REPUBLIC OF TURKEY
MINISTRY OF TRANSPORT
AND INFRASTRUCTURE

AYGM
Altyapı Yatırımları Genel Müdürlüğü

ÇINAR®
ENGINEERING
CONSULTANCY INC.



ISTANBUL NORTH RAIL CROSSING PROJECT (INRAIL)

Environmental and Social Impact Assessment (ESIA) Report

September-2026

Final

ÇINAR®
ENGINEERING
CONSULTANCY INC.

Bağlıca Mah. Çambayırı Cad. Çınar Plaza No:66/5 06790 Etimesgut/ ANKARA

Tel: +90 312 472 38 39 Fax: +90 312 472 39 33

Web: cinarmuhendislik.com

E-mail: cinar@cinarmuhendislik.com

All rights of this report are reserved.

All or part of this report cannot be reproduced, copied, electronically reproduced, traded, transmitted, sold, rented, used for any purpose, or used in any form and method in digital and/or electronic media without written permission from Çınar Engineering Consultancy Inc. as per Law No. 5846 on Intellectual and Artistic Works amended with Law No. 4110.

TABLE OF CONTENT

TABLE OF CONTENT i
LIST OF TABLES iii
LIST OF FIGURES vi
APPENDICES viii
ABBREVATIONS x
EXECUTIVE SUMMARY xiii
1 INTRODUCTION 1
1.1 Project Background 1
1.2 Purpose of the Project 2
1.3 The Need for Environmental and Social Impact Assessment (Screening Process) 2
1.4 Structure of the ESIA Report 3
1.5 Baseline Data Collection and Study Period 4
1.6 Approach and Impact Assessment Methodology 5
1.6.1 E&S Assessment Approach 5
1.6.2 E&S Impact Rating 6
2 LEGAL AND INSTITUTIONAL FRAMEWORK 8
3 PROJECT DESCRIPTION 12
3.1 Project Characteristics 12
3.1.1 Scope of the Project 12
3.1.2 Technical Specifications of the Project 12
*3.1.3 Auxiliary Facilities ..... **Hata! Yer işareti tanımlanmamış.***
3.1.4 Project Lifespan and Labor Demands 13
3.1.5 Project Alternatives 14
3.2 Project Location 14
4 BASELINE DATA 16
4.1 Determination of the Area of Influence (AoI) 16
4.2 Baseline Environmental Conditions 19
4.2.1 Meteorological and Climatic Conditions 19
4.2.2 Land Use and Soil 20
4.2.3 Landscape and Visuals 22
4.2.4 Geological and Hydrogeological Characteristics 24
4.2.5 Nearest Sensitive Receptors 47
4.2.6 Infrastructure Facilities 47
4.2.7 Biodiversity 51
4.2.8 Baseline Environmental Measurements 81
4.3 Baseline Social Conditions 81
4.3.1 Methodology 81
4.3.2 Administrative structure 97
4.3.3 Population structure 99
4.3.4 General Economic Conditions 141
4.3.5 Livelihood sources 145

4.3.6 Unemployment and local employment 155
4.3.7 Health 158
4.3.8 Education 160
4.3.9 Cultural identity & language 161
4.3.10 Membership in NGOs&CSOs 163
4.3.11 Increasing public benefit / interest 163
4.3.12 Stakeholder engagement 164
4.3.13 Land use and land acquisition 165
4.3.14 Current Transportation Features 180
4.3.15 Evaluation of previous projects 183
4.3.16 Cultural Heritage 186
5 ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS 204
5.1 Environmental Risks and Impacts 204
5.1.1 Impacts on Air Quality 204
5.1.2 Impacts on Climate Change 208
5.1.3 Environmental Noise Risks and Impacts 211
5.1.4 Impacts on National Resources 212
5.1.5 Impacts on Biodiversity 213
5.1.6 Resource Efficiency and Pollution Prevention 215
5.1.7 Cumulative Impacts 224
5.2 Social Risks and Impacts 228
5.2.1 Expected Population Change 228
5.2.2 Economy and Employment 228
5.2.3 Occupational Health and Safety (OHS) Risks and Impact 228
5.2.4 Impacts on Communities Health and Safety 231
5.2.5 Land Acquisition Impacts and Risks 232
5.2.6 Impacts on Cultural Heritage 233
5.2.7 Labor Management 235
5.2.8 Gender and Vulnerability Assessment 236
6 ANALYSIS OF ALTERNATIVES 239
6.1 No-Project Alternative 239
6.2 Route Alignment and Station Alternatives 239
6.3 Comparison of Alternatives and Preferred Option 242
7 MITIGATION MEASURES 245
7.1 Mitigation Measures for Construction Phase 246
7.2 Mitigation Measures for Operation Phase 269
8 DESIGN MEASURES ..... **Hata! Yer işareti tanımlanmamış.**

LIST OF TABLES

Table 1-1 Magnitude Factors and Scales 6
Table 1-2 General Criteria for Identification of Receptor Sensitivity and Impact Magnitude Levels 7
Table 1-3 Significance Assessment Matrix 7
Table 2-1 Comparison Between National Legislation and WB ESSs 8
Table 2-2 Roles of Key Government Agencies in Permitting and Compliance 10
Table 3-1 Engineering Structures List 12
Table 4-1 Long-Term Meteorological Data for İstanbul (1950–2024) 19
Table 4-2 Long-Term Meteorological Data for Kocaeli (1929–2024) 20
Table 4-3 Summary of Stream Crossings by Section 45
Table 4-4 Information on the Dams Around Project Route 45
Table 4-5 Major Licensed Excavation Storage Areas in Istanbul (by Capacity) 49
Table 4-6 Water Supply and Drinking Water Treatment Infrastructure in İstanbul and Kocaeli 50
Table 4-7 Wastewater Management Structures for İstanbul and Kocaeli 51
Table 4-8 Legally Protected Areas near the Project Route 57
Table 4-9 Habitats of the Biodiversity Study Area 58
Table 4-10 Number of Environmental Measurements and Analyses 81
Table 4-11 Local CSOs located within the AoI-Intersecting Settlements 85
Table 4-12 Additional Meetings with OIP 86
Table 4-13 Summary of Social Research Methodology 86
Table 4-14 Population figures of AoI-Intersecting Settlements, TurkStat 2024 89
Table 4-15 Sampling values of AoI-Intersecting Settlements- 90
Table 4-16 Completed social studies -May 2025-June 2025 92
Table 4-17 Limitations within the social studies July, 2025 95
Table 4-18 Settlements Intersecting with the AoI (Province, District, and Neighborhood), TurkStat, 2024 98
Table 4-19 Up to date Population Information, TurkStat, 2024 100
Table 4-20 Population Figures, Household Survey, July 2025 (N:2,901 / 802) 102
Table 4-21 Household size (Persons), Household Survey, July 2025 (N: 802) 103
Table 4-22 Household number, Mukhtar Survey, June 2025 (N:48) 104
Table 4-23 Gender Distribution, TurkStat, 2024 108
Table 4-24 Gender Distribution, Household Survey, July 2025 (N:2,901) 109
Table 4-25 Household size of female-headed households, Household Survey, July 2025 (N:41) 111
Table 4-26 Livelihood sources of female-headed households, Household Survey, July 2025 (N:41) 112
Table 4-27 Gender Distribution of Mukhtars, Mukhtar Survey, July 2025 (N:53) 113
Table 4-28 Up to date Age Distribution Information, TurkStat, 2024 115
Table 4-29 Age Group Distribution, Household Survey, July 2025 (N:2,901) 117
Table 4-30 Age dependency ratio (% of working-age population), WDI, 2024 119
Table 4-31 Elderlies, Household Survey, July 2025 (N:174/244) 119
Table 4-32 Elderly individuals living alone, Household Survey, July 2025 (N:15) 120

Table 4-33 Elderly individuals living alone, Mukhtar Survey, July 2025 (N:48) 120
Table 4-34 Population changes figures for the last 25 years 123
Table 4-35 Reasons related to population changes within last 5 years, Mukhtar Survey, July 2025 (N:48) 126
Table 4-36 Population changes figures of last 10 years (‰) 129
Table 4-37 Time Spent in the Settlement, Household Survey, July 2025 (N: 802 / 2,901) 130
Table 4-38 Duration of household's settlement in the current location802 / 2,901)2,901) ... 131
Table 4-39 Migration reasons, Household Survey, July 2025 (N: 2,901) 134
Table 4-40 Relation between migration reason and migration time, Household Survey, July 2025 (N: 802) 138
Table 4-41 Rural and urban population indicators, WDI, 2024 139
Table 4-42 Rural and urban population indicators, TurkStat, 2022 139
Table 4-43 Population Figures of Former Village Neighbourhoods (2008-2012), TurkStat 141
Table 4-44 Main labour force indicators by sex and sub region Level 2, 2023, 15+age 143
Table 4-45 Gender-disaggregated relative poverty rate (2023) 143
Table 4-46 Main livelihood sources, Household Survey, July 2025 (N: 802 / 2,901) 146
Table 4-47 Most common livelihood sources, Mukhtar Survey, July 2025, (N:48) 152
Table 4-48 Employment figures of Türkiye, WDI, 2024 156
Table 4-49 Economic hardship, Mukhtar survey, Mukhtar Survey, July 2025, (N:48) 157
Table 4-50 Religious and culturally significant sites, Mukhtar Survey, July 2025 161
Table 4-51 Ethnic identities& Non-Turkish speakers, MukhtarSurvey, July 2025 (N: 48) 162
Table 4-52 Opinions about future informative activities, Household Survey, July 2025 (N: 802) 165
Table 4-53 Land use within AoI-Intersecting Settlements, Household Survey, July 2025, (N:802) 165
Table 4-54 Land use within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:48) 166
Table 4-55 Residential areas within AoI-Intersecting Settlements, Household Survey, July 2025, (N:72/275) 167
Table 4-56 Residential areas within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:24) 169
Table 4-57 Agricultural areas within AoI-Intersecting Settlements, Household Survey, July 2025, (N:12) 171
Table 4-58 Agricultural areas within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:19) 171
Table 4-59 Most common agricultural products & Ecosystem services, Mukhtar Survey, July 2025, (N:48) 172
Table 4-60 Husbandry areas within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:21) 175
Table 4-61 Grazing areas within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:18) 176
Table 4-62 Animal Products, Mukhtar Survey, July 2025 176
Table 4-63 Commercial areas within AoI-Intersecting Settlements, Household Survey, July 2025, (N:11) 177
Table 4-64 Commercial areas within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:26) 178

Table 4-65 Recognised National Tangible Cultural Heritage Assets within the vicinity of the Project's AoI 192
Table 4-66 Recognised International Tangible Cultural Heritage Assets Within and Around the Project Route..... 194
Table 4-67 Recognised International Intangible Cultural Heritage Elements Within and Around the Project 196
Table 4-68 Intangible Cultural Heritage Items Registered in the National Inventory of the Project's AoI 196
Table 4-69 Tangible Cultural Heritage Site Encountered within the Study Area 197
Table 4-70 Distribution of Tangible Cultural Heritage Sites 197
Table 4-71 Tangible Cultural Heritage Sites within the Cultural Heritage Impact Assessment (CHIA) Study Area..... 198
Table 5-1 Project-Based Potential Impact Elements for the Land Preparation and Construction Phase 234
Table 6-1 Multi-Criteria Analysis – Sabiha Gökçen Airport Station Alternatives 240
Table 7-1 Mitigation Measures for Construction Period 246
Table 7-2 Mitigation Measures for Operation Phase..... 269

LIST OF FIGURES

Figure 1-1 Impact Assessment Steps 6
Figure 4-1 Project's Area of Influence Map 18
Figure 4-2 CORINE Land Cover Data within the Project's AoI 21
Figure 4-3 Major Soil Groups Data within the Project's AoI 22
Figure 4-4 Erosion Levels Data within the Project's AoI 22
Figure 4-5 Summary of Visibility, Landscape Value and Visual Sensitivity of the Project Route 23
Figure 4-6 Earthquake Hazard Map of Türkiye with Project Area Marked 40
Figure 4-7 Project Route Peak Ground Acceleration (PGA 475) 41
Figure 4-8 Magnitude of M≥4.5 Earthquakes within a 100 km radius of the Project Area 41
Figure 4-9 Geological Heritage Sites at and Around Project Route 43
Figure 4-10 Daily Waste Disposal Capacity by Province (ton/day) 48
Figure 4-11 Distribution of İSKİ's Drinking Water Treatment Plants 49
Figure 4-12 Distribution of İSKİ's Wastewater Treatment Plants 51
Figure 4-13 Habitats of the Biodiversity Study Area 59
Figure 4-14 Endemic and Rare Plant Species 61
Figure 4-15 World distribution of *Cordulegaster insignis* () 63
Figure 4-16 World distribution of *Cordulegaster picta* () 63
Figure 4-17 World distribution of *Gomphus flavipes* () 63
Figure 4-18 World distribution of *Sympetrum depressiusculum* () 63
Figure 4-19 Some Odonata species from the Project site () 64
Figure 4-20 Some butterfly species from the Project site () 64
Figure 4-21 Some reptile species observed at project area () 66
Figure 4-22 Some birds photographed at the Project site () 68
Figure 4-23 Some mammal signs photographed at the Project site () 70
Figure 4-24 *Xanthium strumarium* (Invasive Alien Species) 71
Figure 4-25 *Phytolacca americana* (Invasive Alien Species) 71
Figure 4-26 *Ailanthus altissima* (Invasive Alien Species) 71
Figure 4-27 *Buddleja japonica* (Invasive Alien Species) 71
Figure 4-28 *Robinia pseudoacacia* (Invasive Alien Species) 72
Figure 4-29 Gender Distribution, TurkStat, 2024 109
Figure 4-30 Gender distribution of the field, Household Survey, July 2025 (N:2,901) 110
Figure 4-31 Female household heads, Household Survey July 2025 (N:802) 111
Figure 4-32 Gender distribution of the respondents, Household Survey, July 2025 (N:802) ... 112
Figure 4-33 Population pyramids, TurkStat, 2024 115
Figure 4-34 Age Group Distribution, TurkStat, 2024 116
Figure 4-35 Age Group Distribution, Household Survey, July 2025 (N:2,901) 118
Figure 4-36 Population changes figures for the last 25 years 124
Figure 4-37 Population change, Mukhtar Survey, July 2025 (N:48) 125
Figure 4-38 Provincial Breakdown of Syrian Refugees, UNHCR, September 2024 136
Figure 4-39 Rural and urban population indicators, TurkStat, 2022 140
Figure 4-40 Main livelihood sources, Household Survey, July 2025 146

Figure 4-41 Most common livelihood sources, Mukhtar Survey, July 2025, (N:144) 151
Figure 4-42 Land use within AoI-Intersecting Settlements, Household Survey, July 2025, (N:802) 166
Figure 4-43 Land use within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:48) 166
Figure 4-44 Opinions regarding residential areas, Household Survey, July 2025 (N:72) 167
Figure 4-45 Recognized National Tangible Cultural Heritage Assets Within and Around the Project Route..... 194
Figure 4-46 Recognized International Tangible Cultural Heritage Assets Within and Around the Project Route..... 195
Figure 4-47 Locations of the Tangible Cultural Heritage Sites within the CHIA Study Area 201
Figure 4-48 Dursunköy, Tosunbaba Turbah and Nakkaş, Nakkaşbaba Turbah 202
Figure 5-1 Soil Structure Layers 216

APPENDICES

Appendix-1: Summary of Terms of Reference (ToR)

Appendix-2: Geographic and Spatial Maps of Project Area and Area of Influence

Appendix-2.1: Location Map
Appendix-2.2: 1/50,000 scale Topographic Maps Showing the Project Area
Appendix-2.3: 1/40,000 scale Satellite View Maps Showing the Project Area
Appendix-2.4: 1/40,000 scale Corine Land Cover Maps Showing the Project Area
Appendix-2.5: 1/40,000 scale Major Soil Groups Maps Showing the Project Area
Appendix-2.6: 1/40,000 scale Erosion Maps Showing the Project Area
Appendix-2.7: 1/40,000 scale Geology Maps Showing the Project Area
Appendix-2.8: 1/40,000 scale Hydrology Maps Showing the Project Area
Appendix-2.9: 1/40,000 scale Hydrogeology Maps Showing the Project Area
Appendix-2.10: 1/843,984 scale Basin Location Map
Appendix-2.11: 1/416,824 scale Landslide Map
Appendix-2.12: 1/500,000 scale European Aquifer Map
Appendix-2.13: The Map of Active Faults Around the Project Area
Appendix-2.14: 1/100,000 scale Major Licensed Excavation Storage Areas Map

Appendix-3: Baseline Environmental Measurement and Analysis Report

Appendix-4: Landscape and Visual Assessment

Appendix-5: Nearest Sensitive Receptors

Appendix-6: Biodiversity Data's

Appendix-6.1: Biodiversity Study Area and Sampling Points Map
Appendix-6.2: The List of Flora Species around the Project Area
Appendix-6.3: The Map of the National Protected Areas Around the Project Area
Appendix-6.4: Habitat Map
Appendix-6.5: The list of probable Odonata species around the Project Site
Appendix-6.6: Dragonflies which are either mentioned in the Bern Convention, or listed in Annexes II or IV of the Habitats Directive, or which are endemic to Europe or threatened in Europe or the EU27
Appendix-6.7: The list of Probable Lepidoptera species at the Project Site
Appendix-6.8: The list of probable Amphibian species at the Project Site
Appendix-6.9: The list of probable Reptile species at the Project site
Appendix-6.10: The list of Probable Bird species around the Project site
Appendix-6.11: The list of Probable Mammal species around the Project Site
Appendix-6.12: The Map of Critical Habitats Around the Project Area
Appendix-6.13: Supplementary Biodiversity Baseline Study

Appendix-7: Socio Economic Environment

Appendix-7.1: Stakeholder List

Appendix-7.2: The Map of Settlements Intersecting with AoI

Appendix-7.3: The Map of Educational Institutions

Appendix-7.4: The Map of Health Institutions

Appendix-7.5: Maps of Stakeholders-1: Governmental Institutions

Appendix-7.6: Maps of Stakeholders-2: NGOs and Local Media

Appendix-7.7: Minutes of Meetings (MoM)

Appendix-7.8: Photographs taken during the interviews

Appendix-7.9: Informative Brochure

Appendix-7.10: Social Services, Technical Infrastructure & Common Areas

Appendix-8: Expected Amount of Excavation Material

Appendix-9: Air Dispersion Modelling Report

Appendix-10: Legal Framework

Appendix-11: List of Licensed Excavation Material Storage Areas in İstanbul

Appendix-12: Supplementary Noise and Vibration Assessment

Appendix-13: Supplementary Traffic Impact Assessment

Appendix-14: Supplementary Cumulative Impact Assessment

ABBREVATIONS

ABPRS	Address Based Population Registration System
AFAD	Disaster and Emergency Management Presidency
AIIB	Asian Infrastructure Investment Bank
AoI	Area of Influence
ATP	Automatic Train Protection
AYGM	Directorate-General of Infrastructure Investments
BMP	Biodiversity Management Plan
Bern Convention	Convention on the Conservation of European Wildlife and Natural Habitats
BSAP	Biodiversity and National Biological Diversity Strategy and Action Plan
C-ESMP	Design and Build Contractor's Environmental and Social Management Plan
CBD	Convention on Biological Diversity
CEDAW	Convention on the Elimination of All Forms of Discrimination against Women
CEKUD	Environmental Organizations Solidarity Association
CHA	Critical Habitat Assessment
CHIA	Cultural Heritage Impact Assessment
CIA	Cumulative Impact Assessment
CITES	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CoC	Code of Conduct
COPD	Chronic obstructive pulmonary disease
CORINE	Coordination of Information on the Environment Programme led by the European Environment Agency
COVID-19	coronavirus disease 2019
CSO	Civil Society Organization
cm	centimeter
D+B Contractor	Design-Build Contractor
DKMP	General Directorate of Nature Conservation and National Parks
DSİ	General Directorate of State Hydraulic Works
DVIG	Disadvantaged/Vulnerable Individuals or Groups
E&S	Environmental and Social
EBRD	European Bank for Reconstruction and Development
EHSG	Environmental, Health, and Safety Guideline
EIA	Environmental Impact Assessment
ERP	Emergency Response Plan
ERTMS	European Rail Traffic Management System
EPPO	European and Mediterranean Plant Protection Organization
ESCP	Environmental and Social Commitment Plan
ESF	Environmental and Social Framework
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
ESMS	Environmental and Social Management System
ESS	Environmental and Social Standard
ETCS	European Train Control System
ETL	Energy Transmission Line
EU	European Union
Eurostat	European Statistics Office
FGD	Focus Group Discussion
GBV	Gender-Based Violence
GDP	Gross Domestic Product
GIIP	Good International Industry Practice
GIS	Geographic Information System
GRM	Grievance Redness Mechanism
hr	hour
HEAŞ	Sabiha Gökçen Airport Operator
IBA	Important Bird Area
IEMA	Institute of Environmental Management and Assessment
IFC	International Finance Corporation
IFI	International Financial Institutions

IsDB	Islamic Development Bank
ILO	International Labor Organization
INRAIL (or "Project")	İstanbul North Rail Crossing Project
ISTKA	İstanbul Development Agency
IUCN	International Union for Conservation of Nature and Natural Resources
İBB	İstanbul Metropolitan Municipality
İGA	İstanbul Airport Operator
İRAP	Provincial Disaster Risk Reduction Plans (prepared by AFAD)
İSKİ	İstanbul Water and Sewerage Administration affiliated with the Istanbul Metropolitan Municipality
İSTAÇ	Istanbul Environmental Protection and Waste Materials Recycling Industry and Trade Inc., affiliated with the Istanbul Metropolitan Municipality
İSU	Kocaeli Water and Sewerage Administration affiliated with the Kocaeli Metropolitan Municipality
İZAYDAŞ	Izmit Waste and Residue Treatment, Incineration and Recovery Co., affiliated with the Kocaeli Metropolitan Municipality
KADES	Republic of Türkiye Ministry of Interior General Directorate of Security Women Support Application
KAGİDER	Women Entrepreneurs Association of Türkiye
KEİG	Circular on Increasing Women's Employment and Promoting Equal Opportunities
KEFEK	Commission on Equal Opportunities for Women and Men
km	kilometer
KBA	Key Biodiversity Area
KBB	Kocaeli Metropolitan Municipality
KMO	Northern Marmara Motorway
LAU	Local Administrative Unit
LMP	Labor Management Procedure
m	meter
MARKA	Eastern Marmara Development Agency
mg	milligram
ml	milliliters
mm	milimeter
MoEUCC	Ministry of Environment, Urbanization, and Climate Change
MoM	Minutes of Meeting
MoTI	Ministry of Transport and Infrastructure
MTA	General Directorate of Mineral Research and Exploration
N	Population size
n	Required sample size
NA	Not available
NAFZ	North Anatolian Fault Zone
NATM	New Austrian Tunneling Method
NGO	Non-Governmental Organizations
NPAA	National Programmes for the Adoption of the European Union Acquis
NUTS	Nomenclature of Territorial Units for Statistics
OECD	Organisation for Economic Co-operation and Development
OHS	Occupational Health and Safety
OIP	Other Interested Parties
p	Estimated proportion
PAP	Project-Affected Parties
PIU	Project Implementation Unit
PPE	Personal Protective Equipment
PPP	Purchasing Power Parity
RF	Resettlement Framework
RP	Resettlement Plan
SDS	Safety Data Sheet
SEA/SH	Sexual exploitation, abuse, and harassment
SEP	Stakeholder Engagement Plan
SOPs	Standard Operating Procedures
ŞÖNİM	Violence Prevention and Monitoring Centers
TBM	Tunnel Boring Machine

TCDD	Turkish State Railway
TEİAŞ	Turkish Electricity Transmission Corporation
TOKİ	Ministry of Environment, Urbanization and Climate Change and the Housing Development Administration
TKDF	Federation of Women's Associations of Türkiye
ToR	Terms of Reference
TR1	İstanbul region
TR10	İstanbul sub region
TR100	İstanbul province
TR4	Eastern Marmara region
TR42	Kocaeli sub region
TR421	Kocaeli province
TR422	Sakarya province
TR423	Düzce province
TR424	Bolu province
TR425	Yalova province
TURMEPA	Turkish Marine Environment Protection Association
UK	United Kingdom
UN	United Nations
UNGP	UN Guiding Principles on Business and Human Rights
UNHCR	United Nations High Commissioner for Refugees
USD	United States Dollar
VEC	Valued Environmental Component
WB	World Bank
WBG	World Bank Group
WDI	World Development Indicators
WWTP	Wastewater Treatment Plant
YSS	Yavuz Sultan Selim
Z	Z-score

EXECUTIVE SUMMARY

The Istanbul North Rail Crossing Project (INRAIL) is a flagship infrastructure investment that aims to reinforce Türkiye's role as a key regional logistics hub along the Trans-Caspian Middle Corridor. The Project addresses one of the most critical transportation bottlenecks in the country: the lack of a high-capacity rail connection across the Bosphorus. At present, all freight trains are forced to use the Marmaray Tunnel during a limited nighttime window, leading to severe capacity restrictions. The INRAIL alignment extends approximately 127 kilometers between Çayırova in Kocaeli and Çatalca in Istanbul, creating a new electrified, dual-track railway that directly connects the Asian and European sides of the city. The route will also provide seamless access to both İstanbul Airport and Sabiha Gökçen Airport, thereby integrating Türkiye's two busiest airports into the national and international rail network.

