.6 Cultural Heritage

Impacts related to closure will be assessed in detail throughout the Project phases, in advance of closure. It is expected that no impacts on physical cultural heritage will occur at Project Closure. Therefore, the closure impact is considered as insignificant.

10. INSTITUTIONAL ARRANGEMENTS

The Project will comply with both Turkish legislation and IFC/WB Performance Standards requirements through its lifespan. An Environmental and Social Mitigation and Monitoring Plan (ESMMP) is established for the Project in order to determine the implementation program of mitigation measures and actions associated with the potential environmental and social impacts of the Project.

The ESMP sets out the environmental and social impacts of the Project and associated measures to avoid, or where avoidance is not possible, mitigate the adverse on environment and communities.

Sis Enerji has the capability in order to implement mitigation measures and monitoring activities effectively and will establish an organizational structure for the implementation of the ESMMP. Sis Enerji will appoint personnel for the implementation of ESMMP activities throughout the Project life.

Contractors and subcontractors will also be employed by the Project Company during construction phase of the Project. Project Company will assure that the contractors are aware of the requirements of the ESMMP and will meet the requirements of the ESMMP. An effective contractors' management will be achieved by;

- Assessment of environmental and social risks associated with contractors;
- Inclusion of PS and ESMMP requirements in tender documents;
- Selection of contractors with knowledge and skills to perform in accordance with PSs and ESMMP requirements;
- Monitoring of contractors for the compliance with ESMMP requirements;

The Project Company will assign an Environmental Consultant to monitor the implementation of the ESMMP during the Project. The Consultant will report the monitoring results and proposed mitigation measures for the findings periodically.

The roles and responsibilities for the implementation and monitoring of ESMMP during construction and operation phases of the Project is summarized below in Table 10-1.

Table 10-1. Roles and Responsibilities

Activity	Responsible Party	Monitoring Period	Monitoring
Implementation of ESMMP	Project Company/Contractor	Periodically	Analysis/Measurement Reports, Grievance Records, Internal Audit Records
Performance Monitoring of ESMMP	Environmental Consultant	Biannually	Monitoring Report

11. CUMULATIVE IMPACTS

There are several other geothermal power plants with production license in the Province of Manisa according to the information obtained from EPDK The Power plants which are operating close to the Project are Zorlu Alaşehir GPP-2 (24 MW), Enerjeo Kemaliye GPP (24.9 MW), Türkerler Alaşehir GPP-2 (24 MW) and Özmen 1 GPP (24 MW), at a distance of 10.1 km, 11.5 km and 10 km respectively (Energy Market Regulatory Authority). Özmen-1 GPP in the same operation licence area which is at a distance of 25 km to the Project is also owned by Sis Enerji. Satellite image of the GPPs is provided below in Figure 11-1.