Technically, the Project comprises a large number of engineering structures designed to traverse the complex topography of Istanbul. The Project encompasses the design and construction, including electrification, of 122.3 km of double-track main line and 4.7 km of single-track connection lines. The alignment includes 5 twin-tube Tunnel Boring Machine (TBM) tunnels totaling 36.2 km, 22 double-track New Austrian Tunneling Method (NATM) tunnels totaling 23.3 km, 17 cut-and-cover tunnels totaling 3.7 km, and two viaducts and 40 bridges totaling 22.1 km, as well as stations and other associated structures.. Approximately 50% of the route will run underground, a choice aimed at reducing surface impacts on settlements, habitats, and landscapes. The Project also incorporates multimodal freight transfer facilities, transformer centers, emergency shafts, ventilation structures, and construction camps.

The Environmental and Social Impact Assessment (ESIA) has been undertaken in order to identify, predict, and manage the environmental and social risks associated with this large-scale linear infrastructure. The ESIA concludes that, while the INRAIL Project will deliver substantial socio-economic benefits—including reduced road congestion, decreased greenhouse gas emissions, improved safety, and enhanced logistics efficiency—it will also create significant risks that must be carefully mitigated through robust management instruments and institutional arrangements.

A central issue highlighted in the ESIA is the management of excavated material. Construction will generate approximately 30 million cubic meters of spoil, of which an estimated 3 million cubic meters can be reused for backfilling, embankments, and landscaping. The remainder will require careful transport and disposal. Istanbul Metropolitan Municipality and Kocaeli authorities maintain a combined licensed disposal capacity exceeding 49 million m³, distributed across sites such as Çiftalan, Atalaylar, and İmrahor. Temporary storage areas will be selected outside sensitive zones such as water reservoirs and residential areas, with strict dust, erosion, and sediment controls applied. The ESIA identifies uncontrolled dumping in rivers, agricultural fields, or forested lands as a significant environmental risk, and the ESMP includes mitigation measures to prevent such practices. A dedicated Excavated Material Management Plan will be prepared by the Design-Build (D+B) Contractors to ensure full compliance with the Turkish Regulation on Control of Excavation Soil, Construction and Demolition Waste, as well as World Bank standards. This plan will also integrate land management and rehabilitation requirements, ensuring that temporary disposal sites are stabilized and restored post-construction. The D+B Contractors will be responsible for obtaining and maintaining all permits, approvals and licenses required for the excavation, transport, temporary storage, reuse and final disposal of excavated material.

The ESIA provides an integrated framework for environmental and social management. The Environmental and Social Management Plan (ESMP) addresses identified risks with mitigation and monitoring actions, covering noise and vibration, air quality, water resources, waste management, occupational health and safety, community health and safety, biodiversity, and cultural heritage. The Stakeholder Engagement Plan (SEP) establishes transparent information sharing and communication channels with affected communities, municipalities, and civil society,

and defines grievance redress mechanisms accessible to all stakeholders. The Labour Management Procedures (LMP) address risks associated with a large and diverse workforce, setting standards for recruitment, working conditions, grievance handling, prevention of child and forced labor, and occupational health and safety. The Resettlement Framework (RF) provides the guiding principles for addressing land acquisition impacts, livelihood restoration, and compensation, ensuring alignment with both Turkish legislation and World Bank ESS5. The D+B Contractors will prepare and implement lot- and site-specific Contractor's Environmental and Social Management Plans (C-ESMPs) and the applicable sub-management plans in accordance with the finalized ESIA, ESMP, SEP, LMP, RF and the Employer's Requirements.

A comprehensive list of all permits, approvals, licenses, and other applicable legal requirements associated with the design and implementation of the Project is provided in Annex 10.

Key Environmental and Social Risks and Impacts

The ESIA identifies a range of environmental and social risks and impacts associated with the construction and operation of the INRAIL Project. The most significant environmental risks are primarily concentrated in the construction phase and include the large-scale generation and management of excavated material, temporary deterioration of air quality due to dust and emissions, construction noise and vibration, potential impacts on surface and groundwater resources, and localized disturbance to biodiversity and habitats along the linear corridor. Given the extensive tunneling works, improper handling or disposal of excavated material has been identified as a key environmental risk requiring strict management and regulatory compliance.

Key social risks and impacts relate to community health and safety, labor influx, land acquisition and economic displacement, occupational health and safety, and potential impacts on cultural heritage. Increased traffic from construction activities may elevate risks for nearby communities, while the influx of a temporary workforce may create pressure on local services and social cohesion if not adequately managed. Land acquisition activities may result in physical and/or economic displacement, necessitating compensation and livelihood restoration measures in line with national legislation and World Bank ESS5. Based on the finalized detailed design, AYGM will prepare and implement the applicable lot- or section-specific Resettlement Plans and, where required, Livelihood Restoration Plans. Access to affected land and commencement of works in the relevant section will be subject to completion of the applicable resettlement requirements and issuance of land-access clearance in accordance with the Employer's Requirements. In addition, construction activities involving tunneling, viaducts, and heavy machinery pose occupational health and safety risks to workers, which require robust preventive and monitoring measures.

Critical Mitigation Commitments

The Project's most critical mitigation commitments focus on managing construction-related risks and ensuring compliance with national legislation and World Bank Environmental and Social Standards. Key commitments include: (i) implementation of a dedicated Excavated Material Management Plan to ensure safe handling, transport, reuse, and disposal of spoil material; (ii) application of dust, noise, vibration, and traffic management measures to protect community health and safety; (iii) preparation and implementation of land acquisition and livelihood restoration measures in line with the Resettlement Framework; (iv) enforcement of robust occupational health and safety measures for workers, particularly for tunneling and viaduct construction; (v) protection of biodiversity and sensitive habitats through avoidance, minimization, and site-specific mitigation measures; and (vi) application of a Chance Find Procedure to safeguard cultural heritage. These commitments will be implemented through the ESMP and associated management plans throughout the Project lifecycle. No mobilization, establishment of Project Facilities or physical works will commence until the finalized ESIA, ESMP, SEP, C-ESMP and applicable sub-management plans have received the approvals and World Bank No-

Objection required under the Employer's Requirements.

The ESIA concludes that, while these risks and impacts are significant, they are considered manageable provided that the mitigation and management measures defined in the ESMP and associated plans (including the SEP, LMP, RF, and Chance Find Procedure) are effectively implemented throughout the Project lifecycle.

Mitigation and Management Responsibilities

Overall responsibility for environmental and social compliance rests with the Directorate-General of Infrastructure Investments (AYGM) as the Project Implementing Agency. AYGM will ensure that the requirements of the ESIA, ESMP, and associated environmental and social instruments are integrated into the Project design and contractual arrangements. The D+B Contractor(s) will be responsible for preparing, implementing, and monitoring site-specific mitigation measures and sub-management plans, including construction-phase environmental controls, occupational health and safety measures, labor management, and community health and safety actions. The D+B Contractor(s) will also be responsible for obtaining and maintaining the permits, approvals and licenses required for the Works, Project Facilities and Associated Facilities under their responsibility. The Construction Supervision Consultant (CSC) will supervise and verify the Contractors' day-to-day E&S compliance. The Project Management Consultant (PMC) will support AYGM PIU in overall E&S coordination, monitoring and reporting, while the Project Implementation Oversight Consultant (PIOC) will provide independent advisory, review and assurance functions. Relevant public authorities will retain their regulatory oversight and permitting roles, while affected communities and stakeholders will be engaged through the SEP and Grievance Redress Mechanism. Implementation and performance will be monitored throughout the Project lifecycle.

Design-and-Build Approach and ESIA Update Process

The INRAIL Project will be implemented under a D+B contracting approach, whereby the detailed engineering design and construction activities will be undertaken by the appointed contractor(s). Accordingly, this ESIA has been prepared based on the currently available project design information and provides the Project-level assessment of environmental and social risks and impacts based on the design information currently available.. The ESIA and ESMP will be updated, as necessary, once the detailed design is finalized, to reflect site-specific conditions, final layouts, and construction methods, in line with national requirements and the World Bank Environmental and Social Framework (ESF). The updates will also cover material design changes and the relevant Project Facilities and Associated Facilities and will be completed before commencement of the related works.

Stakeholder Consultation, ES Instruments, and Disclosure

Stakeholder consultations were undertaken as part of the ESIA preparation process, including meetings with local authorities, mukhtars, affected communities, and other interested parties within the Project's Area of Influence. These consultations informed the identification of key environmental and social risks, particularly in relation to land use, community health and safety, and construction-related disturbances, and highlighted the importance of early information sharing and accessible grievance mechanisms.

In parallel with the ESIA, key environmental and social instruments have been prepared, including the SEP, LMP, and RF. These instruments provide the overarching framework for stakeholder engagement, labor and working conditions, and land acquisition and resettlement processes and will be further detailed and updated as required during project implementation. Stakeholder engagement will continue during detailed design and construction, particularly where design changes, land acquisition, Project Facilities or Associated Facilities may result in new or additional environmental and social impacts.

The ESIA, along with the SEP and other relevant environmental and social documents, will be disclosed in accordance with national regulations and World Bank disclosure requirements. Materially updated environmental and social instruments will also be disclosed following the applicable review and approval process and before implementation of the activities to which they relate. Information disclosure and ongoing stakeholder engagement will be maintained throughout the Project lifecycle, supported by a project-level Grievance Redress Mechanism.

Other significant risks addressed by the ESIA include community health and safety impacts—particularly traffic risks from heavy machinery, dust and noise emissions, and potential social tensions between workers and local residents—as well as biodiversity conservation, cultural heritage protection, and occupational safety in tunneling and viaduct construction. The Project will also implement a Chance Find Procedure (included in the ESMP) to safeguard cultural resources, including military bunkers and Ottoman-era heritage sites located along the alignment.

In conclusion, the ESIA provides a comprehensive assessment of the baseline environmental and social conditions and identifies and evaluates the risks and impacts associated with project implementation, supported by corresponding mitigation and management measures defined in the ESMP and other subplans. It also underlines that the Project entails complex environmental and social risks, particularly regarding the unprecedented scale of excavated material management and the socio-economic impacts of labor influx and land acquisition. The coordinated implementation of the ESMP, SEP, LMP, and RF together with the lot- and site-specific C-ESMPs, applicable sub-management plans, Resettlement Plans and Livelihood Restoration Plans will be essential to ensuring that these risks are mitigated in accordance with national law and international best practice. With these safeguards in place, the INRAIL Project will strive for compliance with World Bank Environmental and Social Standards (ESSs) while maximizing its long-term developmental benefits for Türkiye and the wider region.

1 INTRODUCTION

1.1 Project Background

Türkiye achieved impressive economic growth (5.4% annually) and significant poverty reduction between 2003 and 2023, outperforming comparable upper-middle-income countries. Poverty rates dropped markedly—from over 20% in 2007 to under 10% by 2021. However, future growth is projected to slow to an average of 3.3% annually between 2023 and 2029, which is lower than Türkiye's historical performance and the expected growth rates of its peers (excluding South Africa). To maintain progress, Türkiye must increase productivity, which has contributed less to growth in recent years than it did in the past.

Boosting productivity can be achieved through trade-oriented investments in logistics. Turkish firms involved in exports or global value chains are more productive than their purely domestic counterparts. Türkiye's strategic location enhances its role in global logistics, with plans to become a logistics hub in the Trans-Caspian Middle Corridor and develop new rail routes. This will support low-carbon, multimodal logistics, aligning with Türkiye's 2053 net-zero goal.

As part of this vision, Türkiye is prioritizing rail infrastructure investments along the Middle Corridor to improve cross-border connectivity. Key upgrades are being made at outdated border crossings, such as the Halkalı–Kapıkule line to the European Union (EU), funded by the EU, Asian Infrastructure Investment Bank (AIIB), and the European Bank for Reconstruction and Development (EBRD). The Divriği–Kars–Georgia line, connecting to the South Caucasus, is being upgraded with financing from the World Bank (WB), Islamic Development Bank (IsDB), and AIIB. That section is the most capacity-constrained in the Middle Corridor, making its modernization a priority.

With rail capacity improvements at both ends of the Middle Corridor, the Bosphorus crossing in İstanbul is the next major bottleneck. Currently, rail traffic can only pass through the Marmaray tunnel, but freight trains are restricted to a limited nighttime window, severely limiting capacity and maintenance time. These limitations are affecting both operational capacity and long-term sustainability.

The only alternative to the Marmaray tunnel for freight is an inefficient and costly rail-to-truck transfer across the Bosphorus, reducing İstanbul's logistics efficiency and making the Türkiye route of the Middle Corridor less competitive than the Black Sea alternative. For passenger transport, an alternative crossing would improve operational resilience, enhance urban mobility, and expand high-speed rail access to underserved parts of İstanbul, including both airports.

A new high-capacity rail crossing of the Bosphorus has become Türkiye's strategic priority. This project will complete the Middle Corridor's uninterrupted rail connection across Türkiye, reinforcing its role as a global trade hub. It will benefit other major trade routes, including the Iraq Development Road and Türkiye's exports to the EU. The project will also reduce congestion, cut emissions, lower road wear, and improve safety by shifting freight from trucks to rail.

The Turkish government plans to build a 127-km greenfield railway bypass around İstanbul, connecting Çayırova (Asian side) to Çatalca (European side) via the Yavuz Sultan Selim Bridge. This electrified, mixed-use line will serve both passenger (up to 160 km/h) and freight (80–120 km/h) trains, linking to the national high-speed rail network. It will offer direct connections to Sabiha Gökçen and İstanbul airports, enhancing urban mobility and multimodal logistics, with air-to-rail freight transfers. The two airports will be the only stations on the bypass.

The cost of this transformative rail link is estimated at US$ 6,2 billion (excluding taxes), with construction planned within the next 6–7 years, and operations expected to begin by mid-2032.

1.2 Purpose of the Project

The INRAIL Project aims to strengthen Türkiye's role as a regional logistics hub by investing in strategic railway infrastructure along the Trans-Caspian Middle Corridor. One of the Project's key priorities is to address growing freight and passenger bottlenecks by establishing a high-capacity rail connection across the Bosphorus via the Yavuz Sultan Selim Bridge, linking İstanbul Airport and Sabiha Gökçen Airport — Türkiye's busiest air transport hubs. The Project also aims to enhance urban mobility, reduce emissions from road transport, reinforce intercontinental connectivity, and support Türkiye's long-term economic and climate goals.

1.3 The Need for Environmental and Social Impact Assessment (Screening Process)

An ESIA is essential for the INRAIL Project, considering its multi-year implementation period, extensive construction activities, and the complex socio-environmental landscape across the project corridor. Given the scale of infrastructure investment and the potential impacts on both urban and peri-urban communities, the ESIA will serve as a critical tool in identifying and managing project-related risks.The primary objective of this ESIA is to ensure that all Environmental and Social (E&S) risks—particularly those associated with labor influx, land use, biodiversity, water pollution, community health and safety, and occupational health and safety—are systematically assessed and that effective, context-specific mitigation measures are developed.

ÇINAR Mühendislik was engaged to carry out Phase I of the INRAIL, focusing on the preparation of baseline E&S assessments and instruments such as theESMP in alignment with the WB's ESF. This phase aims to establish a strong foundation for the project's E&S management, ensuring compliance with both international standards and national regulations.

During Phase I, ÇINAR Mühendislik undertook the following tasks:

- Preparation of Inception Report
- Preparation of ESIA and ESMP: ÇINAR prepared a ESIA and a ESMP in accordance with the WB's ESF and its ESSs. Additionally, the following E&S instruments were prepared and delivered:
    - SEP
    - LMP
    - RF
    - Key inputs for AYGM' Environmental and Social Commitment Plan (ESCP)
- The ESIA and ESMP will serve as a strategic framework to guide the development of detailed mitigation, management, and action plans by the D+B Contractors, who will be selected during the project implementation phase. Following the completion of ESIA/ESMP finalization process, the D+B Contractor will prepare lot- and site-specific C-ESMPs and relevant sub-plans for each work front, which will be subject to AYGM and the World Bank approval prior to construction.
- Stakeholder engagement will be an integral part of the preparation process, ensuring that key perspectives are incorporated across the ESIA, ESMP, and other E&S instruments.

The INRAIL Project is currently classified as having a Substantial E&S risk; this classification has been confirmed by the World Bank and is therefore considered final. Accordingly, the ESIA and other associated E&S instruments have been prepared in line with this confirmed risk classification.

In line with the World Bank ESF, the Project has been assigned a "Substantial" environmental and social risk classification primarily due to: (i) the linear nature and geographic scale of the

railway corridor; (ii) potential land acquisition and economic displacement affecting multiple settlements; (iii) community health and safety risks associated with large-scale construction activities, including traffic and labor influx; (iv) construction-phase impacts such as noise, vibration, dust and biodiversity disturbance; and (v) the multi-contractor implementation structure, which increases coordination and oversight requirements. These risk drivers are consistent with ESF criteria for Substantial Risk Projects.

While the Project is subject to ESIA requirements based on its scale and regulatory classification, the need for a comprehensive ESIA is further driven by the nature of high-impact activities involved, including extensive tunneling works, viaduct construction, large-scale excavated material generation, and construction in proximity to sensitive environmental and social receptors.

Risks related to child and forced labor are not expected for the Project due to the highly specialized nature of the works, formal recruitment procedures, and the applicability of Turkish labor legislation, which strictly prohibits child and forced labor. Nevertheless, these risks will be continuously monitored during implementation through the LMP, including contractual obligations and worker grievance mechanisms.

This ESIA Report will serve as a key Project E&S instrument for AYGM, the financing institutions, the Engineer and the D+B Contractors, providing the basis for the assessment and management of key risk areas such as labor management, land acquisition, biodiversity, stakeholder engagement, and occupational and community health and safety. The findings and mitigation measures outlined in the report will support financing institutions in making informed decisions about the project's compliance, due diligence needs, and monitoring requirements.

By aligning with both national regulatory requirements and international standards, the ESIA will not only support sound risk classification but also demonstrate the Project's commitment to sustainable and responsible infrastructure development.

1.4 Structure of the ESIA Report

The ESIA Report to be prepared contains the following sections that will be included and/or used in other relevant E&S documents to be prepared:

Executive Summary: This section provides a concise overview of the Scoping Report, summarizing the main objectives, key findings, and recommendations for the ESIA studies. It highlights the Project's goals, potential environmental, social, health and safety impacts, the methodology to be applied, and the next steps for the ESIA process.

Section 1 - Introduction: The introduction outlines the Project background, Purpose of the Project, explaining its methodology in determining the E&S scope of the Project. It provides a brief introduction to the Project, highlights its significance and the necessity of an ESIA, and outlines the structure of the ESIA Report.

Section 2 - Legal and Institutional Framework: This section sets out the legal obligations to which the Project will be subject including relevant national legislation as well as international conventions to which Türkiye is a party. It also identifies the gaps between the WB ESSs and national legislative requirements and the measures to be taken to fill these gaps.

Section 3 - Project Description: This section will describe all units of development to be undertaken under the Project. Briefly describe the proposed project and its geographical, environmental, social and temporal context, including any off-site investments that may be required (e.g. private pipelines, access roads, power supply, water supply, housing and raw material and product storage facilities) and the primary suppliers of the project. The section will also cover all associated facilities that are essential for the project's construction and operation, including but not limited to borrow areas for sand and gravel, stone quarries, concrete batch plants, asphalt bases (if applicable), and soil disposal areas resulting from tunneling activities. Considering the details of the project, the need for any plan to meet the requirements of national laws, international obligations, and International Financial Institutions

(IFI's) E&S requirements will be indicated. Include a map in sufficient detail showing the Project area and the area that may be affected by direct, indirect and cumulative impacts of the Project. The description will also include auxiliary facilities required for the project, and whether the project involves any associated facilities. In such case, it will also outline how the application of the ESF requirements to these associated facilities will be managed.

Section 4 - Baseline Data: The Baseline Data section outlines the current E&S conditions of the Project area. It includes an analysis of the natural environment (e.g., land use, water quality, biodiversity) and the social context (e.g., local demographics, types of settlements, economic activities, land ownership, cultural heritage, etc.). This section serves as the reference point for comparing the potential impacts of the Project and determining the significance of those impacts.

Section 5 - Environmental and Social Risks and Impacts: In this section, an ESIA will be conducted for each discipline by identifying the anticipated E&S impacts during the pre-construction, construction, and operation phases of the project, as well as their contribution to the existing pollution load determined in the previous section.

Section 6 - Analysis of Alternatives: The assessment systematically compares feasible alternatives to the proposed project site, technology, design, and operational arrangements—including the “without project” scenario—based on their potential E&S impacts. It evaluates the feasibility of mitigating these impacts for each alternative, taking into account the capital and recurrent costs of mitigation measures, their appropriateness and effectiveness under local conditions, and the institutional, training, and monitoring requirements they may entail. Where possible, the E&S impacts of each alternative are quantified, and economic values are assigned to these impacts when feasible.

Section 7 - Mitigation Measures: The assessment identifies appropriate mitigation measures and highlights any significant residual negative impacts that cannot be fully mitigated, while also evaluating the acceptability of those residual impacts to the extent possible. It outlines differentiated measures to ensure that adverse effects do not disproportionately affect disadvantaged or vulnerable groups and provides the indication of the party/parties responsible for implementation of the measures and/or their monitoring. Additionally, the assessment specifies which issues require no further analysis, providing a clear rationale for this determination. It also offers guidance for the preparation of specific sub-management plans aimed at addressing impacts on various valued E&S components.