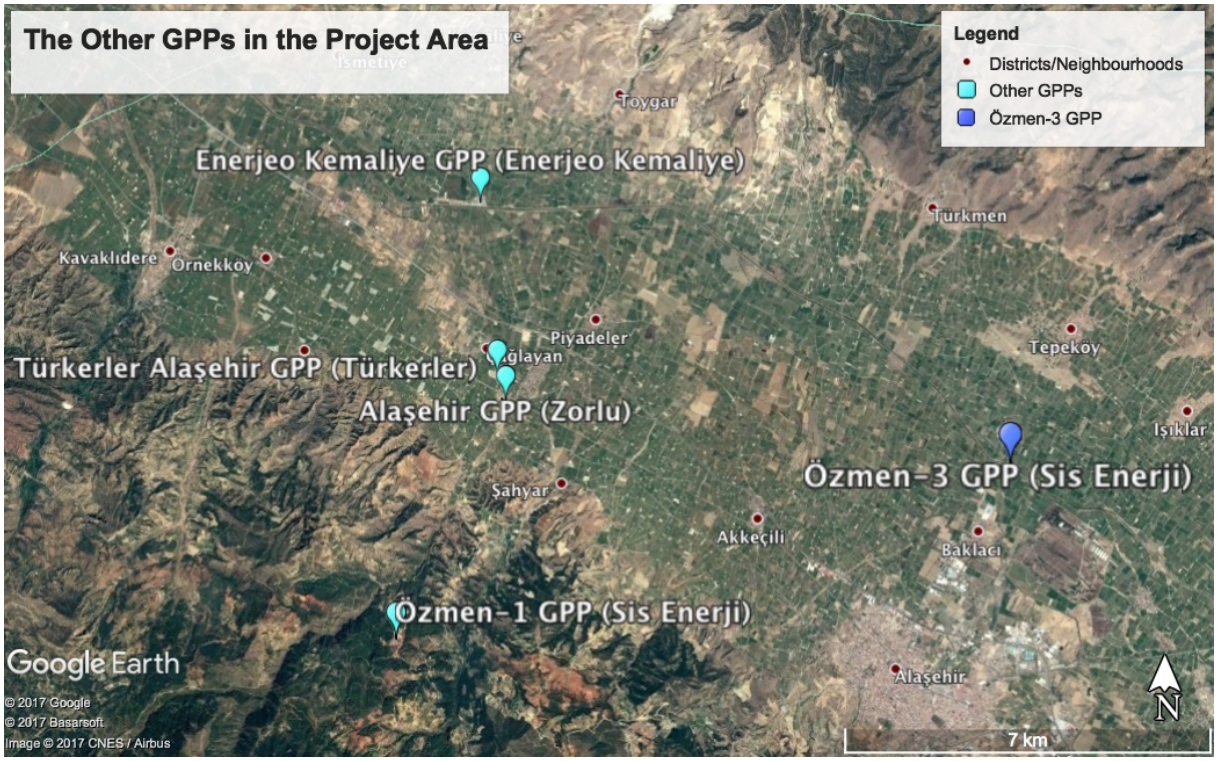


Figure 11-1. Özmen-3 GPP and other GPPs

The license area of the Project comprises of a total of 25 wells with geothermal potential. The construction impacts of the additional wells will be similar to the subject Project . Operation at the additional wells will increase CO_2 release however as mentioned in the previous sections NCG will reduce gradually over time as well as the total amount of annual CO_2 release. Besides Sis Enerji is in the progress of developing a project on the reduction of CO_2 emissions by reinjection in collaboration with Middle East Technical University. Regarding the H_2S emissions which may have effect on locals , the Project Company will continue monitoring H_2S levels. Land take will be an issue regarding the change on agricultural land use characteristics permanently. Primary approach of the Project Company will be to negotiate and reach to an agreed price with the land owners in order to avoid involuntary

resettlement through expropriation.

Although the geothermal capacity is predicted as 31,500 MW by the Ministry of Energy and Natural Resources cumulative impacts of geothermal power plants have not been explicitly determined on the reservoir of the region yet. An extensive study lead by the Association of Geothermal Energy Power Plant Investors has been on-going with the collaboration of stakeholders including Project owners and operators, local authorities and other industry developments in the region.

Given that the Project is at construction stage, nuisance of dust and noise are associated with the drilling and construction activities and transportation activities. Such nuisance is considered as low and temporary, limited to the construction period. Hence dust and noise impacts are not considered to pose a cumulative impact along with other projects in the district. However at the same time there are complaints of locals on noise nuisance during night time. Regarding that construction activities will not be performed during nighttime it is important to conduct efficient stakeholder engagement for good relationship with the locals. Odor caused by hydrogen sulphide from geothermal fluid can be considered to pose a cumulative impact during the operation stage. Continuous monitoring of hydrogen sulphide levels and grievance from communities will be crucial for determining requirements for extended odor control. Project Company will provide an accredited company to conduct air quality measurements in terms of H_2S measurements regularly. Technical measures to abate hydrogen sulphide can be designated once the power plant is operational, given that the sulphide content of geothermal fluid is not known. Still, the closed circuit make-up of the Project will accomplish significant abatement of hydrogen sulfide emissions and related odor.

One of the drivers for the Project is clean electricity generation without depleting the resource and minimizing emissions of greenhouse gases (GHGs) associated with combustion of fossil fuels. Yet, the Project will lead to releases of greenhouse gases, mainly CO_2. During construction, CO_2 will be released from combustion sources such as the diesel generators and the construction plant engines. During tests, but mostly during operation, CO_2 and methane CH_4 will be released as non-condensable gases. The impacts of emissions of greenhouse gases are global, hence cumulative. By nature of these emissions, the specific impacts of any single project cannot be easily assigned.

Discharge of the geothermal fluids resulting from test drills into the drainage canals that lead to Menderes River is a common practice applied by other geothermal power plants in the region. However, test fluids generated by Özmen 3 GPP Project will not be discharged to the drainage canals, instead will be re-injected. Similarly, the operation stage will employ reinjection wells.

12. E&S MITIGATION AND MONITORING PLAN

12.1 Construction Stage

E&S Issues	Potential Impacts and Risks	Mitigation Measures	Monitoring Indicators and Frequency	Responsible Entity	Legal Framework
Geothermal fluid	Groundwater contamination	Geothermal fluid will be reinjected back to the system into reinjection wells Geothermal fluid collection ponds covered with impermeable layer will be established.	Visual inspection to ensure the effectiveness of the mitigation measures. Groundwater quality monitoring will be conducted at downstream of geothermal fluid collection pond quarterly.	Project Company and Contractors	Water Pollution Control Regulation Regulation on Monitoring of Surface water and Groundwater Regulation on Monitoring of Groundwater Against Pollution and Deterioration
Chemicals from drilling	Groundwater contamination	Appropriate well casing will be provided (3 closed casings during drilling and concrete cover at well sides)	Visual inspection to ensure the effectiveness of the mitigation measures Groundwater quality monitoring at downstream of production and reinjection wells will be conducted quarterly for temperature, EC, opacity, density, salinity, chlorophyll-a, PH, dissolved oxygen, hydrogen sulphide, alkalinity, copper, zinc mercury, lead, iron, manganese, cadmium, arsenic, total suspended solids, total organic carbon and petroleum	Project Company and Contractors	Water Pollution Control Regulation Regulation on Monitoring of Surface water and Groundwater Regulation on Monitoring of Groundwater Against Pollution and Deterioration

			hydrocarbons (Quarterly)		
Drilling mud	Soil and groundwater contamination	Drilling mud will be collected in mud ponds provided with impermeable layer. The mud will be analyzed and disposed according to the analysis results.	Visual inspection to ensure the effectiveness of the mitigation measures Analysis report of drilling mud	Project Company and Contractors	Water Pollution Control Regulation Circular on the Disposal of Drilling Mud and Wastes Generated from the Physical Treatment of Chromium Minery, Waste Management Regulation Regulation on Monitoring of Surface water and Groundwater Regulation on Monitoring of Groundwater Against Pollution and Deterioration Regulation on Landfill of Wastes
H_2S emissions	Temporary odor due to H_2S release from test waters	Use of gas separators	Air quality measurements for monitoring of H_2S concentrations at sensitive receptors. (Quarterly)	Project Company and Contractors	Industrial Air Pollution Control Regulation
Wastewater management	Soil and groundwater contamination	Wastewater generated by the workers will be collected in leak proof septic tank and will be disposed by Alaşehir Municipality regularly.	Wastewater disposal records	Project Company and Contractors	Waste Management Regulation Regulation on the Construction of Septic Tanks at Places Where Sewer Construction is Not Possible