Section 8 - Design Measures: The assessment outlines the rationale for selecting the proposed project design, detailing the considerations that led to its adoption over other options. It specifies the applicable Environmental, Health, and Safety Guidelines (EHSGs), or, where the EHSGs are deemed inapplicable, provides a justification for the recommended emission levels and pollution prevention and abatement measures. These recommendations are aligned with Good International Industry Practice (GIIP) to ensure E&S sustainability.

Appendices: The appendices include a list of individuals and organizations that contributed to the preparation of the E&S assessment. It also provides a comprehensive list of references, data sources, and others, including both published and unpublished materials utilized throughout the assessment process. Additionally, the appendix contains a detailed record of meetings, consultations, and surveys conducted with stakeholders—particularly affected communities and other interested parties—along with the methods used to facilitate their engagement and gather their input. Relevant data referenced or summarized in the main text is presented in accompanying tables. Finally, the appendix includes a list of associated reports and plans developed as part of the assessment as well as a summary of the Terms of Reference (ToR) guiding the preparation of the ESIA and related instruments.

1.5 Baseline Data Collection and Study Period

Baseline environmental and social data for the ESIA were collected to establish a comprehensive understanding of existing conditions within the Project Area of Influence prior to construction. The

baseline studies were designed to support the identification and assessment of potential environmental and social risks and impacts associated with the Project and to inform the development of appropriate mitigation and management measures.

Data collection was undertaken using a combination of desk-based review of available reports and official datasets, field surveys, site observations, and stakeholder consultations. Environmental baseline studies covered key aspects such as air quality, noise, vibration, surface and groundwater resources, biodiversity, and physical cultural resources, while social baseline data focused on land use, population characteristics, livelihoods, community infrastructure, and stakeholder concerns.

Field-based baseline surveys and data collection activities were conducted during 2023 and 2024, taking into account seasonal conditions where relevant. Additional biodiversity surveys were undertaken during 2025 and 2026 to supplement and strengthen the biodiversity baseline, as further described in Section 4.2.7 and Appendix 6.13. Secondary data were obtained from national and local authorities, previous studies, and publicly available sources. The baseline information presented in this ESIA reflects the best available data at the time of assessment and provides the basis for evaluating Project-related risks and impacts.

Following preparation of the Project-level ESIA, additional technical assessments were undertaken to further develop and refine the assessment of selected environmental and social topics. These include the Supplementary Noise and Vibration Assessment, Supplementary Traffic Impact Assessment, and Supplementary Cumulative Impact Assessment, which form Appendices 12, 13 and 14, respectively. These assessments supplement the relevant analyses presented in this ESIA and should be read together with the corresponding sections of the ESIA and ESMP.

1.6 Approach and Impact Assessment Methodology

1.6.1 E&S Assessment Approach

Within the scope of the ESIA Report, the following topics have been addressed and included in the ESMP:

- Key performance indicators and monitoring methodology to be evaluated within the scope of monitoring,
- Actions to enhance and strengthen E&S management capacity, along with training for personnel,
- Implementation schedule and cost estimates for impact mitigation, monitoring, and capacity development efforts.

In the preparation of the ESMP and sub-management plans, an E&S assessment approach have been employed. In line with the WB-ESF, the ESIA identifies potential environmental and social risks and impacts at an early stage, while the ESMP sets out the measures to eliminate, minimize, or mitigate these identified risks and impacts. The E&S approach have been applied throughout all elements of the Project. Prediction is the first step in determining and evaluating impacts, followed by a formal impact assessment procedure. The main steps of impact assessment are provided in Figure 1-1.

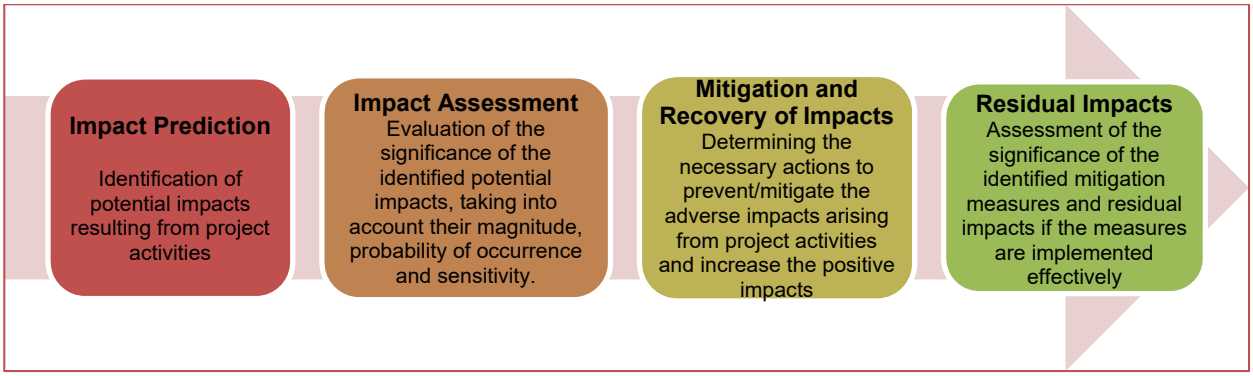


Figure 1-1 Impact Assessment Steps

After the impacts are assessed through several steps as mentioned above, necessary mitigation measures to minimize the adverse impacts and risks, monitoring activities for the full compliance of the requirements, relevant responsible personnel who will continuously take actions and monitor the performance are defined within the ESIA report.

1.6.2 E&S Impact Rating

The methodology to be used for the characterization of E&S impacts arising from the implementation of the Project has been developed based on the methodologies described in the United Kingdom's (UK) applicable government publications on EIA (Institute of Environmental Management and Assessment (IEMA), 2011: The State of EIA Practice in the UK, Scottish Natural Heritage's Handbook on EIA (2013) and other available guidance documents on impact assessment (Canter, 1993, Standards Association of Australia, 1999, etc.).

In accordance with good ESIA practice, the significance of impacts will be determined based on the sensitivity of the receptor and the overall magnitude of the Project's impact on that specific receptor. The magnitude of the impact is determined using quantitative or, where this is not possible, qualitative methods based mainly on professional judgement. An environmental and/or social impact may be beneficial or adverse. The sensitivity of the receptor will be determined based on the baseline information, which takes into consideration the public interest, designations, legal requirements, acceptability, sustainability, etc., and also where relevant, in consultation with the affected communities.

The overall magnitude of an impact or risk is determined by a comprehensive analysis of the criteria which may encompass the following:

- Geographical extent (wide, local or restricted)
- Reversibility (long term reversible/irreversible, medium-term or short-term reversible)
- Duration (long term, medium term or short term)
- Frequency (continuous, recurrent, intermittent or one-off)

Criteria for magnitude factors are provided in Table 1-1.

Table 1-1 Magnitude Factors and Scales

Magnitude Factors	Scales		
	High	**Medium**	**Low**
Geographical extent	Wide	Local	Restricted
	Beyond the AoI	Within the AoI	Within the construction site
Reversibility	Irreversible/ Long-term reversible	Medium-term reversible	Short-term reversible
	Reversible after the operation period or irreversible	Reversible within the operation period	Reversible during construction phase or after one year of construction period
Duration	Long-term	Medium-term	Short-term
	After the operation period	Within the operation period	Within construction period
Frequency	Continuous/ Recurrent	Intermittent	One-off/rare

Magnitude Factors	Scales		
	High	**Medium**	**Low**
Severity	Significant	Moderate	Minimal
	Significant potential change/damage, limited or no mitigation measures	Moderate potential change/damage and/or costly or ineffective mitigation measures	Minimal potential change/damage effective and feasible mitigation measures

** Calculation of overall magnitude: In the table, "High" will be assigned 3 points, "Medium" 2 points, and "Low" 1 point. In total; (5-6 Points: Negligible, 7-9 Points: Low, 10-12 Points: Medium, 13-15 Points: High)*

General criteria to be taken into consideration when determining sensitivity of the receptor and the overall magnitude are provided in Table 1-2, whereas specific assessments and methodological variations (if any) for each environmental and/or social component is presented in this ESIA Report.

Table 1-2 General Criteria for Identification of Receptor Sensitivity and Impact Magnitude Levels

Level	Receptor Sensitivity	Impact magnitude	
		Adverse	**Beneficial**
High	Highly important (national and international scale of importance), high rarity, potential for substitution very limited	Loss of resource and/or quality and integrity of resources; severe damage to key characteristics, features or elements.	Large scale or major improvement of resource quality; extensive restoration or enhancement; major improvement of attribute quality.
Medium	Moderately important (regional scale of importance) and moderate rarity, potential for substitution limited	Loss of resource, but not adversely affecting the integrity; partial loss of/damage to key characteristics, features and elements	Benefit to, or addition of, key characteristics, features or elements; improvement of attribute quality.
Low	Minor importance (local scale of importance), not rare	Some measurable change in attributes, quality or vulnerability; minor loss of, or alteration to, one (maybe more) key characteristics, features or elements	Minor benefit to, or addition of, one (maybe more) key characteristics, features or elements; some beneficial impact on attribute or a reduced risk of negative impact occurring.
Negligible	No or very low importance and rarity	No or very minor loss or detrimental alteration to one or more characteristics, features or elements	No or very minor benefit to or positive addition of one or more characteristics, features or elements

Following the identification of receptor sensitivity and overall magnitude of an impact on that specific receptor, the significance of the impact will be determined by using a standard matrix style approach, which consists of a 4x4 matrix. The matrix and general descriptions of each significance level identified in the matrix are provided in Table 1-3.

Table 1-3 Significance Assessment Matrix

		Receptor Sensitivity			
Overall Magnitude		High	Medium	Low	Negligible
	High	Major	Major	Moderate	Minor
	Medium	Major	Moderate	Minor	Minor
	Low	Moderate	Minor	Minor	Negligible
	Negligible	Minor	Minor	Negligible	Negligible

Source: *Adapted from IEMA, 2011; UK HA 205/08 Volume 11, Section 2; Canter, L., 1993; and other impact assessment methodology guidance/handbooks.*

Major	Impacts are considered to be very important and are likely to be material in decision-making, which would be associated with sites or features of international, national or regional importance as well as local importance if the site or feature is subject to a major change. Mitigation measures are imperative to reduce the significance to lower levels before proceeding with the Project.
Moderate	Impacts are not likely to be key decision-making factors. The cumulative impacts of such factors may influence the decision-making if they lead to an increase in the overall adverse impact on a particular receptor. If possible, impact significance is to be reduced to lower levels by taking mitigation measures; otherwise, acceptance of associated risks is required for proceeding with the Project.
Minor	Impacts may be raised as local factors, which are unlikely to be critical in the decision-making process, but important in enhancing the subsequent design of the Project. Assurance of compliance with standards and safety criteria is sufficient to proceed.
Negligible	No impact or impacts are beneath the level of perception so that they are acceptable with normal operating procedures.

2 LEGAL AND INSTITUTIONAL FRAMEWORK

The administrative structure in Türkiye encompasses both central and local administrations. The central administrative units are represented by ministries. which extend services to local regions through their respective local branches. These branches encompass provincial organizations under the governor's jurisdiction, as well as district organizations under the oversight of district governors. Furthermore, Türkiye is comprised of various provinces, each managed by smaller local administrations that include municipalities and villages/neighborhoods. The administrative leadership within these units is vested in mayors for municipalities and mukhtars for villages/neighborhoods.

Detailed descriptions of the national legislation and international standards relevant to the Project are provided in Appendix-10; therefore, in this section, the GAP Analysis is presented.

GAP Analysis

Within the scope of this ESIA Report, a Gap Analysis has been conducted to identify the requirements of the WBG EHSG that are relevant to the project. The study also examines the extent to which national legislation covers these requirements and identifies the gaps, along with the measures proposed to bridge these gaps in the present project Table 2-1.

Table 2-1 Comparison Between National Legislation and WB ESSs

ESS*	Gaps between the Turkish Legislation and WB ESSs	Measures to bridge gaps/standards to be followed in this project
ESS1 Assessment and Management of E&S Risks and Impacts	The main gaps between the national EIA and the ESS1 are as follows: ▪ The process of integrating social impact assessment into the Turkish EIA has started in recent years. Especially with the EIA Regulation published in the Official Gazette dated 29.07.2022 and numbered 31907, social impact assessment has started to be included in Turkish EIA. Turkish EIA process is currently open for improvement but requires a fully integrated process to reach ESS1. ▪ In addition, the requirement to address cumulative impacts of other concurrent other projects is limited in Turkish EIA legislation. Under ESS1, cumulative impact assessment is in a more important position. Additionally, where the project involves specifically identified physical elements, aspects, and (associated) facilities that are likely to generate impacts, environmental and social risks and impacts have to be identified in the context of the project's area of influence (AoI) under ESS1. ▪ The preparation of ESMPs together with the Stakeholder Engagement Plan (during the EIA application process) has been included in Turkish legislation with the latest regulation. However, the management plans prepared are less comprehensive than the ones required under ESS1. ▪ In addition, ESS1 supports the use of an effective grievance mechanism that can facilitate early indication and prompt remediation for those who believe that they have been harmed by a client's actions. ▪ Supply chain management is also highlighted in ESS1.	According to national EIA Regulation projects are classified into two categories as Annex I and Annex II projects, which is mainly based on magnitude or capacity of planned investment, rather than associated risks and impacts. Therefore, Projects are screened with respect to Annex I and Annex II of the EIA Regulation. However, The WB classifies all projects into one of four classifications: High Risk, Substantial Risk, Moderate Risk or Low Risk by taking into consideration the type, nature, location, sensitivity and scale of the Project, proportional to the significance of the Project's potential E&S risks and impacts. Projects are screened on a case-by-case basis. The INRAIL Project is being evaluated within the scope of Annex I of the national EIA Regulation, and a detailed EIA study will be conducted within the scope of the project. In addition, the project has been identified as a Substantial Risk under the WB ESF. To address this gap, an ESMP has been prepared in line with the WB ESF as part of the Project, together with this ESIA. The Final ESIA and Final ESMP will be updated by AYGM as required once the Project design is finalized. In addition, the D+B Contractor(s) will be responsible for preparing and implementing the contractor's ESMP and other necessary sub-management plans during Project implementation. Moreover, SEP including grievance redness mechanism (GRM) has also been prepared to develop a gender-sensitive GRM procedure that also includes employee complaints, where anonymous complaints can be reported, and to eliminate/close this gap. Cumulative impacts have been assessed at a strategic level based on available information and will be further refined, where required, as part of subsequent project stages in line with ESS1.
ESS2 Labor and Working Conditions	Turkish national laws and regulations are generally close to the requirements of ESS2 in labor and working conditions. The GRM for workers is the most important gap between the national legislative requirements and ESS2. There are no specific requirements for the establishment and implementation of a GRM in Turkish national legislation.	Labor Management Procedures has been prepared for the Project. Moreover, the D+B Contractor will prepare project level Labor Management Plan including gender equality and anti-discrimination, Sexual Exploitation and Abuse/Sexual Harassment (SEA/SH), child labor, forced labor, labor rights and

ESS*	Gaps between the Turkish Legislation and WB ESSs	Measures to bridge gaps/standards to be followed in this project
	Türkiye is party to a multitude of ILO conventions, including but not limited to conventions on equal treatment of employees, gender equality, child labor, forced labor, Occupational Health and Safety (OHS), right of association and minimum wage. Accordingly, the current Turkish Labor Law (No.4857) is to large extent consistent with international requirements.	freedom of association. Workers will receive written contracts and be provided access to Workers' GRM. The Labor Management Procedures establish the overarching framework for the worker Grievance Redress Mechanism, which will be implemented and operationalized by the D+B Contractors.
ESS3 Resource Efficiency and Pollution Prevention and Management	Most Turkish national laws and regulations are in line with European Union (EU) directives. There is no major gap between ESS3 and Turkish national legislation. National EIA process is quite successful in identifying impacts but does not require provision of a detailed overview of mitigation methods and monitoring. However, within the scope of ESS3, the client needs to consider alternatives and implement technically and financially feasible and cost-effective options to reduce project related GHG emissions during the design and operation of the project. Sub-management plans and monitoring programs have started to be integrated into Turkish legislation with the recent EIA Regulation. Furthermore, there are no major gaps between the impacts and mitigation methods in the national legislation and ESS3 on major environmental issues such as waste, air pollution, water resources, wastewater, noise level. On the other hand, ESS3 requires application of pollution prevention and control technologies and practices under the Project consistent with international good practice, as reflected in internationally recognized standards, such as the WBG-EHSG.	The Final ESIA and Final ESMP will be updated by AYGM as required once the Project design is finalized. In addition, the D+B Contractor(s) will be responsible for preparing and implementing the contractor's ESMP and other necessary sub-management plans during Project implementation. The relevant requirements of the WBG EHSG have been applied to the Project in accordance with the ESS3. In cases where the Turkish requirements differ from the levels and measures presented in the WBG EHSG, the more stringent one (such as the most stringent discharge and emission standards) has been applied in the project specifications.
ESS4 Community Health and Safety	In Turkish national legislation, the general principles of community health, safety and security are fragmented under different regulations. The general principles are like ESS4. However, social issues such as labor influx, gender impacts and violence-based risks are more prominent under the ESS4 along with cumulative assessment and communication mechanism with external stakeholders.	The Community Health and Safety Management Plan, as part of the ESMP, will be prepared by the D+B Contractor, taking into account both national legislation and international standards, ensuring the effective implementation of the Public Grievance Redress Mechanism.
ESS5 Land Acquisition, Restrictions on Land Use and Involuntary Resettlement	Turkish legislation on land acquisition basically corresponds to the requirements envisaged by ESS5. However, some gaps include Resettlement Plan (RP) preparation, the implementation of the plan, impact assessment on vulnerable groups, restoration of land-based livelihoods and the lack of recognition of informal land users and squatters. There are the following GAPs between Turkish national legislation and international standards on land acquisition: ▪ Buildings and structures are compensated with depreciations; therefore, full replacement cost is not provided. ▪ According to the Resettlement Law (Law No. 5543), compensation in kind cannot be made except resettlement by the state. ▪ Disclosure and stakeholder engagement, Project level grievance mechanism are not defined as a part of the land acquisition process, ▪ Entitlement defining are limited to the legal title holders of the assets or lands for National Legislation; informal, users, tenants, common land users are not defined as beneficiary and the PAPs without recognizable claims are not eligible for expropriation compensation. ▪ In Turkish Resettlement Law, the cut-off date is defined a three-year residence time limit for non-owners. ▪ Restoration of livelihoods of PAPs are not covered in national legislation and no requirements are defined for the displaced poor or other vulnerable groups to improve their socioeconomic situation.	Within the scope of the ESS5, the Project includes a Project-specific Resettlement Framework (RF) report with mitigation measures on eliminating the negative impacts that may occur on the fixed assets, agriculture and livestock livelihoods of the local people during the construction or transportation process, and a risk assessment regarding the loss of livelihood and economic displacement of the local people in accordance with the WB requirements. The RF has been developed in accordance with the potential land and livelihood losses caused by the Project impacts, based on the determination of livelihoods of local people, socioeconomic status of households and vulnerable groups in accordance with WB ESSs requirements. In addition, Directorate-General of Infrastructure Investments (AYGM) will prepare the required Project-specific Resettlement Plan(s) (RP) and Livelihood Restoration Plan. This instrument will be developed concurrently with the preparation of the final ESIA and the finalization of the project design. RP will provide detailed guidance on resettlement procedures, compensation measures, and livelihood restoration activities to ensure that affected persons are adequately compensated and supported, in line with applicable national legislation and international best practices, including the World Bank's ESF. The applicable RP/LRP shall be implemented and the required completion and land-access clearance process shall be concluded before access to the affected land or commencement of works in the relevant section.

ESS*	Gaps between the Turkish Legislation and WB ESSs	Measures to bridge gaps/standards to be followed in this project
ESS6 Biodiversity Conservation and Sustainable Management of Living Natural Resources	There is no gap in terms of policy level but internationally recognized areas of high biodiversity value including key biodiversity areas, important nature areas, important bird areas and important plant areas are not fully assessed/considered under national legislation. There is no requirement for habitat assessment in national legislation as well.	Biodiversity assessments made within the scope of the ESIA cover internationally recognized areas of high biodiversity value and habitat assessment. In this context, a Critical Habitat Assessment (CHA) has been carried out. The D+B Contractors will update and supplement biodiversity baseline information where required and prepare and implement the applicable lot specific Biodiversity Management Plan and Biodiversity Action Plan, together with any required site-specific sub-plans, based on the finalized design, site-specific findings and the mitigation hierarchy defined in the ESIA, ESMP and Employer's Requirements. A lot specific Biodiversity Management Plan will be prepared by the D+B Contractors, based on site-specific findings and the mitigation hierarchy (avoidance, minimization, restoration) defined in this ESIA.
ESS8 Cultural Heritage	The national legislation covers most of the requirements of the ESS8. However, as ESS8 defines the cultural heritage covering both tangible and intangible heritage, Law No. 2863 covers mainly the movable and immovable tangible cultural and natural assets. Under ESS8, the preparation of the Chance Find Procedure is primarily expected during construction activities, especially for the protection of tangible cultural heritage. In contrast, for intangible forms such as socio-cultural aspects, the implementation of a code of conduct (CoC) and providing training to all employees become prominent compared to the national legislation.	In terms of cultural management, intangible cultural heritage will be considered within the scope of the ESIA and Chance Find Procedure will be given as an Appendix in the ESMP document.
ESS10 Stakeholder Engagement and Information Disclosure	In the Turkish EIA legislation, EIA Report for the projects in the list of Annex-I will be made available to the public opinion at the headquarters of Ministry of Environment, Urbanization, and Climate Change (MoEUCC) or provincial directorates. Following MoEUCC's final assessment of the EIA report, the Governor's Office will disclose its reasoned decision publicly. For the projects in the list of Annex-II, the final Project Introduction File (PIF) will be disclosed publicly at the Provincial Directorates. Similarly, public information and consultation meetings are held only the projects listed in Annex-I of the Turkish EIA Regulation.	SEP including GRM has been prepared in accordance with the requirements of ESS10. As per ESS5, special consultations are included for project persons who will be subject to land acquisition. SEP/GRM will also be disclosed to stakeholders within the scope of the WB requirements.

In the event of any differences between applicable national requirements and the World Bank ESF, including the ESSs, or international good practice, the more stringent requirement will apply.

Roles and Responsibilities of Government Authorities in Permitting and Compliance

The implementation of the INRAIL Project is subject to a range of permits, approvals and authorisations issued by different government authorities in accordance with national legislation. The roles and responsibilities of these authorities vary depending on the type of permit and the project phase, including planning, construction and operation.

Table 2-2 summarises the key government agencies involved in permitting and regulatory compliance for the Project, together with their respective mandates and oversight responsibilities. This overview is intended to clarify institutional roles and ensure transparency regarding regulatory compliance and supervision throughout the Project lifecycle.