Solid waste management	Soil and groundwater contamination	Improper dumping of solid waste to the environment which can cause soil and groundwater contamination will be prevented. Wastes will be collected and stored separately according to their types. Domestic solid waste will be collected in leak proof garbage containers. Waste will be collected and disposed by Alaşehir Municipality. Vegetative top soil stripped during site preparation will be stored separately to be used for landscaping purposes Excavated soil will be stored and re-used for backfilling during construction activities. Waste Management Plan will be implemented for the collection, storage and disposal of wastes	Visual inspection to ensure the effectiveness of the mitigation measures Waste disposal records	Project Company and Contractors	Waste Management Regulation
Handling of hazardous material	Soil and groundwater contamination	Hazardous material will be stored in leak proof containers on impermeable ground. Spill kits will be available at the site for immediate response. MSDS for chemicals will be available for the workers. Hazardous Chemicals Management Plan will be developed and implemented.	Visual inspection to ensure the effectiveness of the mitigation measures Soil quality analysis for heavy metal and hydrocarbons if any contamination risk is observed	Project Company and Contractors	Regulation on Soil Pollution Control and Point Source Polluted Areas
Groundwater use	Sustainability of shallow aquifers	-	Automated monitoring system will be established at two locations to monitor temperature	Project Company and Contractors	Water Pollution Control Regulation,

			and EC in groundwater. (continuously) Water level measurements (Monthly)		Regulation on Monitoring of Surface water and Groundwater Regulation on Monitoring of Groundwater Against Pollution and Deterioration
Impact on flora and fauna	Loss of vegetation and top soil	Topsoil will be stripped and stored in designated storage areas for further site restoration works. Storage areas will be prevented from the accumulation of storm water, provided with drainage. Weed growth in stockpiles of topsoil will be prevented and the stockpiles will be seeded if required. Existing access roads will be used for Project purposes and off-road driving will be prohibited. Project activities will be limited in the construction area and construction sites will be surrounded with fences to prevent wild animals intrusion to the site. Hunting or collection of animals and in particular of Testudo graeca (Common tortoise) will be strictly prohibited within the Project area. Awareness among all construction workers will be provided during the lifetime of the Project for especially the fauna species with limited mobility. If these species,	Visual inspections to ensure the effectiveness of the mitigation measures (Daily)	Project Company and Contractors	Waste Management Regulation Water Pollution Control Regulation,, IFC PS6

		particularly Testudo graeca (Common tortoise) are observed, they will be translocated to undisturbed but similar areas.			
OHS	Poisoning from H_2S and odour nuisance. Workers health and safety risks during the construction works	An OHS Management Plan will be developed and implemented for the Project. All workers will be provided with OHS training prior to start working Workers will be provided with appropriate PPE. H2S detectors will be placed at well heads to monitor H2S levels Emergency Response Plan will be improved including evacuation procedure regarding H2S release	Visual inspections to ensure the effectiveness of the mitigation measures (Daily)	Project Company and Contractors	Law on Occupational Health and Safety
Community HS	Nuisance from noise and dust, H_2S exposure	Maintenance of construction equipment will be conducted regularly, exhaust mufflers will be applied to the equipment in order to minimize noise emissions and also speed limits will be implemented for the vehicles. Construction works will not be performed at nighttime. Construction site and wells will be surrounded by fences. Warning signs will be in place around the Project area, the wells and pipeline in order to inform the locals for Project site associated risks. H_2S levels will be monitored through H_2S detectors at well	Environmental noise measurement at sensitive receptors. (Upon grievance)	Project Company and Contractors	Regulation on Assessment and Management of Environmental Noise Industrial Air Pollution Control Regulation IFC PS4