Table 2-2 Roles of Key Government Agencies in Permitting and Compliance

Permit / Approval	Responsible Authority	Role and Responsibility
Environmental Impact Assessment (EIA)	Ministry of Environment, Urbanization and Climate Change (MoEUCC)	Review and approval of EIA documents; oversight of environmental compliance during project lifecycle

Permit / Approval	Responsible Authority	Role and Responsibility
Environmental Permit	MoEUCC (Provincial Directorates)	Issuance of environmental permits under the Environmental Permits and Licenses Regulation; compliance monitoring
Forest Land Use Permit	General Directorate of Forestry (OGM)	Approval of temporary or permanent use of forest lands; definition of mitigation and afforestation obligations
Pasture Permit	Ministry of Agriculture and Forestry / Provincial Pasture Commissions	Approval of pastureland conversion; compensation and rehabilitation requirements
Zoning / Development Plan Permit	Relevant Metropolitan / District Municipalities	Approval of zoning plans, development rights and construction permits
Road Access and Connection Permits	General Directorate of Highways (KGM) / Relevant Municipality	Approval of road connections, access points and construction works affecting public roads
Water Use and Discharge Permits	State Hydraulic Works (DSİ) / MoEUCC	Authorization of water abstraction, discharge and dewatering activities; protection of water resources
Utility Relocation Approvals	Relevant Utility Authorities (electricity, gas, telecom)	Approval and supervision of relocation of existing infrastructure

All required permits and approvals will be obtained prior to the commencement of the relevant project activities. Compliance with permit conditions and applicable legal requirements will be ensured by the Project Owner and, during the construction phase, by the D+B Contractors under the supervision of the competent authorities. Regulatory compliance will be monitored through routine inspections, reporting obligations and implementation of the ESMP and the C-ESMP, as applicable.

3 PROJECT DESCRIPTION

The INRAIL Project is a strategic infrastructure initiative aimed at establishing a high-capacity, heavy-duty overland railway connection between the European and Asian sides of İstanbul. By addressing a critical gap in the national railway network, the project is expected to significantly enhance Türkiye's intercontinental rail connectivity and overall logistics efficiency.

The Project involves the construction of a 127-kilometer greenfield dual-track railway line, along with full electrification and advanced signalling systems. The alignment runs from Çayırova Station on the Asian side to Çatalca Station on the European side, crossing the Bosphorus via the Yavuz Sultan Selim Bridge, where space has been pre-designated for rail use.

In addition, the project includes high-standard rail connections to İstanbul Airport (on the European side) and Sabiha Gökçen Airport (on the Asian side). It is being implemented by AYGM under the Ministry of Transport and Infrastructure (MoTI) of the Republic of Türkiye.

3.1 Project Characteristics

3.1.1 Scope of the Project

The Project is a strategic greenfield railway development designed to strengthen Türkiye's intercontinental rail connectivity by establishing a high-capacity rail corridor between the Asian and European sides of İstanbul. The Project aims to provide a dedicated alternative to the Marmaray Tunnel, particularly for freight transport, while also enhancing multimodal passenger connectivity. The proposed line will extend approximately 127 kilometers and include tunnels, viaducts, and bridges to traverse the complex topography of İstanbul, utilizing the Yavuz Sultan Selim (YSS) Bridge for the Bosphorus crossing.

The scope of the Project includes all civil works and infrastructure components necessary for the construction and operation of a fully electrified, double-track, signalized railway line suitable for both freight and passenger services. The Project will involve the development of passenger stations at Sabiha Gökçen Airport and İstanbul Airport. In addition, multimodal freight transfer facilities will be established at these airports as well as at Çayırova and Çatalca. Auxiliary facilities required for the implementation of the INRAIL Project include, but are not limited to maintenance depots, emergency shafts, ventilation structures, construction camps, temporary access roads, logistics and laydown areas, material storage sites, batching plants, quarries, borrow pits, spoil disposal areas, pre-cast yards, worker accommodation facilities, and other temporary construction-support zones identified during detailed design. These facilities will be assessed as Project Facilities or construction-support facilities, as applicable. Any facilities meeting the definition of Associated Facilities under the World Bank ESF will be identified and assessed separately in accordance with ESS1. The Project will be implemented under a D+B contract modality. The ESIA and ESMP have been prepared based on the available design information and will be updated, in accordance with the WB-ESF, as the detailed design progresses and any site-specific changes arise.

3.1.2 Technical Specifications of the Project

The railway line, with a total length of 127 kilometers, branches off the Marmaray Line at the Çayırova location, passes by Sabiha Gökçen Airport, turns north after the airport, crosses the Bosphorus via the Yavuz Sultan Selim Bridge, reaches İstanbul Airport, and finally connects to the Halkalı-Kapıkule Line at Çatalca on the European side.

To minimize E&S impacts along the alignment, various engineering structures are planned. List of engineering structures and their properties are summarized in Table 3-1.

Table 3-1 Engineering Structures List

Name of Structure	Number	Length (km)
Tunnel Boring Machine (TBM) Tunnel	5 twin-tube	36.2
New Austrian Tunneling Method (NATM) Tunnel	22 double-track	23.3
Viaduct	2	22.1
Bridge	40	
Cut-and-Cover Tunnel	17	3,7

For electrification, preliminary locations for three traction transformer substations have been identified; however, their final number, locations, types and capacities will be determined through the system-wide power supply design and detailed design process. The Project will also include 154 kV energy transmission lines and associated traction power infrastructure.

3.1.3 Auxiliary Facilities

"Auxiliary Facilities" refers to the supporting infrastructure necessary for the effective implementation and operation of the Project. These facilities ensure that construction, maintenance, and energy transmission processes function efficiently. The auxiliary facilities of the Project include:

- Construction Sites,
- Energy Transmission Lines (ETLs), and
- Disposal Areas for Excavated Material.

Multiple construction sites can be established for the Project to host temporary facilities such as storage areas, concrete plants, staff accommodations, and disposal areas for excavated material. These sites will also support vehicle and equipment maintenance. Their exact number and locations are not yet determined and will be selected by the future contractor, subject to approval by AYGM, ensuring they are not placed in environmentally protected areas like agricultural lands, wetlands, or water reservoirs. These arrangements are addressed in the ESIA and ESMP.

ETLs will be used to transmit electricity generated by the facility to the national grid. The projects and routes of the ETL lines have not yet been finalized as of the date of this report.

Under the D+B approach, no auxiliary facility will be established without prior site-specific environmental and social screening in accordance with the ESIA and ESMP requirements. Where necessary, site-specific ESMPs and/or updates to the ESIA will be prepared by the Contractor to address potential environmental and social risks, subject to review and approval by AYGM and the Lenders.

Associated Facilities: With respect to Associated Facilities as defined under the World Bank Environmental and Social Framework, the Project does not currently envisage any facilities beyond those described above. The facilities directly developed or controlled as part of the Works will be treated as Project Facilities and assessed under the applicable Project E&S instruments. Should any facility meet the definition of an Associated Facility at later stages, the same ESF requirements applicable to Project-financed facilities will apply, it will be assessed and managed in accordance with the requirements of the WB ESF/ESSs.

3.1.4 Project Lifespan and Labor Demands

The INRAIL Project is planned to be implemented over an estimated period of 6 to 7 years, with construction activities expected to commence in the near term and operations targeted to begin by mid-2032. The Project's implementation will require a significant labor force across multiple phases, including planning, construction, and operations.

Based on current construction planning, the INRAIL Project is expected to require a peak workforce of approximately 1,500–2,000 workers during the construction phase. This workforce will include unskilled and semi-skilled laborers, skilled workers, tunnel and railway technicians, machine operators, engineers, OHS staff, and management personnel. A portion of this workforce—primarily specialized or managerial staff—is expected to originate from outside the

region, resulting in a temporary labor influx into the Project's Area of Influence (AoI).

Preliminary assessments indicate that most of the construction workforce will be accommodated in designated labor camps, while a smaller number of specialized personnel may reside in nearby settlements. Final workforce distribution, labor influx levels, and accommodation arrangements will be confirmed during the detailed design and contractor mobilization stages and addressed through the Contractor's Labor Management Plan.

During the operation phase, the Project is expected to employ approximately 50–75 personnel for train operations, maintenance, control systems management, and safety monitoring. These operational staff requirements are long-term and will not create significant labor influx–related impacts.

During both the construction and operation phases, the Project will employ a large number of workers including:

- Direct workers, employed by the implementing agency and contractors;
- Contracted workers, engaged through third-party construction and service providers;
- Primary supply workers, involved in the provision of key materials and equipment for the Project.

In line with national legislation and international standards, the Project will adhere to Türkiye's labor laws and relevant International Labour Organization (ILO) conventions, to which Türkiye is a party. These include key provisions on:

- Non-discrimination and equal opportunity in employment,
- Freedom of association and the right to collective bargaining,
- Prohibition of child labor and forced labor,
- Minimum working age and wage regulations,
- Occupational health and safety (OHS) standards and measures,
- Grievance and dispute resolution mechanisms.

Risks related to child or forced labor are not expected in this Project. This ESIA evaluates labor-related risks such as potential violations of equal opportunity, discriminations, gender-based violence (GBV), or harassment in the workplace, while the corresponding mitigation measures and monitoring systems are covered in the ESMP. A LMP is developed in accordance with both Turkish labor law and internationally recognized standards, including the WB's ESF. The LMP provides a comprehensive framework to manage labor-related risks and obligations during the Project lifecycle and serves as the basis for the D+B Contractor(s) to develop their own Labour Management Plans.

OHS considerations are integrated into the ESIA and ESMP. These concerns will be further addressed by the D+B Contractors through C-ESMP and sub-management plans, ensuring alignment with both national regulations and WB's guidelines. The OHS risk assessment will cover both construction and operational phases of the Project.

The operation phase will also require a smaller but stable workforce for rail operations, maintenance, and monitoring activities. Employment opportunities during this phase will contribute to local economic development, particularly in İstanbul and surrounding regions.

3.1.5 Project Alternatives

The alternatives evaluated for the Project are listed and discussed in Section 6 of this report.

3.2 Project Location

INRAIL will be located on both the Asian and European sides of İstanbul. The railway line will begin near Çayırova Station in Kocaeli Province (Asian side) and extend westward to Çatalca Station in İstanbul Province (European side). The location map of the Project is given in Appendix

2.1, topographic maps are available in Appendix 2.2 and the satellite maps of the also shown in Appendix 2.3.

The Project alignment traverses multiple districts within the provinces of Kocaeli and İstanbul. Detailed information on the Project footprint, surrounding land use, sensitive receptors, and landscape and visual context is provided in the relevant annexes, including Appendix 4 (Lanscape and Visual), Appendix 5 (Nearest Sensitive Receptors), and Appendix 8 (Expected Amount of Excavation Material with Expected Usage Area).

4 BASELINE DATA

4.1 Determination of the Area of Influence (AoI)

According to the *"Regulation on Control of Air Pollution from Industrial Sources"*, which was published in the Official Gazette dated 03.07.2009 and numbered 27277, the impact area is defined as the area with a radius of 50 (fifty) times the height of the stack from the center of the emissions.

For facilities with an effective height of emissions less than 30 m from the ground, the facility impact area is a square area with a side length of 2 km. If the surface distribution of off-stack emission sources (area source) is greater than 0.04 km^2, the facility impact area is a square area with a side length of 2 km, with the area source in the center of the square. The facility impact area is taken as basis in determining the surface distribution of emission sources.

The Investigation Area is a square area with a side length of 1 km within the facility impact area. In special cases where a decision on pollution cannot be made, the side lengths of the investigation area are taken as 500 meters.

For the INRAIL Project, the general AoI has been determined as 500 meters from the project alignment in all directions. This decision considers not only emissions dispersion, but also additional environmental and social parameters:

- Noise and Vibration impacts are expected during construction and are typically significant within a few hundred meters.
- Ecological Effects such as habitat disturbance and vegetation clearance are concentrated close to the corridor.
- Community Impacts (e.g., access limitations, temporary nuisances) generally occur within a short distance from the alignment.
- Land Use and Visual Impacts are also most prominent within the 500-meter buffer.

The INRAIL alignment largely falls within the Area of Influence of the Northern Marmara Motorway, with only limited sections outside this zone. While the motorway is already operational, INRAIL is still under planning and construction. Given the similar linear nature of both infrastructures, the methods used to determine the AoI in the Northern Marmara Motorway ESIA have been applied for INRAIL as a reference. In the NMM ESIA, a 500-meter AoI was considered sufficient to encompass environmental and social impacts. Applying the same distance for INRAIL ensures that the assessment covers potential cumulative and corridor-specific impacts, while maintaining consistency with prior regional infrastructure projects.

At this stage, the 500-meter corridor has been considered sufficient to cover the expected construction and operation-related impacts based on the current design. Noise monitoring was conducted at the nearest settlements, all of which are located within this 500 m corridor (See Appendix-3). Similarly, preliminary traffic and haulage impacts, including dust, noise, and load effects on local roads, have been evaluated; however, a more detailed assessment will be conducted once the final alignment and logistics routes are confirmed. Area-based assessments for hydrogeological impacts are provided in Section 4.2.4. Based on the findings of these studies, groundwater impact areas will be redefined in subsequent phases if necessary. Area-based assessments for hydrogeological impacts are provided in Section 4.2.4. Based on the findings of these studies, groundwater impact areas will be redefined in subsequent phases if necessary.

In addition to the main project corridor, the Area of Influence (AoI) also includes areas associated with potential excavated material disposal sites and any new borrow areas that may be identified for sourcing sand, gravel, rock, or soil during construction. These locations are considered part of the Project's AoI due to their potential environmental and social interactions, including land use,

transport, dust, noise, and community safety aspects. The specific locations and characteristics of such sites will be confirmed during detailed design and assessed in accordance with the same environmental and social management requirements applicable to the main project alignment.

Furthermore, the 500-meter AoI allows for an integrated assessment of multiple impact pathways, including interactions with the existing motorway, and provides a basis for planning mitigation measures to protect both environmental and social receptors. This distance also aligns with international best practice for linear infrastructure projects of comparable scale and complexity.

Considering all these factors, the AoI for the INRAIL Project is set at a general 500 meters in all directions from the alignment, supplemented by topic-specific refinements (e.g., for hydrogeology, traffic, and noise) as the Project design advances. All these considerations have been taken into account, and this section has been further detailed accordingly. This AoI is illustrated in Figure 4-1.

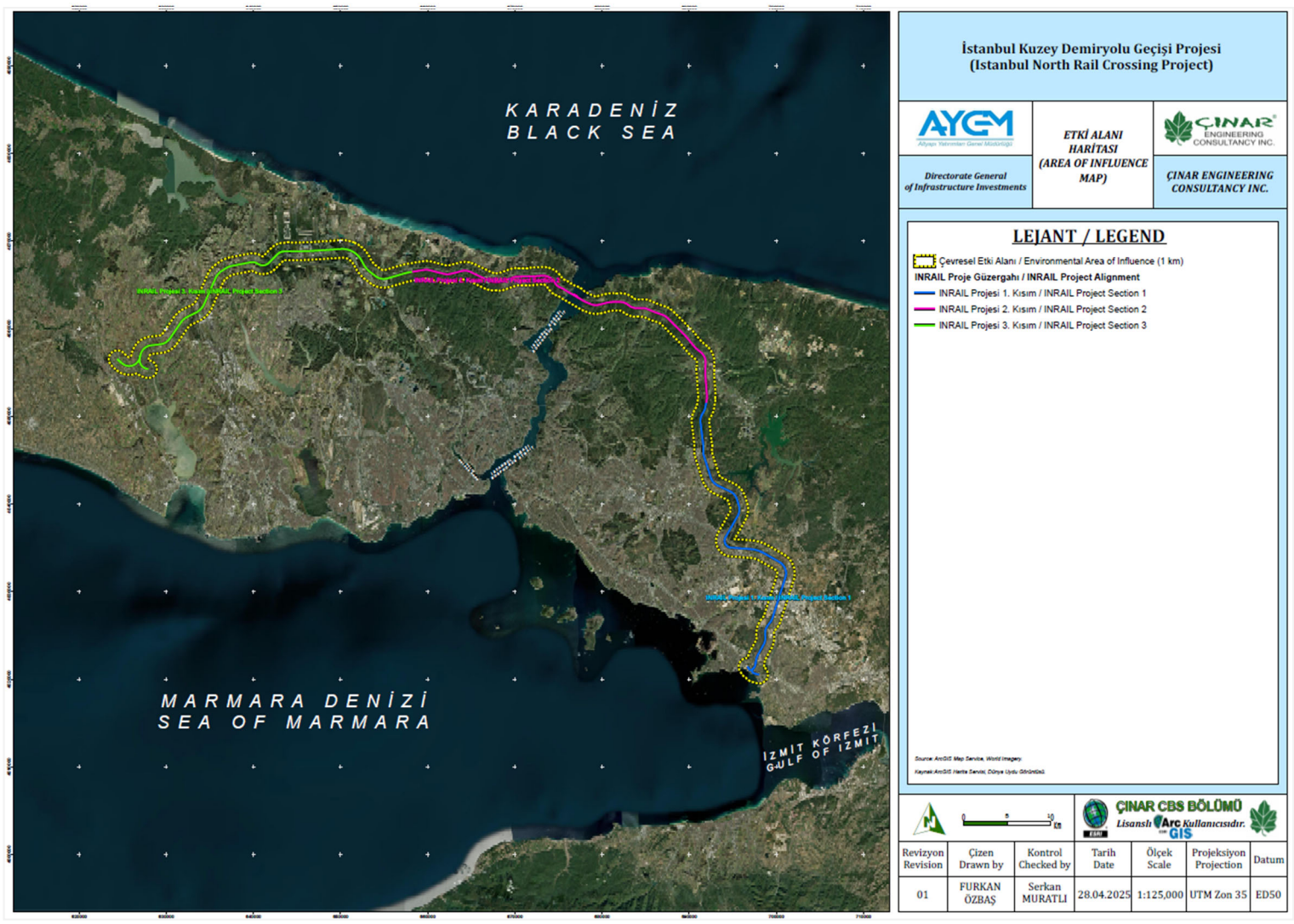


Figure 4-1 Project's Area of Influence Map

4.2 Baseline Environmental Conditions

4.2.1 Meteorological and Climatic Conditions

This section evaluates the climatic profile of İstanbul and Kocaeli based on long-term meteorological data from 1950 to 2024. Key indicators such as monthly average temperature, maximum and minimum temperatures, precipitation levels, number of rainy days, and sunshine duration are analyzed to establish the current climate conditions. These parameters form the basis for understanding INRAIL Project location overall climate regime and serve as a baseline for monitoring climate change impacts and supporting environmental assessments. This data-driven analysis provides insight into seasonal variations, vulnerability to extreme weather events, and overall climatic trends observed in the region.

İstanbul is located in a transitional climatic zone where both Mediterranean and Black Sea climate characteristics are observed. Due to its geographic location and topographical variations, the city exhibits significant microclimatic differences, particularly between coastal areas and inland regions. Long-term meteorological conditions are given with Table 4-1.

Table 4-1 Long-Term Meteorological Data for İstanbul (1950–2024)[1]

Month	Avg. Temp (°C)	Avg. Max Temp (°C)	Avg. Min Temp (°C)	Avg. Precip. (mm)	Rainy Days (days)	Sunshine Duration (hrs)
January	5,5	9,0	2,2	99,0	13,2	2,4
February	6,0	9,7	2,7	78,6	11,4	3,3
March	7,8	12,0	4,2	68,2	10,8	4,4
April	12,0	16,4	8,0	44,9	9,3	6,4
May	16,8	21,7	12,6	41,7	8,4	8,5
June	21,5	26,7	17,5	36,3	5,5	10,5
July	24,4	29,4	20,6	34,7	3,2	11,0
August	24,5	29,6	20,7	48,0	3,8	10,5
September	21,1	26,2	17,2	61,0	6,4	8,3
October	16,5	21,2	12,7	97,1	9,5	5,8
November	12,0	15,8	8,7	95,0	11,2	3,5
December	8,2	11,5	5,1	109,4	13,0	2,2
Annual Avg.	**15,0**	**19,7**	**11,1**	**813,9**	**115,0**	**6,1**

The annual average temperature in İstanbul is approximately 15 °C. The warmest months are July and August, with average temperatures reaching 24.4–24.5 °C. January is the coldest month, with an average temperature of around 5.5 °C. Average maximum temperatures peak at around 29–30 °C in the summer, while average minimums drop to 2–3 °C in the winter. Frost and occasional snowfall can occur, especially in elevated inland districts.

The annual average precipitation is approximately 814 mm. The wettest months are December (109.4 mm) and January (99.0 mm), while the driest period is observed during the summer, particularly in July and August (around 35–48 mm). This distribution indicates seasonal irregularities in rainfall. İstanbul experiences an average of 115 rainy days per year, with most occurring in the winter months. During the summer, the number of rainy days drops significantly, averaging fewer than four days per month.

Sunshine duration reaches its peak in July (11.0 hr/day) and drops to as low as 2–3 hr/day in winter.

As a result, according to the Köppen–Geiger climate classification, İstanbul is generally classified as Csa (Mediterranean climate with hot, dry summers) in some inland and southern parts, and Cfa (humid subtropical climate) or Cfb (temperate oceanic climate) in coastal and northern districts.

This reflects the city's climatic diversity, influenced by its complex topography, land–sea interactions, and urban microclimates.

[1] *https://www.mgm.gov.tr/veridegerlendirme/il-ve-ilceler-istatistik.aspx?k=A&m=ISTANBUL*

Kocaeli, located in the northwestern part of Türkiye, is influenced by both the Black Sea and Mediterranean climates, and exhibits transitional climate characteristics due to its unique topography and coastal proximity. The province is characterized by warm summers, mild winters, and relatively high annual precipitation. Long-term meteorological conditions are given with Table 4-2.

Table 4-2 Long-Term Meteorological Data for Kocaeli (1929–2024)

Month	Avg. Temp (°C)	Avg. Max Temp (°C)	Avg. Min Temp (°C)	Avg. Precip. (mm)	Rainy Days (days)	Sunshine Duration (hrs)
January	6.2	9.8	3.3	93.0	16.95	2.5
February	6.7	10.7	3.5	76.0	14.83	3.0
March	8.6	13.3	4.9	71.5	13.99	4.0
April	13.0	18.6	8.5	51.3	11.22	5.8
May	17.6	23.3	12.8	48.4	9.80	7.3
June	21.7	27.5	16.6	55.5	8.28	8.9
July	23.9	29.6	19.0	44.9	5.77	9.5
August	24.0	29.8	19.3	42.8	5.02	9.0
September	20.5	26.2	16.1	58.6	7.27	7.1
October	16.2	21.1	12.5	85.0	11.40	4.7
November	12.2	16.5	8.8	79.1	12.38	3.6
December	8.5	12.0	5.5	107.9	16.24	2.6
Annual	**14.9**	**19.9**	**10.9**	**814.0**	**133.2**	**5.7**

The annual average temperature in Kocaeli is 14.9 °C. July and August are the warmest months, with averages of around 24 °C. The coldest month is January with an average of 6.2 °C, indicating a relatively mild winter typical of a temperate climate zone. The highest recorded temperature was 44.1 °C in July, while the lowest was -18.0 °C in February. These values show that Kocaeli occasionally experiences extreme weather events, especially during continental air mass intrusions in winter and heatwaves in summer.

Kocaeli receives an annual average of 814 mm of precipitation, closely aligned with national averages. The wettest months are December (107.9 mm) and January (93.0 mm), while the driest period occurs in summer—particularly in July and August with precipitation below 45 mm. This pattern reflects a clear seasonal rainfall regime, with winter peaks and summer minimums. The province records approximately 133 rainy days per year. The months with the highest number of rainy days are December and January, with over 16 days on average, while the driest periods are again in the summer months (fewer than 6 rainy days).