		heads. Community will be informed immediately in case of high levels. An emergency preparedness and response plan to be enacted in the event of abnormal operation. Information boards about public safety hazards and emergency contact information will be available in the Project site.			
Land use	Loss of agricultural land	In case of land take negotiations with the land owners and mutual agreement on price will be primary approach of the Project Company. In case of a Resettlement Action Plan/Abbreviated Resettlement Action Plan (RAP/ARAP) for land acquisition will be prepared and implemented. Stakeholder Engagement Plan will be updated.	Meeting records with stakeholders Grievance records	Project Company and Contractors	Expropriation Law, IFC PS5
Labor Influx	Impact on local infrastructure and social conflicts	Priority to local employment will be given to the extend possible. Awareness of workers on expected behavior on their relations with the locals through a developed Code of Conduct	Grievance Records Stakeholder Engagement Activities	Project Company and Contractors	IFC PS2, PS4
Transportation / Traffic	Risks to locals and especially to children Damaging Roads	Site specific traffic management will be developed and implemented. If damage on the roads occurs due to Project activities, required maintenance and repair will be performed. Local communities will be informed on the traffic schedule.	Visual inspections to ensure the effectiveness of the mitigation measures Grievance Mechanism	Project Company and Contractors	IFC PS1, PS4

		Warning and safety signs will be in place on the access roads and exit and entrance of the construction site.			
Cultural Heritage	Possible archeological finds	Construction works will be monitored for archaeological remains. Work will cease in case any archaeological remains are met. Chance Find Procedure will be prepared and implemented.	Reporting by archaeologists (Upon any chance finds)	Project Company and Contractors	Law on Preservation of Cultural and Natural Assets
Employment	Positive impact on local employment	-	Number of local workers employed	Project Company	-
Local economy	Positive impact on local economy	-	Records of local material and service providers Records of local procurement	Project Company	-

12.2 Operation Stage

E&S Issues	Potential Impacts and Risks	Mitigation Measures	Monitoring Indicators and Frequency	Responsible Entity	Legal Framework
Geothermal fluid	Groundwater contamination	Geothermal fluid will be reinjected back to the system into reinjection wells Geothermal fluid collection ponds covered with impermeable layer will be established.	Visual inspection to ensure the effectiveness of the mitigation measures Groundwater quality monitoring will be conducted at downstream of geothermal fluid collection pond quarterly.	Project Company	Water Pollution Control Regulation Regulation on Monitoring of Surface water and Groundwater Regulation on Monitoring of Groundwater Against Pollution and Deterioration
Chemicals from drilling	Groundwater contamination	Appropriate well casing will be provided (3 closed casings during drilling and concrete cover at well sides)	Visual inspection to ensure the effectiveness of the mitigation measures Groundwater quality monitoring at downstream of reinjection wells will be conducted quarterly for temperature, EC, opacity, density, salinity, chlorophyll-a, PH, dissolved oxygen, hydrogen sulphide, alkalinity, copper, zinc mercury, lead, iron, manganese, cadmium, arsenic, total suspended solids, total organic carbon and petroleum hydrocarbons (Quarterly)	Project Company	Water Pollution Control Regulation Regulation on Monitoring of Surface water and Groundwater Regulation on Monitoring of Groundwater Against Pollution and Deterioration
Drilling mud	Soil and groundwater contamination	Drilling mud will be collected in mud ponds provided with impermeable layer. The mud will be analyzed and disposed according to the analysis	Visual inspection to ensure the effectiveness of the mitigation measures Analysis report of drilling mud	Project Company	Water Pollution Control Regulation Circular on the Disposal of Drilling Mud and Wastes

E&S Issues	Potential Impacts and Risks	Mitigation Measures	Monitoring Indicators and Frequency	Responsible Entity	Legal Framework
		results.			Generated from the Physical Treatment of Chromium Minery, Waste Management Regulation Regulation on Monitoring of Surface water and Groundwater Regulation on Monitoring of Groundwater Against Pollution and Deterioration Regulation on Landfill of Wastes
H_2S emissions	Temporary odor due to H_2S release from test waters	Use of gas separators	Air quality measurements for monitoring of H_2S concentrations at sensitive receptors. (Quarterly)	Project Company	Industrial Air Pollution Control Regulation
Wastewater management	Soil and groundwater contamination	Wastewater generated by the workers will be collected in leak proof septic tank and will be disposed by Alaşehir Municipality regularly.	Wastewater disposal records	Project Company	Waste Management Regulation Regulation on the Construction of Septic Tanks at Places Where Sewer Construction is Not Possible
Solid waste management	Soil and groundwater contamination	Improper dumping of solid waste to the environment which can cause soil and groundwater contamination will be prevented. Wastes will be collected and stored	Visual inspection to ensure the effectiveness of the mitigation measures Waste disposal records	Project Company	Waste Management Regulation