Sunshine duration varies considerably throughout the year, from a low of 2.5 hr/day in January to nearly 9.5 hr/day in July.

As a result, according to the Köppen–Geiger climate classification, Kocaeli generally falls within or near the Cfa (humid subtropical climate with hot summers) or Cfb (temperate oceanic climate) categories. This classification reflects the region's relatively mild winters, warm and humid summers, and the absence of a distinct dry season.

4.2.2 Land Use and Soil

4.2.2.1 Land Cover Characteristics

Land use and land cover characteristics within the project area have been assessed using the CORINE Land Cover 2020 dataset, developed under the Coordination of Information on the Environment (CORINE) Programme led by the European Environment Agency. This dataset provides standardized land cover and land use information across Europe, generated through satellite imagery and computer-assisted visual interpretation methods. The CORINE system enables consistent tracking of environmental changes, supports rational management of natural resources, and contributes to the development of data-driven environmental policies. CORINE land cover maps of Project's AoI are provided in Appendix-2.4.

The land use analysis indicates that forests and semi-natural areas represent the largest share of the surveyed area (37.66%), followed by artificial surfaces (31.27%) and agricultural areas

(29.54%), which occur in relatively comparable proportions. Water bodies constitute only 1.53% of the total area.

This distribution reflects that the Project corridor traverses a mosaic of natural habitats and areas subject to significant human influence. Consequently, both natural ecosystems and modified land uses (settlements, infrastructure, and agricultural lands) will require careful consideration in the planning and implementation of mitigation measures. The relatively high proportion of artificial surfaces and agricultural areas also suggests that some sections of the alignment may offer opportunities to minimize impacts on high-value natural habitats by optimizing the alignment or construction methods. Detailed CORINE Land Cover data within the AoI is presented in Appendix 2.4 and summary of the results of the analyses according to construction sections are presented in Figure 4-2.

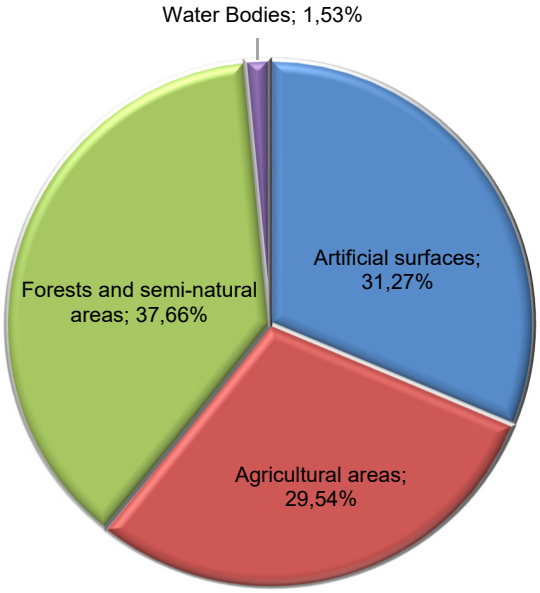


Figure 4-2 CORINE Land Cover Data within the Project's AoI [2]

4.2.2.2 Major Soil Groups

Major soil groups corresponding to the study corridor have been described based on the land asset data of the former Abolished Ministry of Food, Agriculture and Livestock for İstanbul and Kocaeli provinces. Maps of the main soil groups, including their areas, are presented in Appendix 2.5, also the summary of the results of the analyses done in this scope are provided in Figure 4-3.

4.2.2.3 Erosion

Erosion level assessment corresponding to the study corridor have been described based on the land asset data of the former Abolished Ministry of Food, Agriculture and Livestock for İstanbul and Kocaeli provinces. Erosion level maps including their risks are presented in Appendix-2.6. The results of the analyses done in this scope are provided in Figure 4-4.

---

[2] ***Artificial surfaces*** *include continuous and discontinuous urban fabric, industrial or commercial units, road and rail networks, airports, mineral extraction sites, dump sites, construction sites, and sport and leisure facilities.*
Agricultural areas *include non-irrigated arable land, permanently irrigated land, pastures, complex cultivation patterns, and land principally occupied by agriculture with significant areas of natural vegetation.*
Forests and semi-natural areas *include broad-leaved forest, coniferous forest, mixed forest, natural grassland, and transitional woodland shrub.*
Water bodies *include water courses, standing water bodies, and marine waters – sea and ocean.*

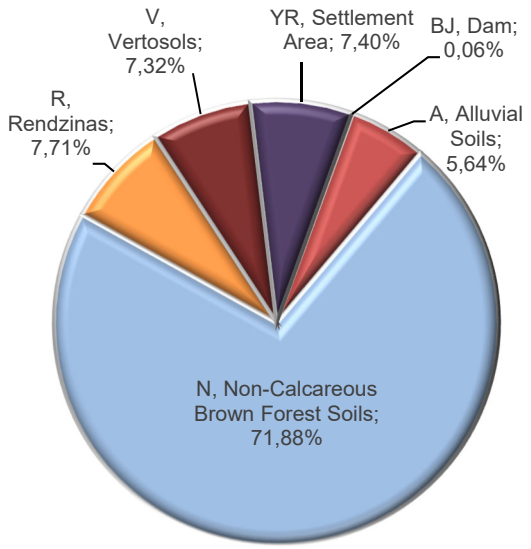


Figure 4-3 Major Soil Groups Data within the Project's AoI

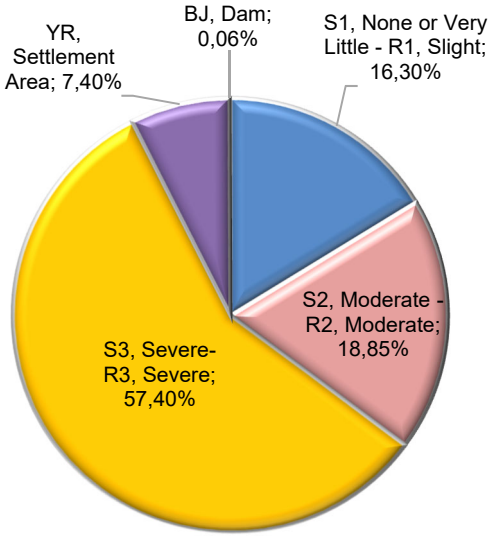


Figure 4-4 Erosion Levels Data within the Project's AoI

4.2.3 Landscape and Visuals

This section presents the existing landscape character and visual quality of the areas along the proposed INRAIL Project alignment. The assessment considers topography, land use, vegetation cover, landscape features, and scenic value, as well as the visual sensitivity of nearby receptors such as residents, road users, and recreational areas. The baseline understanding of the landscape and visual context forms the basis for identifying and evaluating potential visual impacts during construction and operation phases of the Project.

The Project corridor traverses a variety of landscape units, including agricultural lands, forested areas, semi-urban zones, and industrial areas. The visual impact potential of the Project varies depending on the elevation, line-of-sight availability, and the presence of sensitive visual receptors.

Methodology for Landscape and Visual Sensitivity Assessment

The assessment of landscape and visual characteristics along the INRAIL Project corridor is based on a combination of desktop analysis, site visits, and interpretation of topographical and land use data. The evaluation framework considers the following four key components:

Landscape Type

This refers to the predominant physical and visual characteristics of the area, including natural or human-modified features. The landscape is classified based on land use (e.g. agricultural, forested, industrial), terrain (e.g. flat, undulating, hilly), and vegetation cover.

Visibility

Visibility assesses the extent to which the Project components would be visible from a given location. This is influenced by line of sight, elevation differences, vegetation, buildings, and other obstructions. Visibility is categorized as:

- High: The project area is clearly visible with little or no obstruction.
- Medium: Partial visibility due to intermittent screening by vegetation or terrain.
- Low: The project is largely screened and not easily visible.

Landscape Value

This criterion reflects the aesthetic, cultural, and ecological importance of the landscape. It is determined based on visual quality, presence of protected or scenic areas, land use integrity, and the extent of human modification. Categories include:

- High: Landscapes with natural beauty, cultural or ecological value (e.g. protected forests, heritage zones).
- Medium: Ordinary rural or semi-natural areas with moderate visual interest.
- Low: Visually degraded or heavily industrialized environments.

Visual Sensitivity

Visual sensitivity is derived by integrating the three criteria above and considering the nature of the visual receptors (e.g. residents, travelers, recreational users). Areas with higher visibility, higher landscape value, and receptors with greater susceptibility to visual change are assigned higher sensitivity levels:

- High Sensitivity: Residential areas, recreational sites, or protected landscapes with high visibility.
- Medium Sensitivity: Agricultural or mixed-use areas with moderate visibility and landscape value.
- Low Sensitivity: Industrial zones or infrastructure corridors with limited visibility and low landscape value.

This structured methodology ensures a consistent and transparent approach in identifying visual impact risks along the Project route. The resulting sensitivity ratings are used to inform the landscape impact assessment and guide the development of mitigation measures.

A visual classification was conducted to evaluate visibility, landscape value, and overall visual sensitivity along the Project corridor. According to the analysis, approximately 45% of the alignment passes through tunnels, thereby having no visual exposure. Among surface areas, zones with medium visual sensitivity are most common (35%), followed by areas with low (8.7%) and high (6.7%) sensitivity. Notably, while 28% of the corridor has high landscape value, much of it overlaps with low visibility areas, suggesting that the actual perceived visual impact remains limited. The combined assessment indicates a generally low to moderate visual impact potential across the route (See Figure 4-5).

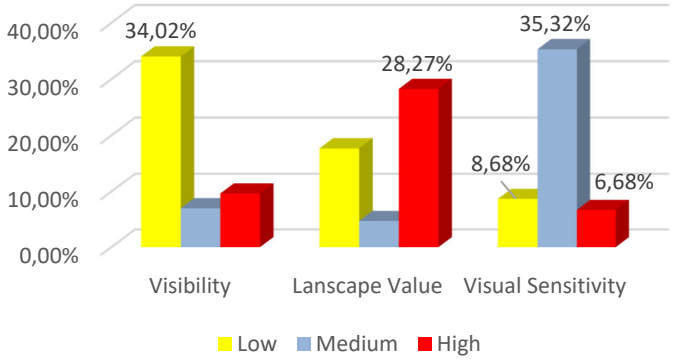


Figure 4-5 Summary of Visibility, Landscape Value and Visual Sensitivity of the Project Route

Among the remaining sections, medium sensitivity areas are the most prevalent, while areas with high sensitivity represent a small portion of the corridor. Notably, some high landscape value zones overlap with low visibility areas, further minimizing potential aesthetic impacts.

Detailed analysis results and graphical representation are provided in “Appendix 4 – Landscape and Visual Assessment”.

4.2.4 Geological and Hydrogeological Characteristics

4.2.4.1 Geology

The information provided in this section is based on a detailed literature review of the Project route and its vicinity, reports compiled by related authorities such as General Directorate of Mineral Research and Exploration (MTA), Department of Geological Surveys, G22, F20, F21, F22 Geology Sheets and Meriç-Ergene and Northern Marmara Basins Master Plan Report.

4.2.4.1.1 Regional Geology

In İstanbul and its surrounding regions, two major rock assemblages are exposed. These two assemblages, juxtaposed by tectonic activity, are referred to as the Istranca Unit for the metamorphic sequence, and the İstanbul Unit for the non-metamorphic sequence.

The Istranca Unit, which occupies wide areas between Tekirdağ and Edirne in the northern part of the Thrace Peninsula, includes schists, quartzites, and magmatic rocks, with a small portion extending into the İstanbul provincial boundaries. In the western and northern parts of the Çatalca district, units belonging to this metamorphic sequence, such as the Tekedere Group, Kızılağaç Metagranite, Şermat Quartzite, and Mahya Schist, are exposed.

The İstanbul Unit contains non-metamorphic Paleozoic and Mesozoic rock units that cover wide areas on both sides of the Bosphorus and in the Kocaeli Peninsula. Terrestrial deposits representing fluvial and lagoon environments of Lower Ordovician age (Kocatöngel Formation and Kurtköy Formation) constitute the oldest surface exposures of the İstanbul Unit within the metropolitan area and its vicinity.

During the Early Ordovician, the region, which was above sea level, experienced a transgression represented by the quartzites of the Ordovician-aged Aydos Formation, followed by increasingly deeper and tectonically stable marine conditions during the Silurian–Devonian periods. During this period, from older to younger, the Yayalar Formation (Lower Ordovician) with siltstone-sandstone, the Pelitli Formation (Lower Ordovician–Silurian) reflecting shelf-type carbonate deposition, the Kartal Formation (Lower–Middle Devonian) representing a low-energy open shelf environment with fossiliferous micaceous shales and occasional limestone, and the Denizli Köyü Formation (Upper Devonian–Lower Carboniferous) with nodular limestones indicating an open shelf-slope environment, were deposited. Within the Denizli Köyü Formation, the silicified sediments of the Baltalimanı Member, observed as guide horizons at the uppermost parts, suggest volcanic activity near the marine basin, supplying intense silica during the Early Carboniferous.

In the Early Carboniferous, turbiditic currents developed under unstable conditions, represented by the flysch-type sandstone-shale alternations of the Trakya Formation. Due to tectonic activities effective during the Carboniferous–Permian interval, magmatic intrusions developed, represented by the Sancaktepe Granite (Permian), and the area returned to continental conditions. Accordingly, terrestrial deposits of Permian(?)–Early Triassic age (Kapaklı Formation) were deposited. During the Middle–Late Triassic, the region was once again covered by a transgressive sea with intertidal deposits (Demirciler Formation), shelf carbonates (Ballıkaya Formation), and slope deposits (Tepeköy Formation and Bakırlıkıran Formation). No rock units formed during the Jurassic–Early Cretaceous interval have been encountered in the region. The Late Cretaceous is represented by the volcaniclastic-terrigenous sequences composed of andesitic volcanics and flysch-type clastics of the Sarıyer and Yemişliçay Formations. The Upper Cretaceous-aged Çavuşbaşı Granodiorite is considered a plutonic rock related to island arc volcanism during the closure of the Tethys Ocean.

During the Eocene, compressional movements that affected much of Anatolia also impacted the Marmara Basin, including the İstanbul region, leading to intense folding and faulting. It is considered that the Sarıyer-Şile Fault, which traverses the region in an approximately east-west

direction and caused the Paleozoic and Mesozoic rock units to overthrust the Upper Cretaceous–Early Eocene sequences, developed as a result of these movements. The olistostromes observed within the shales of the Lower–Middle Eocene Şile Formation in the Şile region are understood to have developed under unstable environmental conditions created by these tectonic activities.

In the Middle Eocene (Lutetian), the region experienced a new transgression, and during the Middle Eocene–Early Oligocene, the coastal areas of Çatalca and Şile were covered by a sea where beach and reef deposits accumulated. During the Middle–Late Oligocene, due to tectonic movements affecting the entire Thrace Basin, the region rose again, entering a continental phase that has continued to the present. During this period, fluvial deposits (Kıraç Formation and Çukurçeşme Formation) and lagoon-lake deposits (Danişmen Formation and Çekmece Formation), representing the Late Oligocene–Late Miocene interval, developed. The compressional movements oriented roughly north-south caused the development of northwest-southeast and northeast-southwest trending shear fault and joint systems. These shear fractures formed zones of weakness that controlled the morphological development of the Bosphorus and Dardanelles straits, the major river valleys in the region, and the Golden Horn, resulting in zigzag geometries consistent with these orientations. Although these shear faults, which have left clear morphological traces through their zones of weakness, may appear active today, no field evidence such as displacement or pressure ridges indicating current activity has been observed. On the contrary, these fault zones are at least partially covered by continental deposits of Upper Miocene–Pliocene age.

Along the project route, Pliocene-aged unseparated terrestrial clastic units, Ordovician-aged terrestrial clastics, Upper Senonian-aged clastic and carbonate units, Upper Eocene–Lower Oligocene-aged volcanic and sedimentary sequences and Quaternary-aged alluvial units are exposed. The general geological map of the project route and impact area is given in Appendix-2.7.

4.2.4.1.2 Geology of the Project Route and Impact Area

The geology of the project route and AoI has been evaluated within the scope of the project in three different sections, each approximately 40 to 42 kilometers in length. Detailed stratigraphic evaluations for each section are presented below under separate headings.

4.2.4.1.2.1 Geology of Project Route - Section 1

Section 1 (starting from Gebze (Çayırova), passing through Sabiha Gökçen Airport Station, and continuing up to Km 38+330; including the Çayırova connection) contains units ranging in age from Emsian–Eifelian to Quaternary, indicating the presence of Paleozoic, Mesozoic, and Cenozoic rocks within the area. The geological units present include Dk, NplQk, OSg, OSga, Oa, Ob, Oku, Okua, PgNomk, PgNomm, Qal, SDyd, SDyig, SDyik, and SDyis. These units consist of sandstone-shale-limestone from the Emsian–Eifelian, conglomerate-sandstone-mudstone from the Upper Pliocene–Lower Quaternary, shale-sandstone and feldspathic quartz sandstone from the Middle Ordovician–Lower Silurian, quartz sandstone-conglomerate, sandstone-shale, feldspathic sandstone-mudstone-conglomerate, conglomerate-sandstone from the Lower Ordovician, sandstone-conglomerate and shale-marl-siltstone-claystone-conglomerate-coal from the Upper Oligocene–Lower Miocene, Quaternary alluvium, reefal limestone-shale from the Wenlock–Ludlow, limestone-shale from the Pridoli–Lochkovian, nodular limestone-shale-siltstone from the Lochkovian–Pragian, and laminated limestone-shale from the Upper Ludlow–Pridoli. The site features a complex lithological diversity characterized by Devonian and Silurian limestones (Kartal, Dolayoba, Gebze, Kaynarca, Sedefadası), Ordovician–Silurian sandstone-shale sequences (Gözdağ, Aydınlı), Ordovician units (Kurtköy, Bakacak, Ayazma), Oligocene–Miocene deposits (Kayalıtepe, Meşetepe), and extensive Quaternary alluvial deposits. This diversity indicates the influence of both primary sedimentary and tectonic processes in shafping the stratigraphy of the area.

Stratigraphy

Stratigraphic information regarding the geological formations present in Section 1 is provided below, while the geological map of Section 1 is presented in Appendix-2.7.1.

Phanerozoic

Cenozoic

Quaternary

Alluvium (Qal)

Extensive alluvial deposits on the İstanbul Peninsula extend along the valleys north of Büyükçekmece Lake and Küçükçekmece Lake. Additionally, broad alluvial plains are observed at the downstream sections of Ayamama Stream and Çavuşbaşı Stream, as well as in the Çırpıcı Meadow. Furthermore, alluvial deposits have developed in the valleys of Alibey Stream, Kağıthane Stream, Kemerburgaz, and Boğluca.

The alluvium, generally composed of interbedded and transitional layers of unconsolidated clay, silt, sand, and fine gravel, exhibits a thickness ranging from 5 m to 25 m. Borehole studies revealed 11 m of alluvium in Haramidere (Tozak, 1982), and 6 m and 11.5 m of alluvium in Baltalimanı.

Between Üsküdar and Sarayburnu, Bosphorus deposits composed of silt, clay, sand, and gravel present thicknesses ranging from 5 m to 110 m (Şimşek, 1987). In the Golden Horn, sediment thicknesses locally reach 20 m, 22 m, 35 m, and 50 m (Ünsal, 1987; Haliç, 1988; Ulusu, 1988). In boreholes drilled at the Yarımburgaz marshland, north of Küçükçekmece, an alluvial sequence with a total thickness of 43 m was identified, comprising modern alluvium with a thickness of 3 m at the top, underlain by brownish-yellow sandy and silty clays, followed by black to dark grey, gravelly, organic-rich swamp clays, and gravel layers at the base reaching up to 5 m.

In the downstream section of Ayamama Stream, Meriç et al. (1991) examined a Holocene-aged sequence they named "Kuşdili", with maximum thicknesses of 23.80 m (including 20 m, 13 m, 6.2 m, and 1.3 m intervals) underlying modern alluvium. The basal parts of the unit consist of gravel, overlain by sands of varying thickness and lateral continuity, and grey to black clays and muds. Formed in a low-energy brackish lagoon-swamp environment, the sequence contains intensive gypsum formations at two distinct levels and includes foraminifera, ostracods, and mollusks. It has been suggested that the same sequence outcrops as a terrace at approximately 40 m elevation on the valley slopes and ridges of the Ayamama Stream, overlying the Bakırköy Formation (Fazlı S. Oktay, personal communication).

Neogene

Upper Pliocene-Lower Quaternary

Karapürçek Formation (NpIQk)

The Karapürçek Formation is dated to the Late Pliocene–Early Quaternary (Emre et al., 1998; Gedik et al., 2005b) and is represented by fluvial and alluvial fan deposits consisting of poorly consolidated conglomerate, sandstone, siltstone, claystone, and mudstone. It comprises yellow, yellowish-brown, and red sandstones, gravelly sandstones, and conglomerates, along with greenish-grey siltstones, claystones, and mudstones, generally lacking visible stratification. The conglomerates are poorly sorted, with rounded to sub-rounded clasts, occurring as lenses within sandstones and mudstones (Gedik et al., 2005b). The formation exhibits a maximum thickness of approximately 30 m. It lies conformably, or with possible conformity, over the underlying Darıca Formation and unconformably on older units, while the top surface is marked by an erosional boundary, locally overlain by alluvial deposits. Outcropping around Tuzla and Darıca, the unit was deposited in fluvial and alluvial fan environments. The discovery of large and small mammalian

fauna within exposures in the region has enabled its age determination as Late Pliocene–Early Pleistocene (Emre et al., 1998; Gedik et al., 2005b).

Upper Oligocene-Lower Miocene

Kayalıtepe Formation (PgNomk)

The Kayalıtepe Formation is dated to the Late Oligocene–Early Miocene (Gedik et al., 2005a, b) and consists of white, light yellow, and locally reddish-pink colored, weathered zones displaying yellowish-red-brown hues, poorly consolidated, cross-bedded quartz sandstones, and conglomerates. The grains, composed of 80–90% quartz and quartzite, exhibit rounded, sub-rounded, and angular shapes with poor sorting characteristics. The unit locally contains claystone lenses and demonstrates good aquifer properties (Gedik et al., 2005a, b). The formation, with a maximum thickness of approximately 100 m, is transitional with the overlying and lateral Meşetepe Formation, while it rests unconformably over older units below. Lacking fossil findings, the unit is represented by fluvial deposits. Named after Kayalı Tepe, the formation crops out in the areas of Samandıra, Battal Gazi, Harmandere, Orhanlı, Göçbeyli, Cumaköy, and Gebze (Gedik et al., 2005a, b).

Meşetepe Formation (PgNomm)

The Meşetepe Formation is dated to the Late Oligocene–Early Miocene (Gedik et al., 2005a, b) and is predominantly composed of coal-bearing shale, marl, siltstone, and claystone, with lesser amounts of quartz sandstone and conglomerate. The dominant lithology consists of finely laminated, thinly bedded alternations of green-grey, greenish-grey, and dirty white shale-marl-siltstone-claystone, while white, reddish-brown, and locally reddish-pink, cross-bedded, poorly consolidated quartz sandstone and conglomerate lenses are also present. Upsection, sandstones become more dominant, with gravelly sandstones and conglomerates displaying poor sorting and rounded to sub-rounded clasts (Gedik et al., 2005a, b). The formation exhibits a maximum thickness of approximately 100 m, with notable lateral and vertical lithological variations. It is transitional with the underlying and lateral Kayalıtepe Formation and locally lies unconformably on older units, while it is unconformably overlain by younger units. Representing lacustrine, fluvial, and alluvial fan deposits, the age of the formation has been determined based on palynological analyses conducted on the coal-bearing layers (Gedik et al., 2005a, b).