E&S Issues	Potential Impacts and Risks	Mitigation Measures	Monitoring Indicators and Frequency	Responsible Entity	Legal Framework
		separately according to their types. Domestic solid waste will be collected in leak proof garbage containers. Waste will be collected and disposed by Alaşehir Municipality. Vegetative top soil stripped during site preparation will be stored separately to be used for landscaping purposes Excavated soil will be stored and re-used for backfilling during construction activities. Waste Management Plan will be implemented for the collection, storage and disposal of wastes			
Handling of hazardous material	Soil and groundwater contamination	Hazardous material will be stored in leak proof containers on impermeable ground. Spill kits will be available at the site for immediate response. MSDS for chemicals will be available for the workers. Hazardous Chemicals Management Plan will be developed and implemented.	Visual inspection to ensure the effectiveness of the mitigation measures Soil quality analysis for heavy metal and hydrocarbons if any contamination risk is observed	Project Company	Regulation on Soil Pollution Control and Point Source Polluted Areas
Groundwater use	Sustainability of shallow aquifers	-	Automated monitoring system will be established at two locations to monitor temperature and EC in groundwater. (continuously)	Project Company	Water Pollution Control Regulation, Regulation on Monitoring of Surface water and Groundwater

E&S Issues	Potential Impacts and Risks	Mitigation Measures	Monitoring Indicators and Frequency	Responsible Entity	Legal Framework
			Water level measurements (Monthly)		Regulation on Monitoring of Groundwater Against Pollution and Deterioration
OHS	Poisoning from H_2S and odour nuisance. Workers health and safety risks during the construction works	H_2S detectors will be placed at well heads OHS Management Plan will be developed and implemented Emergency Response Plan will be improved including evacuation procedure regarding H_2S release Appropriate PPEs will be provided for workers Appropriate Training will be provided for the workers	Visual inspection to ensure the effectiveness of the mitigation measures (Daily)	Project Company	Law on Occupational Health and Safety
Community HS	Nuisance from noise and dust, H_2S exposure	Maintenance of construction equipment will be conducted regularly, exhaust mufflers will be applied to the equipment in order to minimize noise emissions and also speed limits will be implemented for the vehicles. Construction works will not be performed at nighttime. Construction site and wells will be surrounded by fences. Warning signs will be in place around the Project area, the wells and pipeline in order to inform the locals for Project site associated risks.	Environmental noise measurement at sensitive receptors. (Upon grievance)	Project Company	Regulation on Assessment and Management of Environmental Noise Industrial Air Pollution Control Regulation IFC PS4

E&S Issues	Potential Impacts and Risks	Mitigation Measures	Monitoring Indicators and Frequency	Responsible Entity	Legal Framework
		H_2S levels will be monitored through H_2S detectors at well heads. Community will be informed immediately in case of high levels. An emergency preparedness and response plan to be enacted in the event of abnormal operation. Information boards about public safety hazards and emergency contact information will be available in the Project site.			
CO_2 emissions	Gas release from steam separation	-	Biannual assessment	Project Company	-
Land use	Loss of agricultural land	In case of land take negotiations with the land owners and mutual agreement on price will be primary approach of the Project Company. In case of a Resettlement Action Plan/Abbreviated Resettlement Action Plan (RAP/ARAP) for land acquisition will be prepared and implemented. Stakeholder Engagement Plan will be updated.	Meeting records with stakeholders Grievance records	Project Company	Expropriation Law, IFC PS5
Labor Influx	Impact on local infrastructure and social conflicts	Priority to local employment will be given to the extend possible. Awareness of workers on expected behavior on their relations with the locals through a developed Code of Conduct	Grievance Records Stakeholder Engagement Activities	Project Company	IFC PS2, PS4
National economy	Positive impact on	-	Annual energy production	Project Company	-

E&S Issues	Potential Impacts and Risks	Mitigation Measures	Monitoring Indicators and Frequency	Responsible Entity	Legal Framework
	national economy				
Employment	Positive impact on local employment	-	Number of local workers employed	Project Company	-
Local economy	Positive impact on local economy	-	Records of local material and service providers Records of local procurement	Project Company	-

13. Bibliography

Alessandro Franco, M. V. (2011, December 16). *An integrated "Reservoir-Plant" strategy for a sustainable and efficient use of geothermal resources.* https://www.researchgate.net/publication/257176410_An_integrated_Reservoir-Plant_strategy_for_a_sustainable_and_efficient_use_of_geothermal_resources

DiPippo. (2008). *Geothermal Power Plants: Principles, Applications, Case Studies and Environmental Impact, Elsevie.* Burlington, USA: Oxford.

Energy Market Regulatory Authority .*Energy Market Regulatory Authority* . http://lisans.epdk.org.tr/epvys-web/faces/pages/lisans/elektrikUretim/elektrikUretimOzetSorgula.xhtml

Energy Sector Managament Assistance Program. (2016, 09). *Greenhouse Gases From Geothermal Power Production* . http://documents.worldbank.org/curated/en/550871468184785413/pdf/106570-ESM-P130625-PUBLIC.pdf

Germencik Municipalitiy. March 2016 tarihinde http://www.germencik.gov.tr/default_b0.aspx?content=1095

IFC. (2007). IFC Environmental, Health and Safety Guidelines for Geothermal Power Generation: http://www.ifc.org/wps/wcm/connect/329e1c80488557dabe1cfe6a6515bb18/Final%2B-%2BGeothermal%2BPower%2BGeneration.pdf?MOD=AJPERES&id=1323161975166

International Association for Impact Assessment. (2015).

Manisa İl Kültür ve Turizm Müdürlüğü. *Manisa'dan Yetişenler.* http://www.manisakulturturizm.gov.tr/TR,151849/manisadan-yetisenler.html

Manisa Provincial Culture and Tourism Directorate .*Manisa'dan Yetişenler.* http://www.manisakulturturizm.gov.tr/TR,151849/manisadan-yetisenler.html

Manisa Provincial Health Directorate. (2017). http://www.manisa.saglik.gov.tr/TR,21793/saglik-kurumlari.html

Megan Beardsley, C. L. (1998, June 15). U.S. Environmental Protection Agency's (EPA) Report No. NR-009A on Exhaust Emission Factors for Nonroad Engine Modeling -- Compression-Ignition .

Republic of Turkey, Ministry of Forestry and Water Affairs, General Directorate of Meteorology. (2017). *Official Statistics*. https://mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?m=MANISA

Republic of Turkey, Ministry of Forestry and Water Affairs, General Directorate of Meteorology. (tarih yok). *Climate Condition of Manisa Province*. 2017 tarihinde http://www.izmir.mgm.gov.tr/files/iklim/manisa_iklim.pdf

Turkish Statistical Institute . (2016). https://biruni.tuik.gov.tr/gosterge/?locale=tr

Turkish Statistical Institute. (2013). Aydın with Selected Indicators. http://www.tuik.gov.tr/ilGostergeleri/iller/AYDIN.pdf

Turkish Statistical Institute. (2013). Manisa with Selected Indicators. http://www.tuik.gov.tr/ilGostergeleri/iller/AYDIN.pdf