Paleozoic

Devonian

Emsian-Eifelian

Kartal Formation (Dk)

The Kartal Formation is of Emsian–Eifelian age (Gedik et al., 2005a, b) and comprises, in its lower parts, greywackes and shales locally intercalated with limestone; in the middle, carbonate-rich greywackes and shales with interbedded limestone; and in the upper parts, shales with rare limestone interlayers. It is characterized by grey, greenish-grey, and dark grey-black, thin to medium-bedded sandstones (greywackes), laminated and fissile shales, and occasional clayey limestones. In the middle sections, laminated, bioclastic-turbiditic limestones and sandy limestone-shale alternations are observed. The formation has a thickness of approximately 750 m and transitions conformably from the underlying İstinye Formation to the overlying Büyükada Formation. Lithologies exhibit lateral and vertical gradation without significant lateral facies changes (Gedik et al., 2005a, b). Rich in fossils, the depositional environment of the formation is interpreted as a deep ramp (ramp-type shelf) setting (Önalan, 1988). Named after the Kartal district, the unit crops out in Göztepe, Bostancı, Samandıra, Orhangazi, Aydınlı, and Gebze areas.

Pridoli–Lochkovian

Gebze Member (SDyig)

The Gebze Member is of Pridoli (late Silurian)–early Lochkovian (early Gedinnian) age (Gedik et al., 2005a, b), comprising dark grey-black, thin to thick-bedded limestones with abundant sparite veins, alternating with dark grey-black limestones, calcareous and bituminous shales. It locally includes pink shale interlayers, with limestones representing carbonate mudstone and wackestone microfacies, displaying an upward increase in bed thickness. The upper levels contain lenticular contributions enriched with grainstones and reefal organisms (Gedik et al., 2005b). It has a thickness of approximately 150 m and transitions conformably from the underlying Sedefadası Member to the overlying Kaynarca Member. Named after Gebze, the member was deposited in lower ramp-type shelf depressions at the base, transitioning to the same ramp environment in the upper parts (Önalan, 1988; Gedik et al., 2005a, b).

Upper Ludlow–Pridoli

Sedefadası Member (SDyis)

The Sedefadası Member is of late Ludlow–Pridoli age (Gedik et al., 2005b) and consists of thin-laminated micritic limestones alternating with grey-pink, calcareous shales. The limestones are grey to dark grey, generally thin-laminated, occasionally thin-bedded, with shale-rich sections exhibiting parallel and rare cross-laminations (Gedik et al., 2005a, b). It has a maximum thickness of approximately 75 m and transitions conformably from the underlying Dolayoba Formation to the overlying Gebze Member. Although no fossil findings have been reported, its age has been determined based on its stratigraphic position (Paeckelmann, 1938; Haas, 1968; Kaya, 1973; Önalan, 1982, 1988). Named after Sedef Island, the member was deposited within intra-shelf basins (shallow ramp-type shelf depressions) and developed in these environments (Önalan, 1982, 1988; Gedik et al., 2005b).

Lochkovian–Pragian

Kaynarca Member (SDyik)

The Kaynarca Member is of Lochkovian–Pragian (Gedinnian–Siegenian) age (Gedik et al., 2005a, b) and comprises dark grey-black, nodular limestones, thin-bedded calcareous shales, siltstones, and shales. The lower parts display nodular limestone-calcareous shale alternations, while the upper parts show nodular limestone-siltstone-shale alternations, transitioning into siltstone and shale dominance towards the top, near the transition to the Kartal Formation. The limestones exhibit carbonate mudstone and wackestone microfacies (Gedik et al., 2005a, b). Its maximum thickness is approximately 75 m, transitioning conformably from the underlying Gebze Member to the overlying Kartal Formation. Rich in fossils, the member was deposited on the low-angle slopes of a ramp-type shelf and is named after Kaynarca, located east of Pendik (Önalan, 1988; Gedik et al., 2005a,b).

Wenlock–Ludlow

Dolayoba Formation (SDyd)

The Dolayoba Formation is of Wenlock–Ludlow age (Gedik et al., 2005b) and consists of light grey, yellowish-grey, pink, and locally light brown, thin to thick-bedded reefal limestones. The limestones are locally recrystallized and dolomitized, with yellow-beige, thin-bedded siliceous shale interlayers near the base. The formation is rich in fossils, including corals (Halysites, Favosites, Heliolites, Syringopora), brachiopods, orthoceras, crinoid stems, and conodonts (Gedik et al., 2005a,b). Lithologically, it is characterized by dolomitic, sparitic, peloidal-sparitic, biosparitic, recrystallized, sandy, and clayey limestones, with upper sections containing large nodular structures, limonitic wackestone, secondarily dolomitized packstone, and grainstone microfacies (Önalan, 1981, 1982). It has a thickness of approximately 100 m, transitioning conformably from the underlying Gözdağ Formation to the overlying İstinye Formation. Named after Dolayoba, located north of Pendik, the formation represents reef core, inter-reef, and fore-reef deposits (Önalan, 1981; Gedik et al., 2005b).

Silurian

Upper Llandovery

Aydınlı Member (OSga)

The Aydınlı Member is of late Llandovery age (Gedik et al., 2005a, b) and consists of beige-white and yellowish-brown, thin to medium-bedded feldspathic quartz sandstones. It contains a high proportion of plutonic rock fragments with minor shale and siderite contributions and locally includes lenticular conglomerate interlayers. The sandstones are fine to coarse-grained, angular to sub-angular, and are locally intruded by diorite dykes (Gedik et al., 2005a, b). The unit has a thickness of approximately 75 m and does not exhibit significant lateral variation. It transitions conformably from and laterally to the Gözdağ Formation below, and to the Dolayoba Formation above. Rich in fossils, the member has been interpreted as sand bar deposits formed between lagoon-shelf sediments and reef carbonates (Önalan, 1981; Gedik et al., 2005a, b). Named after Aydınlı village north of Tuzla district, the unit can be correlated with the iron-bearing quartz sandstones and quartzites at the base of the Küreihadit Formation in the Kocaeli Peninsula in terms of rock type and stratigraphic position.

Ordovician

Middle Ordovician–Lower Silurian

Gözdağ Formation (OSg)

The Gözdağ Formation is of Middle Ordovician–early Lower Silurian (Llandovery) age (Sayar & Schallreuter, 1989) and consists of alternating sandstone (greywacke) and shale. Thin-bedded to laminated siltstone-shale in greenish-grey, grey, and yellowish-brown weathered sections, and dark green to greenish-grey thin to medium-bedded sandstones are distinctive features. The upper levels include purple, brown, and grey siltstone-shale alternations with lenticular feldspathic quartz sandstones (subarkoses), these levels being designated as the “Aydınlı Member” (Önalan, 1981, 1982). The formation locally includes well-laminated structures and micaceous sandstone-shale alternations. Its thickness ranges from 200–500 m, transitioning conformably from the Aydos Formation below to the Dolayoba Formation above. Fossil-rich, the unit contains cephalopods, brachiopods, trilobites, corals, ostracods, graptolites, and orthoceras fossils (Penck, 1919; Yalçınlar, 1956). Deposited in a lagoon-shelf environment, the formation developed under nearshore, open marine conditions (Önalan, 1981; Sayar, 1984).

Lower Ordovician

Aydos Formation (Oa)

The Aydos Formation is of Early Ordovician age (Baykal, 1962/1963; Haas, 1968) and consists of quartz sandstones and quartz conglomerates. It comprises white, light grey, beige, and reddish-purple, thin to thick-bedded, silica-cemented quartz sandstones with interlayers of monomineralic quartz conglomerates. The lower parts include pinkish-purple quartz sandstones interbedded with siltstone-shale. Sedimentary structures such as large and small-scale cross-bedding, parallel lamination, ripple marks, desiccation cracks, and herringbone cross-bedding are distinctive. Paleocurrent analysis indicates sediment supply from granitic and metamorphic sources to the north-northeast (Önalan, 1981, 1982). Fossil content is limited, with only vertical vermes tubes (Monocraterion) and trilobite traces (Cruziana) present (Kaya, 1978; Önalan, 1981, 1982). The thickness varies between 10–100 m, transitioning conformably from the underlying Kurtköy Formation and passing upward into the Gözdağ Formation. The sedimentological and lithological characteristics indicate deposition in a coastal-marine environment.

Ayazma Member (Okua)

The Ayazma Member, of Early Ordovician age, is a subarkosic unit located at the top of the Kurtköy Formation (Kaya, 1978). It consists of purple and locally cream-colored, trough cross-

bedded subarkoses, quartz-rich feldspathic sandstones, fine quartz-pebble-bearing feldspathic sandstones, quartz sandstones, quartz conglomerates, and parallel-laminated shales. The subarkoses are medium-grained, well to moderately sorted, and the conglomerates are well-graded and medium-bedded. It reaches a thickness of up to 75 m, transitioning conformably and laterally from the Kurtköy Formation below and conformably overlain by the Aydos Formation. The fossil-free member is interpreted to have been deposited in a fluvial–coastal (marine) transitional environment based on its stratigraphic position and lithological characteristics (Önalan, 1981).

Kurtköy Formation (Oku)

The Kurtköy Formation is of Early Ordovician age (Baykal & Kaya, 1965; Haas, 1968; Önalan, 1981) and consists of purple sandstones, mudstones-shales, and conglomerates. It includes pale purple, greyish-purple, red, and rarely greenish-grey, medium to thick-bedded feldspathic sandstones, gravelly sandstones, sandy conglomerates, and conglomerates, with dark purple-burgundy laminated shale layers. The unit is well-cemented, with multi-component grains sourced from metamorphic, magmatic, and volcanic (spilite, andesite) rocks, showing angular to sub-rounded shapes. The upper parts transition into the Aydos Formation with subarkosic characteristics, designated as the “Ayazma Member” (Önalan, 1981). The formation transitions conformably from the underlying Bakacak Formation and conformably passes into the overlying Aydos Formation. Its thickness locally reaches up to 1000 m, with lateral and vertical lithological variations. Fossil-free, the unit was deposited in a fluvial-coastal environment sourced from granitic and metamorphic terranes in the northeast based on sedimentological and paleocurrent analyses (Önalan, 1981).

Bakacak Formation (Ob)

The Bakacak Formation is of Early Ordovician (Tremadocian) age (Dean et al., 1997; Gedik et al., 2002) and consists of green to greenish-grey, thin to medium-bedded sandstones alternating with purple laminated shales. The sandstones are highly resistant, displaying chevron splitting, with upward increases in grain size, bed thickness, and sandstone frequency. The formation transitions conformably from the Kocatöngel Formation below to the Kurtköy Formation above, with a thickness reaching up to 750 m. Fossil-free, the unit, based on its stratigraphic position and lithological features, shows a transition from marine deposition at the base to fluvial deposition at the top, suggesting a possible deltaic depositional environment (Gedik et al., 2002).

4.2.4.1.2.2 Geology of Project Route - Section 2

Section 2 (starting at Km 38+330, passing over the YSS Bridge, and ending approximately 12 kilometers before Istanbul Airport) includes geological units ranging from the Lower Ordovician to the Middle–Upper Miocene, illustrating a complex stratigraphy where Paleozoic basement rocks are overlain by Mesozoic and Neogene deposits. The units present in Section 2 are Ct, Ctb, Ctg, Ctk, KTa, Ks, Kyi, Kyr, Oku, PgNomk, PgNomm, Qal, Qp, TRba, TRbk, TRe, TRk, and Tmpb. These consist of Lower Carboniferous sandstone-shale-siltstone, polygenic conglomerate, siltstone-claystone-siliceous shale/greywacke, sandstone with thin interbedded limestone and shale, Upper Campanian–Selandian bioclastic limestone-shale, Upper Cretaceous lava-tuff-agglomerate-conglomerate-sandstone, Upper Santonian–Campanian turbiditic sandstone-shale-tuff-limestone and andesite-basalt-agglomerate-tuff, Lower Ordovician feldspathic sandstone-mudstone-conglomerate, Upper Oligocene–Lower Miocene sandstone-conglomerate and shale-marl-siltstone-claystone-conglomerate-coal, Quaternary alluvium and beach sands, Upper Triassic sandstone-shale, Lower Triassic limestone-calcareous shale-dolomitic limestone, sandy shale-quartzite and basaltic lava, and Middle–Upper Miocene clayey sand and gravel. The wide lithological diversity indicates that Section 2 is characterized by multi-facies structures developed under both continental and shallow marine environmental conditions.

Stratigraphy

Stratigraphic information regarding the geological formations present in Section 2 is provided below, while the geological map of Section 2 is presented in Appendix-2.7.2.

Phanerozoic

Cenozoic

Quaternary

Alluvium (Qal)

Extensive alluvial deposits on the İstanbul Peninsula extend along the valleys north of Büyükçekmece Lake and Küçükçekmece Lake. Additionally, broad alluvial plains are observed at the downstream sections of Ayamama Stream and Çavuşbaşı Stream, as well as in the Çırpıcı Meadow. Furthermore, alluvial deposits have developed in the valleys of Alibey Stream, Kağıthane Stream, Kemerburgaz, and Boğluca.

The alluvium, generally composed of interbedded and transitional layers of unconsolidated clay, silt, sand, and fine gravel, exhibits a thickness ranging from 5 m to 25 m. Borehole studies revealed 11 m of alluvium in Haramidere (Tozak, 1982), and 6 m and 11.5 m of alluvium in Baltalimanı.

Between Üsküdar and Sarayburnu, Bosphorus deposits composed of silt, clay, sand, and gravel present thicknesses ranging from 5 m to 110 m (Şimşek, 1987). In the Golden Horn, sediment thicknesses locally reach 20 m, 22 m, 35 m, and 50 m (Ünsal, 1987; Haliç, 1988; Ulusu, 1988). In boreholes drilled at the Yarımburgaz marshland, north of Küçükçekmece, an alluvial sequence with a total thickness of 43 m was identified, comprising modern alluvium with a thickness of 3 m at the top, underlain by brownish-yellow sandy and silty clays, followed by black to dark grey, gravelly, organic-rich swamp clays, and gravel layers at the base reaching up to 5 m.

In the downstream section of Ayamama Stream, Meriç et al. (1991) examined a Holocene-aged sequence they named "Kuşdili", with maximum thicknesses of 23.80 m (including 20 m, 13 m, 6.2 m, and 1.3 m intervals) underlying modern alluvium. The basal parts of the unit consist of gravel, overlain by sands of varying thickness and lateral continuity, and grey to black clays and muds. Formed in a low-energy brackish lagoon-swamp environment, the sequence contains intensive gypsum formations at two distinct levels and includes foraminifera, ostracods, and mollusks. It has been suggested that the same sequence outcrops as a terrace at approximately 40 m elevation on the valley slopes and ridges of the Ayamama Stream, overlying the Bakırköy Formation (Fazlı S. Oktay, personal communication).

Dune-Beach Sand (Qp)

The sands observed along the Black Sea coast are differentiated as dune sands in the inland parts of the coastal zone and as beach sands within the wave action zone.

Neogene

Upper Oligocene-Lower Miocene

Kayalıtepe Formation (PgNomk)

The Kayalıtepe Formation is dated to the Late Oligocene–Early Miocene (Gedik et al., 2005a, b) and consists of white, light yellow, and locally reddish-pink colored, weathered zones displaying yellowish-red-brown hues, poorly consolidated, cross-bedded quartz sandstones, and conglomerates. The grains, composed of 80–90% quartz and quartzite, exhibit rounded, sub-rounded, and angular shapes with poor sorting characteristics. The unit locally contains claystone lenses and demonstrates good aquifer properties (Gedik et al., 2005a, b). The formation, with a maximum thickness of approximately 100 m, is transitional with the overlying and lateral Meşetepe Formation, while it rests unconformably over older units below. Lacking fossil findings, the unit is represented by fluvial deposits. Named after Kayalı Tepe, the formation crops out in

the areas of Samandıra, Battal Gazi, Harmandere, Orhanlı, Göçbeyli, Cumaköy, and Gebze (Gedik et al., 2005a, b).

Meşetepe Formation (PgNomm)

The Meşetepe Formation is dated to the Late Oligocene–Early Miocene (Gedik et al., 2005a, b) and is predominantly composed of coal-bearing shale, marl, siltstone, and claystone, with lesser amounts of quartz sandstone and conglomerate. The dominant lithology consists of finely laminated, thinly bedded alternations of green-grey, greenish-grey, and dirty white shale-marl-siltstone-claystone, while white, reddish-brown, and locally reddish-pink, cross-bedded, poorly consolidated quartz sandstone and conglomerate lenses are also present. Upsection, sandstones become more dominant, with gravelly sandstones and conglomerates displaying poor sorting and rounded to sub-rounded clasts (Gedik et al., 2005a, b). The formation exhibits a maximum thickness of approximately 100 m, with notable lateral and vertical lithological variations. It is transitional with the underlying and lateral Kayalıtepe Formation and locally lies unconformably on older units, while it is unconformably overlain by younger units. Representing lacustrine, fluvial, and alluvial fan deposits, the age of the formation has been determined based on palynological analyses conducted on the coal-bearing layers (Gedik et al., 2005a, b).

Middle-Upper Miocene

Belgrat Formation (Tmpb)

The Belgrad Formation is dated to the latest Upper Miocene–Pliocene (Umut et al., 1984) and is composed of unconsolidated, poorly sorted red, brown, and brownish-yellow gravels and sands with a red clay-silt matrix. Locally, it includes greenish-grey bentonitic clays, low-calorific thin lignite bands, and silicified wood fragments, displaying trough cross-bedded structures. The formation has a wide distribution in the northern part of the İstanbul Peninsula between Karaburun–Kumköy–Kemerburgaz–Boğluca, while in other parts of the peninsula, it appears as thin, scattered patches on hills and ridges. Its thickness generally ranges between 15–25 m, reaching 5–75 m in certain areas. Boreholes in Kemerburgaz measured thicknesses of 21.5 m and 25 m. The formation lies discordantly, either angularly or non-angularly, on older units. The deposits initially accumulated under arid climatic conditions, partially in swamp or floodplain environments, and later as meandering and braided river deposits. The name of the formation was first used by Eroskay (1978).

Mesozoic

Upper Cretaceous

Sarıyer Formation (Ks)

The Sarıyer Formation is of Upper Cretaceous age (Abdüsselamoğlu, 1963; Kaya, 1971; Ternek, 1987) and consists of conglomerates and sandstones interbedded with andesitic lava, tuff, and agglomerate layers. It predominantly contains volcaniclastic turbiditic clastic sequences with lens-shaped channel-fill conglomerates. Locally within the formation, fossiliferous (Orbitoides-bearing) limestones, lavas, tuffs, and agglomerate lenses are observed, with the volcanic rocks within the unit being classified as the Şile Volcanics Member. The formation has extensive outcrops in the northern part of the Bosphorus between Kısırkaya, Gümüşdere, Uskumruköy, Zekeriyaköy, Rumelifeneri, and Garipçe (Pehlivan, 1990). Its thickness, including volcanic rocks, exceeds 1000 m. The unit is tectonically in contact with underlying Triassic and Carboniferous units, and is unconformably overlain by the Belgrad or Danişmen Formations. It is interpreted that the unit developed in a nearshore shallow marine environment with associated volcanic activity in a turbiditic facies (Baykal, 1963; Kaya, 1971; Ternek, 1987).

Upper Santonian-Campanian

Riva Formation (Kyr)

The Riva Formation is dated to the Late Santonian–Campanian (Ercan et al., 1998) and is a volcanic unit extensively distributed along the Black Sea coast, comprising basalt, andesite, dacite, rhyolite, trachyandesite, spilite, green-colored tuffs, and subordinate intercalations of sandstone and shale. The most common rocks within the formation are porphyritic, hyaloporphyritic, and partially pilotaxitic andesitic lavas, characterized by microcrystalline groundmass containing plagioclase, biotite, hornblende, augite, and minor opaque minerals (Yeniyol & Ercan, 1989/1990). Sanidine crystals are prominent in trachyandesites, while albite and augite are common in spilites, with serpentinization and carbonation observed. The formation is laterally and vertically transitional with the İshaklı Formation, and locally with the Akveren Formation. Its thickness can exceed 400 m. The volcanics are calc-alkaline in character, high in potassium, of sialic origin, and belong to the group of orogenic volcanics developed under a compressional tectonic regime (Yeniyol & Ercan, 1989/1990).

İshaklı Formation (Kyi)

The İshaklı Formation is of Late Santonian–Campanian age (Gedik et al., 2005a) and is characterized by interbedded volcanogenic sandstone and shale. It consists of brownish-grey, thin to medium-bedded volcanogenic sandstones, and green to greenish-grey, locally red thin-bedded shales, with occasional contributions of agglomerate, tuff, tuffite, and andesite. The unit displays turbiditic features with lens-shaped, poorly sorted conglomerates and, rarely, thin to medium-bedded grey limestones, exhibiting slump and load structures. The formation is tectonically in contact with underlying Paleozoic–Triassic units, transitions conformably onto the Teksen Formation east of Şile, and unconformably overlies Triassic units in other regions, while transitioning upward into the Akveren Formation. Its thickness exceeds 500 m. The formation, named after İshaklı Village, is widely exposed in the Kocaeli Peninsula and northern Thrace (Baykal, 1943; Abdüsselamoğlu, 1963a; Yurtsever, 1996).

Upper Campanian-Selandian

Akveren Formation (KTa)

The Akveren Formation is of Late Campanian–Selandian age (Gedik et al., 2005a,b) and is composed of bioclastic limestones interbedded with marl and shale. The unit includes pink, thin to medium-bedded calcarenites, purple sandstones, dirty yellow platy limestones, and intercalated volcanics. Its clastic and volcanic composition partially differentiates it from equivalent outcrops in the Kocaeli Peninsula. The formation transitions conformably from the underlying Riva Formation and is unconformably overlain by younger units. Its thickness generally ranges between 50–70 m. The depositional environment of the formation is interpreted as a deep shelf–slope setting. The unit, named after Akviran Village south of Ayancık district, is used within map sheets for defining similar Late Cretaceous (Maastrichtian) rock types (Ketin & Gümüş, 1962; Baykal, 1962/1963).

Upper Triassic

Bakırlıkıran Formation (Trba)

The Bakırlıkıran Formation is of Norian age (Dağer, 1978; Yurtsever, 1982) and consists of grey and yellowish-grey, thin to medium-bedded quartz sandstones alternating with greenish-grey, thin-bedded to laminated shales. The sandstones display grading and local cross-bedding and contain plant fragments in some sections. The formation, positioned at the top of the Permo-Triassic succession, is tectonically related to the underlying Ballıkaya Formation and the overlying Riva Formation and has an approximate thickness of 35 m (Kaya & Lys, 1979/1980; Yurtsever, 1982). It crops out around Zekeriyaköy–Uskumruköy in the northern Bosphorus region. The formation was deposited in a progressively shallowing shelf environment, displaying a monotonous appearance with its resistant sandstone-shale alternation.

Lower Triassic

Ballıkaya Limestone (TRbk)

The Ballıkaya Limestone is dated to the late Scythian–Ladinian (Dağer, 1978; Kaya, 1969, 1971) and is composed of grey, massive, dolomitic limestones. The unit is represented by limestone and calcareous shale-limestone alternations at the base and dolomites in the upper parts. The limestones are dark grey, aphanitic, thick-bedded, and massive, with oncolitic-oolitic levels in the lower sections. The shale-limestone alternation consists of olive greenish-grey and greyish-yellow weathered calcareous shales interbedded with dark grey aphanitic limestones. The upper dolomites are light grey, brittle, and locally display bedding traces, reaching a thickness of up to 150 m (Kaya, 1971; Kaya & Lys, 1980). The measured thickness in stratigraphic sections is around 235 m (Kaya, 1971; Kaya & Lys, 1980). The formation crops out with a NW-SE orientation east and west of the Bosphorus, south of Gümüşdere Village (Kaya, 1969, 1971). The abundant gastropods, oolitic structures, and the absence of terrestrial coarse material indicate deposition in a nearshore shallow marine environment.

Erikli Formation (TRe)

The Erikli Formation is Scythian in age (Kaya & Lys, 1980) and is composed of quartz-rich subgreywackes, locally conglomeratic subarkoses, feldspathic subgreywackes, and quartz-feldspathic greywackes (Yurtsever, 1982). The unit, with intercalated sandy shale layers, consists of white, well-sorted grains tightly cemented with silica and quartz overgrowth, displaying deformation and elongation within lithic grains. The lower contact is stratigraphically conformable, while the upper contact with the Ballıkaya Limestone is indistinct (Kaya, 1971; Kaya & Lys, 1980). The thickness is approximately 114–115 m (Kaya, 1971; Kaya & Lys, 1980). The formation was deposited within the epineritic zone, in a deep environment at the lower section and a shallow transgressive environment at the upper section (Kaya, 1971). It presents a typical section south of Çiftalan Village, west of the Bosphorus, with extensive outcrops south of Gümüşdere Village, and maintains continuity on both sides of the Bosphorus (Yurtsever, 1982).

Kocatarla Formation (TRk)

The Kocatarla Formation is Scythian in age (Kaya & Lys, 1980) and is composed predominantly of dark olive-grey, massive, occasionally vesicular, primarily weathered basaltic lavas and diabases (Kaya, 1971; Kaya & Lys, 1980). Petrographically, it exhibits an intersertal texture under the microscope, with zoned plagioclase with albite twinning and minor pyroxene within a very fine-grained matrix, with voids locally filled with calcite. The formation has been mapped only south of Gümüşdere Village and at Yumrukaya Hill south of Erikli Village (Kaya & Lys, 1980). It unconformably overlies the siliceous shale-greywacke member of the Gümüşdere Formation and conformably underlies the Erikli Sandstone. Its thickness ranges between 85–125 m (Kaya, 1971; Kaya & Lys, 1980). The albite diabases within the Kapaklı Formation in the northern Kocaeli Peninsula and east of the Bosphorus are considered equivalents of the Kocatarla Formation (Altınlı, 1968; Yurtsever, 1982; Özdemir et al., 1973).

Paleozoic

Carboniferous

Lower Carboniferous

Trakya Formation (Ct)

The Trakya Formation is of Lower Carboniferous age (Kaya, 1971; Okay, 1987) and comprises dirty yellow, yellowish-grey, and grey siliceous shales, micaceous sandstones, siltstones with limestone lenses, and shales with interbedded sandstones. Its lithology is characterized by thin-bedded, hard, plant-imprinted siliceous shales; medium to thick-bedded micaceous sandstones; and laminated, platy-splitting siltstone-shale alternations, occasionally containing calcareous levels (Yurtsever, 1992). The formation has widespread outcrops west of the Bosphorus, including Sarıyer, Zekeriyaköy, Arnavutköy, İkitelli, and Yenikapı. Its thickness ranges from 600–1700 m

(MTA ISKI Project, 1992), exceeding 1000 m locally (Kaya, 1971; Okay, 1987), and in some interpretations surpassing 2000 m (Kaya & Lys, 1980). This turbiditic unit was deposited in a neritic to bathyal environment, transgressive at the base and regressive at the top (Kaya, 1971). It is overlain discordantly by Cenozoic rock units towards the top and is locally intruded by dykes. The Trakya Formation, within its primary succession of sandstone-claystone-siltstone-shale alternations, locally contains polygenic conglomerate levels with gradational lower and upper contacts. The use of the name "Trakya Formation" as a stratigraphic unit was first introduced by Kaya (1971).

Küçükköy Sandstone Member (Ctk)

The Küçükköy Sandstone Member, forming a significant part of the Trakya Formation, consists of a shale-greywacke alternation and is named after Küçükköy, where its type section was defined (Kaya, 1971). The member typically crops out in the Küçükköy and Alibeyköy areas, and is widely exposed west of the Bosphorus in regions such as Bebek, Levent, Etiler, Mecidiyeköy, Şişli, Beşiktaş, Beyoğlu, Kasımpaşa, Alibeyköy, north of Ayazağa, Kemerburgaz, Bahçeköy, Eyüp, Gaziosmanpaşa, Habibler, Mahmutbey, and Arnavutköy. In areas where it cannot be distinctly identified, it is included within the Trakya Formation.

Gümüşdere Siliceous Shale-Greywacke Member (Ctg)

The Gümüşdere Siliceous Shale-Greywacke Member is part of the Trakya Formation and mainly comprises lydite, greywacke, and siliceous shale (Yurtsever, 1992). It presents bedded structures in dark grey, black, and greyish-yellow colors, with laminations, occasional plant remains, coal laminations, and thin radiolarian-bearing chert bands (Kaya, 1971). The polygenic conglomerate levels are composed of sand to very fine gravel-sized grains, while the greywackes are feldspathic and laminated. It shows a gradational contact with the underlying Cebeciköy Limestone Member and a sharp contact with the overlying Çamurluhan Shale Member, while being unconformably overlain by quartz sandstones of the Erikli Sandstone (Kaya & Lys, 1980). Its thickness is approximately 500 m (Kaya, 1971), with fossil plant remains from Cebeciköy indicating a Westphalian–Dinantian age, while plant fossils from the siliceous shales indicate an Upper Viséan age (Yalçınlar, 1954; Kaya, 1971). The member was deposited in a shallow marine environment in the south, transitioning to a deeper shelf environment in the north following erosion.

Balıklıhavuz Conglomerate Member (Ctb)

The Balıklıhavuz Conglomerate Member is a lens-shaped polygenic conglomerate unit within the Trakya Formation, composed of white, grey, yellow, and light brown gravels (Kaya, 1971; Pehlivan, 1990). The gravels range from 1.5–4 cm in size and consist of feldspar, quartz, and various rock fragments. Originating as a channel-fill deposit, it formed from the A division of a fluxoturbidite sequence (Pehlivan, 1990). The member crops out in locations such as Büyüktarla Dere southwest of Erikli Village, Karanlık Dere southwest of Gümüşdere Village, north of Mahmutbey, and the ridges of Kasımpaşa and Hasköy. Its thickness varies between 20–30 m and it is of Lower Carboniferous (mainly Viséan) age (Yurtsever, 1982; Özdemir et al., 1973).

Ordovician

Lower Ordovician

Kurtköy Formation (Oku)

The Kurtköy Formation is of Early Ordovician age (Baykal & Kaya, 1965; Haas, 1968; Önalan, 1981) and consists of purple sandstones, mudstones-shales, and conglomerates. It includes pale purple, greyish-purple, red, and rarely greenish-grey, medium to thick-bedded feldspathic sandstones, gravelly sandstones, sandy conglomerates, and conglomerates, with dark purple-burgundy laminated shale layers. The unit is well-cemented, with multi-component grains sourced from metamorphic, magmatic, and volcanic (spilite, andesite) rocks, showing angular to sub-rounded shapes. The upper parts transition into the Aydos Formation with subarkosic

characteristics, designated as the “Ayazma Member” (Önalan, 1981). The formation transitions conformably from the underlying Bakacak Formation and conformably passes into the overlying Aydos Formation. Its thickness locally reaches up to 1000 m, with lateral and vertical lithological variations. Fossil-free, the unit was deposited in a fluvial-coastal environment sourced from granitic and metamorphic terranes in the northeast based on sedimentological and paleocurrent analyses (Önalan, 1981).

4.2.4.1.2.3 Geology of Project Route - Section 3

Section 3 (starting at Km 19+540, entering Istanbul Airport Station at Km 31+420, and continuing to Km 28+242.92 at Çatalca Connection-1; including Çatalca Connection-2) comprises younger geological units ranging from the Quaternary to the Middle–Upper Eocene and Middle–Upper Miocene, reflecting the dominance of younger stratigraphic units within the project area. The units present include Qal, Teoi, and Tmpb. The Qal unit is Quaternary alluvium composed of gravel, sand, and clay; the Teoi unit is Middle–Upper Eocene and consists of tuff interbedded clayey and sandy limestone, marl, claystone, and sandstone; while the Tmpb unit is Middle–Upper Miocene and consists of clayey sand and gravel. The presence of these units indicates that Section 3 is predominantly characterized by Neogene and Quaternary-aged continental and transitional environment deposits.

Stratigraphy

Stratigraphic information regarding the geological formations present in Section 3 is provided below, while the geological map of Section 3 is presented in Appendix 2.7.3.

Phanerozoic

Cenozoic

Quaternary

Alluvium (Qal)

Extensive alluvial deposits on the İstanbul Peninsula extend along the valleys north of Büyükçekmece Lake and Küçükçekmece Lake. Additionally, broad alluvial plains are observed at the downstream sections of Ayamama Stream and Çavuşbaşı Stream, as well as in the Çırpıcı Meadow. Furthermore, alluvial deposits have developed in the valleys of Alibey Stream, Kağıthane Stream, Kemerburgaz, and Boğluca.

The alluvium, generally composed of interbedded and transitional layers of unconsolidated clay, silt, sand, and fine gravel, exhibits a thickness ranging from 5 m to 25 m. Borehole studies revealed 11 m of alluvium in Haramidere (Tozak, 1982), and 6 m and 11.5 m of alluvium in Baltalimanı.

Between Üsküdar and Sarayburnu, Bosphorus deposits composed of silt, clay, sand, and gravel present thicknesses ranging from 5 m to 110 m (Şimşek, 1987). In the Golden Horn, sediment thicknesses locally reach 20 m, 22 m, 35 m, and 50 m (Ünsal, 1987; Haliç, 1988; Ulusu, 1988). In boreholes drilled at the Yarımburgaz marshland, north of Küçükçekmece, an alluvial sequence with a total thickness of 43 m was identified, comprising modern alluvium with a thickness of 3 m at the top, underlain by brownish-yellow sandy and silty clays, followed by black to dark grey, gravelly, organic-rich swamp clays, and gravel layers at the base reaching up to 5 m.

In the downstream section of Ayamama Stream, Meriç et al. (1991) examined a Holocene-aged sequence they named "Kuşdili", with maximum thicknesses of 23.80 m (including 20 m, 13 m, 6.2 m, and 1.3 m intervals) underlying modern alluvium. The basal parts of the unit consist of gravel, overlain by sands of varying thickness and lateral continuity, and grey to black clays and muds. Formed in a low-energy brackish lagoon-swamp environment, the sequence contains intensive gypsum formations at two distinct levels and includes foraminifera, ostracods, and mollusks. It has been suggested that the same sequence outcrops as a terrace at approximately 40 m

elevation on the valley slopes and ridges of the Ayamama Stream, overlying the Bakırköy Formation (Fazlı S. Oktay, personal communication).

Middle-Upper Miocene

Belgrat Formation (Tmpb)

The Belgrad Formation is dated to the latest Upper Miocene–Pliocene (Umut et al., 1984) and is composed of unconsolidated, poorly sorted red, brown, and brownish-yellow gravels and sands with a red clay-silt matrix. Locally, it includes greenish-grey bentonitic clays, low-calorific thin lignite bands, and silicified wood fragments, displaying trough cross-bedded structures. The formation has a wide distribution in the northern part of the İstanbul Peninsula between Karaburun–Kumköy–Kemerburgaz–Boğluca, while in other parts of the peninsula, it appears as thin, scattered patches on hills and ridges. Its thickness generally ranges between 15–25 m, reaching 5–75 m in certain areas. Boreholes in Kemerburgaz measured thicknesses of 21.5 m and 25 m. The formation lies discordantly, either angularly or non-angularly, on older units. The deposits initially accumulated under arid climatic conditions, partially in swamp or floodplain environments, and later as meandering and braided river deposits. The name of the formation was first used by Eroskay (1978).

Paleogene

Middle-Upper Eocene

İhsaniye Formation (Teoi)

The İhsaniye Formation spans from the Upper Eocene to the Middle Oligocene (Dizer, 1985; Yurtsever et al., 1993; Yurtsever, 1996; Çağlayan & Yurtsever, 1998). It exhibits lithologies of clayey limestone, marl, sandy limestone, and calcareous siltstone, including intercalations of carbonate-cemented sandstone and conglomerate, as well as local tuff levels. The unit, which appears in dirty white, light grey, beige, and yellowish-white colors, and with thin, medium, and thick bedding, contains tuff, echinoids, and shells of lamellibranchs and gastropods (Yurtsever et al., 1993; Yurtsever, 1996). It has extensive outcrops across the İstanbul Peninsula, around Lake Terkos, along the Karaburun coast, and between Lakes Büyükçekmece and Küçükçekmece. The measured thickness ranges between 100–200 m (Akartuna, 1953). The formation was deposited in a fore-reef depositional environment or in the deeper parts of a carbonate platform lacking reef development. Its upper levels are consistent with shallow and deep marine facies around Karaburun (Oktay et al., 1992) and correlate with fore-reef, basin, and channel facies within the Thrace Basin (Görür et al., 1981).

4.2.4.2 Tectonics

İstanbul and its surrounding region are located within a geologically complex tectonic setting. To the south, the northern branch of the North Anatolian Fault Zone (NAFZ) forms a 30–40 km wide deformation zone in the northern half of the Sea of Marmara, characterized by a series of basins opened by normal faults between NW–SE trending strike-slip faults. Some of these fault segments extend as far north as the southern parts of the İstanbul metropolitan area. To the north, along the Black Sea slope, there is a possible normal fault system that may represent a continuation of the Srednogorie Zone extending from Bulgaria, while to the northwest, the NW–SE trending Thrace (Istranca) Fault runs parallel to the Black Sea coast along the Istranca Mountains, reaching near Lake Terkos. This fault likely bifurcates east of Lake Terkos. Additionally, smaller-scale faults are present between these main fault zones, the most notable of which is the Büyükdere Fault. An east-west trending fault is located north of Mount Aydos, and a NW–SE trending linearity in the same area is identifiable on aerial photographs.

The İstanbul region and its surroundings bear deep imprints of numerous and diverse tectonic movements that were active during the Carboniferous–Neogene period. The structural elements developed due to these movements, such as folds, faults, and joints, have further complicated

the geological structure of the region. This section addresses the main faults identified during field studies. Particularly in areas where Paleozoic-aged rock units are exposed, numerous faults of varying sizes trending E–W, N–S, NE–SW, and NW–SE are notable. In the study area, in addition to faults directly observed in excavations and natural slopes or identified through linear features such as contacts and marker horizons noticeable even at map scale, there are also regionally extensive faults extending for kilometers.

The major rivers of İstanbul, including Alibey Stream, Kağıthane Stream, Riva Creek, and Ömerli Dam Lake and its tributaries, as well as the Bosphorus and the Golden Horn, exhibit zigzag geometries aligned in NE–SW and NW–SE directions. In particular, the sharp zigzag coastal morphology of the Bosphorus, developed parallel to these directions, is prominent. The valleys where Büyükçekmece and Küçükçekmece lakes are located, and the large ridge composed of metamorphic rocks in the Çatalca district, extend in a NW–SE direction. In the area between Büyükçekmece Lake and Küçükçekmece Lake, where the Eocene–Lower Oligocene aged Ceylan Formation is widespread, an intersecting drainage network with NE–SW and NW–SE trends is clearly observed. Vertical faults following valleys developed parallel to these trends within the Ceylan Formation are also noticeable. On the northeastern shore of Büyükçekmece Lake, such a fault is observed to affect the Oligocene-aged Danişmen Formation. It is known that during the Early Eocene and Middle–Late Oligocene, strong compressional movements were active in the Thrace Basin and the İstanbul region, including the Büyükçekmece Lake basin. The strike-slip fault that extends along the Black Sea coastal zone on both sides of İstanbul, previously known as the Şile Overthrust and later as the Şile-Sarıyer Fault, is a clear example of Early Eocene movements. The N–S oriented Oligocene movements in the İstanbul region led to the development of shear fractures aligned with the NE–SW and NW–SE directions. The weakness zones created by these fractures controlled the zigzag patterns of the Bosphorus, the Dardanelles, the Golden Horn, and the major river courses of İstanbul.

The North Anatolian Fault is located to the south of the project area, and the closest distances of Sections 1, 2, and 3 to this fault are 8.8 km, 39.7 km, and 28.5 km, respectively. The active fault map of the project area is presented in Appendix-2.13.

4.2.4.3 Natural Hazards

4.2.4.3.1 Landslide Risk

İstanbul Province exhibits a significant risk of mass movements, predominantly in the form of landslides, with limited occurrences of surface flow and rockfall events (AFAD, 2022). On the European side, landslide-prone areas are concentrated in the Çatalca plateau, the Büyükçekmece–Avcılar coastal belt, and the vicinities of Çantaköy–Değirmenköy and Silivri. Additionally, active movements are observed on the slopes of former mining pits and artificial fill slopes near the coast in Sarıyer and Eyüpsultan, necessitating caution in land use planning within these zones (AFAD, 2022).

The total landslide-affected area in İstanbul is approximately 45.3 km², with 36.7 km² located on the European side and 8.6 km² on the Asian side (AFAD, 2022). In the Asian districts of Tuzla, Pendik, Sultanbeyli, Sancaktepe, Çekmeköy, and Beykoz, localized landslide risk potentials are present due to lithological characteristics and slope conditions. On the European side, active and potential landslide zones are also present in Arnavutköy, Eyüpsultan, Sarıyer, and Çatalca districts along the railway alignment (AFAD, 2022).

The Project route and impact area were examined using the landslide inventory data from the MTA General Directorate of MTA Geosciences Map Viewer Portal [(3)].

As a result of the investigation, there is no mass movement such as areal flow, sliding, active or

[3] *Source: http://yerbilimleri.mta.gov.tr*

old landslide on the project route, while an old landslide polygon developed from west to east on the hilly area approximately 55 m south of the project route within the project impact area of Section-2 (See Appendix 2.11).

However, for the safety of the highway built in the past in the old landslide area passing through the skirts of the hilly area in question, the slopes in the area have been arranged and the slopes have been reinforced with wiremesh application against any rock fall, and in the current situation, when the topographical situation, slope and direction of movement of the old landslide polygon are examined, it does not pose a risk for the project route.

4.2.4.3.2 Flood and Inundation Risk

İstanbul is characterized by a high flood and inundation risk, exacerbated by rapid urbanization and deficiencies in drainage planning (AFAD, 2022). Flood incidents typically occur when the carrying capacities of drainage channels and stream beds are exceeded by sudden precipitation events, leading to uncontrolled surface runoff (AFAD, 2022).

In the Asian districts of Tuzla and Pendik, the river basins draining into the Marmara Sea increase flood risk, particularly during extreme precipitation events. On the European side, Arnavutköy, Eyüpsultan, Sarıyer, and Çatalca districts contain river basins prone to overflow, posing a risk to critical infrastructure along the railway corridor (AFAD, 2022).

Notably, the 2009 flood event along Ayamama Creek caused severe inundations affecting industrial zones and transportation corridors in Arnavutköy, Eyüpsultan, and surrounding districts. Similar severe rainfall events in 2017 and 2020 also resulted in widespread urban flooding in various districts of İstanbul (AFAD, 2022).

It is noted that no flood or inundation-prone zones are located within the boundaries of the project area along the railway alignment.

4.2.4.3.3 Avalanche

Due to the topographical and climatic characteristics of İstanbul, there is no avalanche risk within the province. The Provincial Disaster Risk Reduction Plans (İRAP) confirms that avalanche hazards are not present, and therefore, no additional consideration is required for avalanche risk in the districts along the railway project alignment (AFAD, 2022).

It is also confirmed that no avalanche risk is present within the boundaries of the project area along the railway alignment.

4.2.4.3.4 Seismicity

İstanbul is located along the NAFZ, which is the most significant active tectonic zone in Türkiye, and therefore is subject to a high seismic risk (AFAD, 2022). Historical records indicate that the province has experienced major destructive earthquakes, including those in 1509, 1766, and 1894. In particular, the northern branch of the North Anatolian Fault Line, passing through the Marmara Sea, constitutes the greatest earthquake threat for İstanbul (AFAD, 2022).

According to analyses conducted within the scope of İRAP, a potential major earthquake in İstanbul could result in loss of life, structural damage, disruption of infrastructure systems, and widespread socio-economic losses. For this reason, İstanbul has been classified by AFAD as a first-degree seismic zone, and strict adherence to seismic codes in building and infrastructure projects is mandatory (AFAD, 2022).

Due to its proximity to the NAFZ, earthquake risk varies across districts in İstanbul. The districts traversed by the project alignment—Tuzla, Pendik, Sultanbeyli, Sancaktepe, Çekmeköy, Beykoz, Sarıyer, Eyüpsultan, Arnavutköy, and Çatalca—are among the sensitive areas in terms of seismic risk (AFAD, 2022).

The closest distances to the North Anatolian Fault Line for Section 1, Section 2, and Section 3 of

the alignment are 8.8 km, 39.7 km, and 28.5 km, respectively.

The renewed "Türkiye Earthquake Hazard Map", published in the Official Gazette dated 18.03.2018 and numbered 30364 (duplicate) and entered into force as of 01.01.2019, is given in Figure 18 and the Project area is marked on (Figure 4-6).

The Project route was examined on the interactive earthquake hazard map published by Disaster and Emergency Management Authority (AFAD). In the investigation made, the maximum ground acceleration for the 475-Year Recurrence Period (PGA 475) was determined to be between 0.241 and 0.496 g along the route, and the maximum ground acceleration due to the earthquake decreases from south to north as it moves away from the Marmara Sea (Figure 4-7).

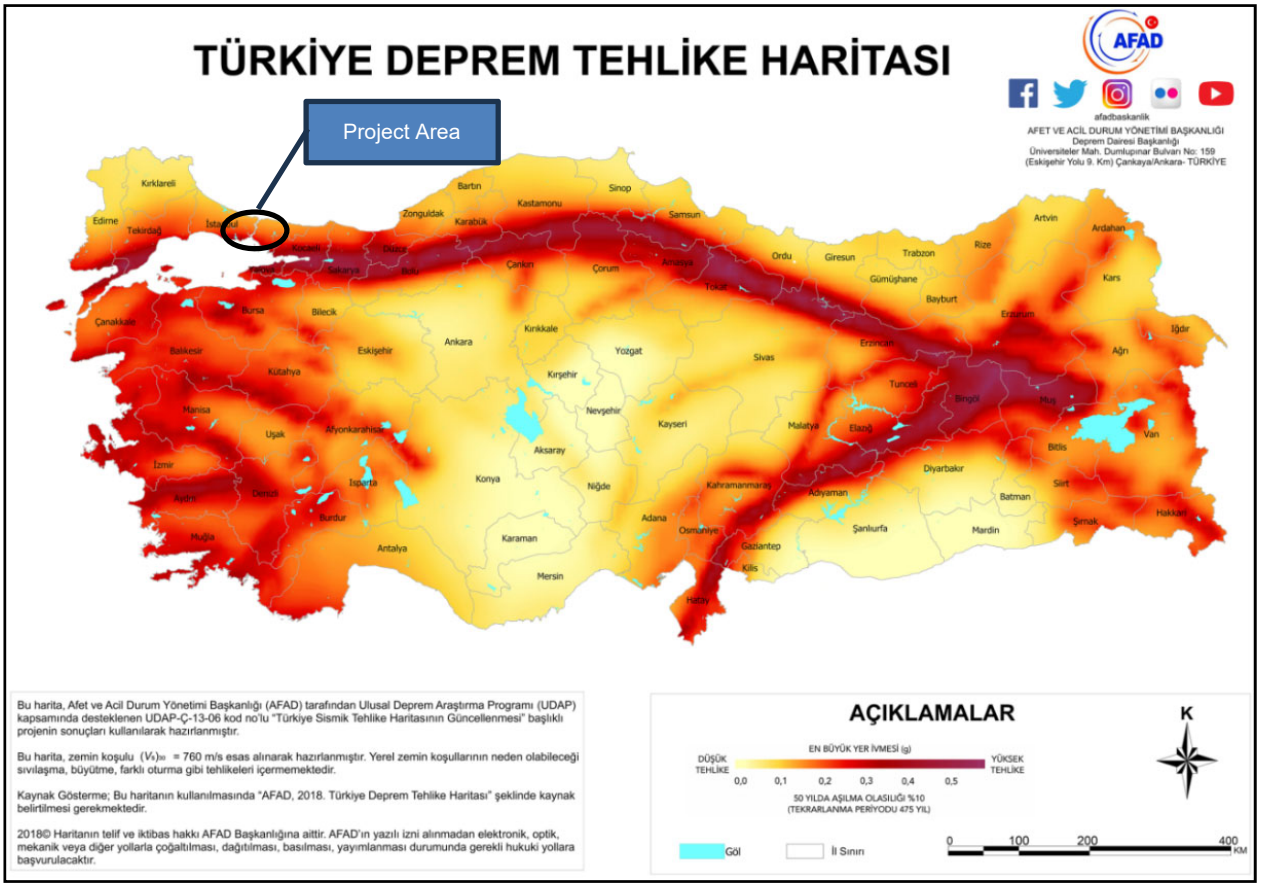


Figure 4-6 Earthquake Hazard Map of Türkiye with Project Area Marked

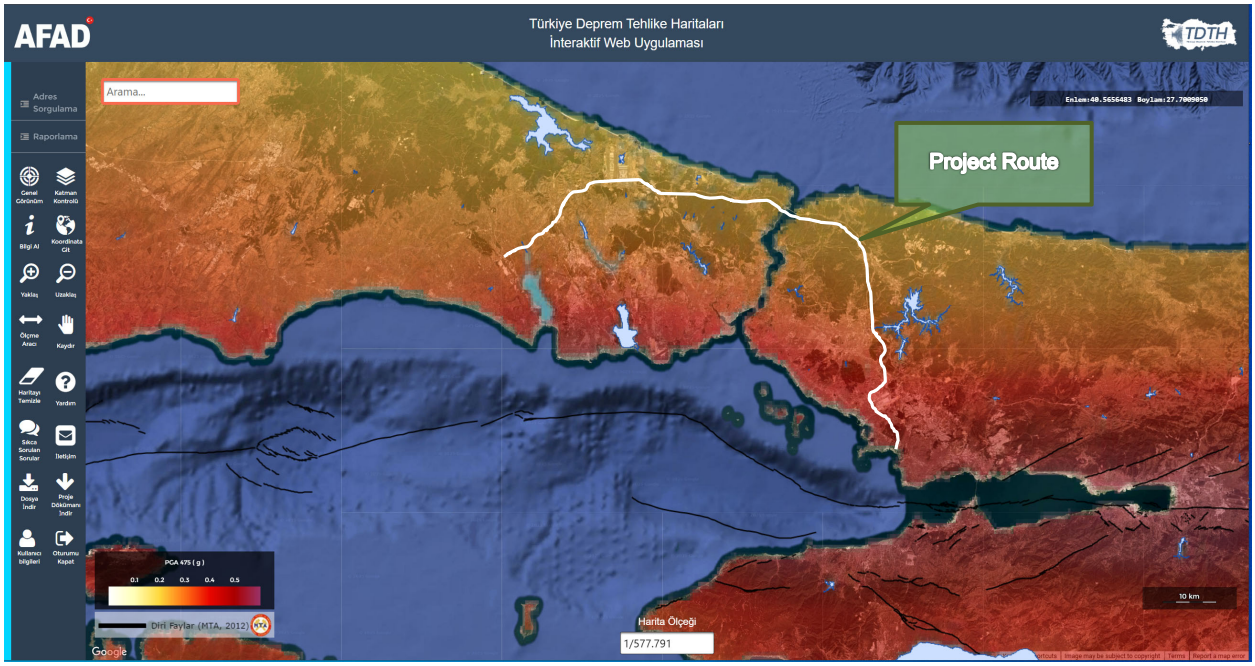


Figure 4-7 Project Route Peak Ground Acceleration (PGA 475)

Earthquakes with magnitudes M≥ 4.5 from 1900 to the present (2025) within a 100 km diameter, with the Project area being the center, are shown in Figure 4-8. The details of these earthquakes are provided in Figure 4-8.

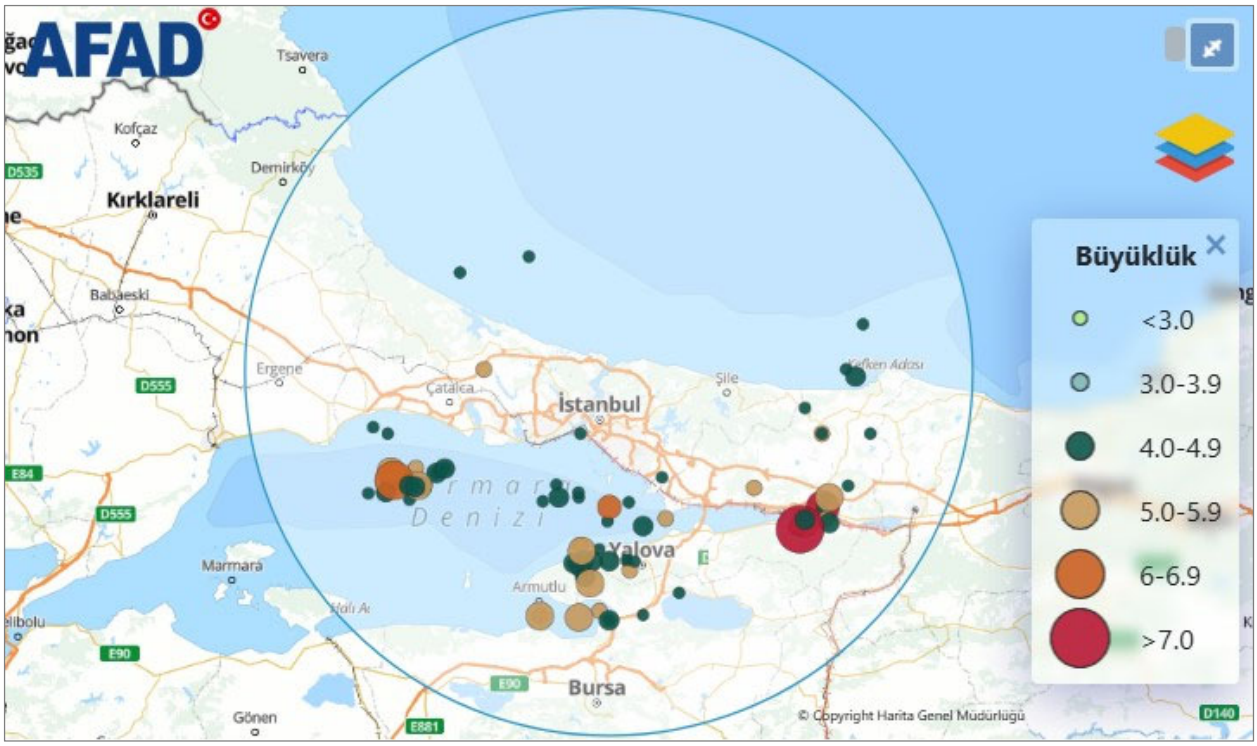


Figure 4-8 Magnitude of M≥4.5 Earthquakes within a 100 km radius of the Project Area

İstanbul is located along the NAFZ, which is the most significant active tectonic zone in Türkiye, and therefore is subject to a high seismic risk (AFAD, 2022).

Seismic Context and Historical Earthquakes within 100 km of the Project Area

The Project Area is situated along the NAFZ, Türkiye's most significant active tectonic structure,

which poses a high seismic risk (AFAD, 2022). Over the past 125 years, 52 earthquakes of magnitude M4.5 or greater have been recorded within a 100 km radius of the alignment, predominantly in the M4.5–5.9 range and at shallow depths (<20 km). While these earthquakes have been locally felt, destructive-scale events have been relatively infrequent.

Two significant events stand out:

- **17 August 1999 İzmit Earthquake (Mw 7.6):** Epicenter near Gölcük; 45 seconds duration; caused extensive casualties (17,480 fatalities, 23,781 injuries) and large-scale structural damage, with a tsunami of up to 2.5 m in the Sea of Marmara.
- **23 April 2025 Marmara Sea Earthquake (Mw 6.2):** Epicenter in the Sea of Marmara; depth 6.9 km; caused minor structural damage and widespread shaking, but no fatalities.

Magnitude distribution of historical events is as follows:

- **M4.5–4.9:** ~65% of events
- **M5.0–5.9:** ~27%
- **M6.0–6.9:** ~6%
- **M ≥ 7.0:** 1 event (2%)

The temporal distribution shows clustering during certain years (notably 1999, 1963, and 2025), indicating periods of heightened seismic activity.

This seismic history confirms that the Project is in a seismically active zone, requiring structural design in compliance with Turkish Seismic Code and international best practice, with special attention to shallow crustal earthquake loading scenarios.

The buildings to be built within the scope of the Project must be in accordance with the principles of the "Regulation on the Buildings to be Constructed in Disaster Areas" published in the Official Gazette dated 14/07/2007 and numbered 26582 of the Ministry of Public Works and Settlement, and the Disaster and Emergency Services published in the Official Gazette dated 18.03.2018 and numbered 30364 and entered into force on 01.01.2019. Also, the provisions of the "Turkish Building Earthquake Regulation" of the Situation Management Presidency must be strictly followed.

4.2.4.3.5 Geological Heritage Sites

The geological heritage areas in the region along the project route and impact area were examined using the geological heritage inventory published by the Geological Heritage Protection Association of Türkiye (Jemirko). Accordingly, there are no geological heritage areas in the region along the project route (See Figure 4-9).



Figure 4-9 Geological Heritage Sites at and Around Project Route

4.2.4.4 Hydrology

4.2.4.4.1 Regional Hydrology

The project route is located within the boundaries of the Meriç-Ergene and Marmara Basins, which are among the 25 major basins in Türkiye.

According to General Directorate of State Hydraulic Works (DSİ) 2023 Official Statistics, the Marmara Basin has a rainfall catchment area of 23,074.0 km². In the 2023 surface water potential assessments, the basin's average annual flow was recorded as 7.4 km³, contributing 4.1% to Türkiye's total surface water flow. Regarding groundwater potential in 2023, the basin's usable groundwater reserve was determined as 210.7 hm³/year, while the basin's groundwater recharge was 241.7 hm³/year.

The Marmara Basin is located in the northwest of Türkiye and, with an area of approximately 23,074.0 km², encompasses the provinces of Balıkesir, Bursa, Kütahya, Bilecik, and Çanakkale. The most prominent rivers in the basin are the Susurluk, Gönen, and Biga streams. The Susurluk River merges with tributaries such as Simav, Adırnaz, Emet, and Orhaneli, discharging into the Sea of Marmara near Karacabey while irrigating large agricultural areas along its course. The basin also contains natural lakes such as Ulubat and Kuş, as well as significant artificial reservoirs like Manyas and İkizcetepeler. These surface water resources are vital for agricultural activities, drinking water supply, and ecosystem services. However, since the 2000s, increasing urban, industrial, and agricultural activities have disrupted the hydrological balance of the basin, leading to visible deterioration in both the quality and quantity of water bodies.

Climatically, the Marmara Basin exhibits transitional climate characteristics under the influence of both the Mediterranean and Black Sea climates. The annual average precipitation ranges between 600 and 1,200 mm, with rainfall concentrated during the winter and autumn months, while drought conditions are observed during the summer months. This increases the need for agricultural irrigation and necessitates the use of groundwater, particularly in summer. The geological structure of the basin is highly complex, comprising batholithic granites, metamorphic rocks, and alluvial deposits, which influence both horizontal and vertical water movement. Groundwater quality varies regionally; however, nitrate, heavy metal, and pesticide pollution have

been detected in aquifers around Bursa, Balıkesir, and Bandırma. Additionally, excessive abstraction has led to significant drops in groundwater levels and permanent declines in some areas.

The Project Area is located within the Black Sea, Northern Marmara, Ağva, and Gulf sub-basins, which are sub-basins of the Marmara Basin (See Appendix-2.10).

Black Sea Sub-Basin (European Side)

The Black Sea Sub-Basin on the European side of İstanbul encompasses streams draining into the Black Sea and includes Lake Terkos. This basin, which contains forested and agricultural areas, ensures continuous surface water flow to the Black Sea with a seasonal runoff regime. Lake Terkos, which has potable water potential, is the most significant surface water source in the basin and plays a critical role in supplying drinking water to İstanbul.

Northern Marmara Sub-Basin (European Side)

The Northern Marmara Sub-Basin extends from the Black Sea coast to the Marmara Sea on İstanbul's European side, covering stream networks and urban areas. The basin includes Alibey, Sazlıdere, and Büyükçekmece Reservoirs, which play a significant role in meeting İstanbul's drinking water demand. Additionally, Lake Küçükçekmece is located within the basin boundaries; however, it is not used for drinking water supply. With its rich surface water resources, the basin holds a critical position in ensuring the continuity of İstanbul's water resources.

Ağva Sub-Basin (Anatolian Side)

The Ağva Sub-Basin is located on the Black Sea coast of İstanbul's Anatolian side and consists of forested areas, natural streams, and a seasonal runoff regime. The basin also includes the Ömerli Reservoir, which supplies drinking water to İstanbul. With this characteristic, the basin plays a significant role in İstanbul's water supply while maintaining ecosystem integrity.

Gulf Sub-Basin (Anatolian Side)

The Gulf Sub-Basin covers streams draining into the Marmara Sea and the coastal zone on İstanbul's Anatolian side. The basin also includes the Elmalı-2 Reservoir, one of İstanbul's important drinking water sources. Influenced by industrial, agricultural, and urban areas, the basin ensures water flow into the Marmara Sea while possessing a surface water potential that meets the water needs of residential areas.

4.2.4.4.2 Hydrology of the Study Area

The hydrological characteristics of the project route have been evaluated under the headings of "Streams" and "Dams, Lakes, Ponds, and Irrigation Areas".

Streams

The project alignment intersects with numerous seasonal and perennial streams along its route. Depending on hydrological characteristics, these crossings will be bridged or culverted to ensure unimpeded flow and maintain ecological continuity.

Within Section 1, notable streams include Ağıl, Büyük, Balıksu, Bezirgan, Çakal, Çaylan, Çeşme, Gelin, Gökçe, Göksu, Kayadağ, Keçiağılı, Köprücük, Pınaryatak, and Yassıkaya Streams, which are primarily seasonal, alongside perennial streams such as Büyük, Domuzkestaneliği, Hamza, Kayalı, Suvat, and Umur. Gökçe Stream displays both seasonal and perennial flow characteristics.

In Section 2, the alignment crosses a denser network of streams, including perennial ones such as Ayvalı, Çayağzı, Domuzkestaneliği, Gümüş, Halayık, Ihlamur, Kalaycı, Kanlı, Karakütük, Karanlık, Kartal, Kavaklık, Kireçli, Kız, Kocacı, Küçükkavak, Meçit, Mihralem, Milko, Öksüz, Poyraz, Soğuksu, Suvat, Tatlısu, Tütüncüler, and Ütük. Seasonal streams, including Adakoru,

Artin, Büyükçakal, Çamaşır, Değirmen, Dervistarla, Dışbudak, Elma, Erikli, Garipçe, Gürgen, Kestane, Kolağası, Marmaracık, Muşmula, Sarmaşık, Sazlı, Şaban, and Uzunye, form the remainder of the crossings. Gümüş Stream exhibits both seasonal and perennial flow.

In Section 3, the route intersects perennial streams such as Baklalı, Boyalık, Çamaşır, Değirmenönü, Dursunköy, Fezlekay, Gürcüpınarı, Hamzalı, Hasanbey, İdriskuyu, İncirli, Kanlıgeçit, Kapıcı, Odayeri, Ortasofa, Sarmaşık, and Taşlıgeçit. Seasonal streams dominate this section and include Avcıtepe, Balıklı, Buzakçıçardağı, Büyükkemer, Büyükkurtkaya, Çatal, Çırçır, Fındıklı, İğrek, Işıkçayır, Karasu, Kayan, Koyalıkçayırı, Kuloğlu, Küçükkurtkaya, Memiş, Nergiz, Osmanboğazı, Paylioğlu, Sığırsuatı, Söğütlügöl, Teknetarla, Tokatmekan, Tokmak, Topçu, and Viran. Taşlıgeçit and Tokmak Streams have mixed seasonal and perennial flow characteristics.

This hydrological inventory confirms that the Project traverses a diverse network of watercourses, requiring site-specific design measures for each crossing to maintain hydraulic performance and ecological connectivity.

Number of stream crossings within the impact area are detailed by section in Table 4-3.

Table 4-3 Summary of Stream Crossings by Section

Section	Total Streams	Perennial	Seasonal	Mixed (Seasonal/Perennial)
Section 1	20	7	12	1
Section 2	48	27	20	1
Section 3	46	18	26	2
Total	**114**	**52**	**58**	**4**

Dams, Lakes, Ponds, and Irrigation Areas

There are 4 important drinking water dams in the region where the Project route is located. The Project route intersects with the reservoir areas of Ömerli and Büyükçekmece Dams and passes through the absolute, short, medium and long-distance protection areas of these dams. The Project route does not intersect with the remaining Sazlıdere and Alibey dams but remains within the long-distance protection areas of these dams. Summary information on the dams located on and around the Project route is given in Table 4-4.

Table 4-4 Information on the Dams Around Project Route

Name of Dam	Purpose of Use	Construction Date	Status	Distance and Direction to Route	Crossed Dam Protection Zone
Ömerli Dam	Drinking Water	1973	Operation	Reservoir Crossed by Project Route	Absolute-Short-Medium-Long Distance Protection Zones
Alibey Dam	Drinking Water Flood Control	1983	Operation	6.5 km S	Long Distance Protection Zone
Sazlıdere Dam	Drinking Water	1996	Operation	3.0 km SE	Long Distance Protection Zone
Büyükçekmece Dam	Drinking Water Irrigation	1988	Operation	Reservoir Crossed by Project Route	Absolute-Short-Medium-Long Distance Protection Zones

Crossings over Ömerli and Büyükçekmece Dams will be made via project-designated bridges. Activities around Ömerli, Büyükçekmece, Alibey, and Sazlıdere Dams will comply with Articles 9–12 of the Regulation on the Protection of Drinking and Utility Water Basins (Official Gazette No. 30224, dated 28.10.2017). Seven ponds lie within the forest area south of Section 2, with Ayvat Pond, the closest, located 1.7 km outside the impact area also Kırkmerdiven and Topaçlı Pond are existing in Section 2. Additionally, Balık Lake and Terkos Dam Lake are situated 4.2 km west of Section 1 and 6.0 km northwest of Section 3, respectively. No irrigation areas exist along or near the project route.

Hydrology maps illustrating the hydrological components, including the dams and their protection zones within and around the project area, are presented in Appendix-2.8.

4.2.4.5 Hydrogeology

4.2.4.5.1 Regional Hydrogeology

According to the European International Hydrogeological Map, prepared by the International Association of Hydrogeologists and supported by the Commission for the Geological Map of the World, aquifers and water structures have been defined.

In this classification, aquifers are divided into various categories as follows: Highly Productive (Porous Aquifers), Low to Moderate Productivity (Porous Aquifers), Highly Productive (Fractured Aquifers), Low to Moderate Productivity (Fractured Aquifers), Regionally Important Aquifer Rocks (Porous or Fractured), and Non-Aquifer Rocks (Porous or Fractured).

The project area is located within the zones defined as Non-Aquifer Rocks (Porous or Fractured) and Locally Confined Productive Aquifer Rocks (Porous or Fractured).

A map showing the status of the project area and its surroundings according to the standards of the European International Aquifer Map is presented in Appendix-2.12.

4.2.4.5.2 Hydrogeology of the Study Area

Within the scope of the project, the hydrogeology of the study area has been evaluated across three different sections. Hydrogeological evaluations for each section, along with information related to the formations, are presented below under separate headings.

4.2.4.5.2.1 Hydrogeology of Project Route - Section 1

Most of the units in Section 1 are composed of low-permeability rocks, showing weak aquifer characteristics from a hydrogeological perspective. However, the Quaternary alluvial unit (Qal), the Ayazma Member (Okua), and the Kayalıtepe Formation (PgNomk) stand out as permeable units, enhancing groundwater flow and storage capacity in the area. Groundwater flow generally occurs within limited permeable zones, especially within sandstone and limestone layers, reflecting a complex hydrogeological structure where interbedded aquifer and aquitard systems coexist. The hydrogeological setting indicates that while the majority of the formations act as barriers or have low transmissivity, localized high-permeability zones contribute to groundwater movement within the region. The hydrogeological map of Section 1 is presented in Appendix-2.9.1.

4.2.4.5.2.2 Hydrogeology of Project Route - Section 2

Most of the rocks in Section 2 have low permeability with limited aquifer characteristics, serving primarily as confining layers in the hydrogeological system. However, the Quaternary alluvium and beach sands (Qal, Qp) and the Kayalıtepe Formation (PgNomk) act as permeable units, enhancing the groundwater potential within the area. Groundwater flow primarily occurs within alluvial zones and locally within permeable sandstone layers, while the widespread presence of volcanic rocks and claystone-shale dominated sequences results in low general groundwater flow rates. The hydrogeological system reflects localized aquifer development with restricted flow paths influenced by the lithological variability across the section. The hydrogeological map of Section 2 is presented in Appendix-2.9.2.

4.2.4.5.2.3 Hydrogeology of Project Route - Section 3

The alluvial unit (Qal) in Section 3 is highly permeable and serves as the main aquifer within the area, supporting groundwater recharge and flow. In contrast, the İhsaniye Formation (Teoi) and the Belgrad Formation (Tmpb) exhibit low permeability, limiting groundwater movement across the section. Consequently, the groundwater potential in Section 3 is primarily restricted to the alluvial zones, with slow and localized groundwater flow patterns observed due to the prevalence of low-permeability formations within the section. The hydrogeological map of Section 3 is presented in Appendix-2.9.3.

4.2.5 Nearest Sensitive Receptors

An assessment was conducted to identify sensitive receptors located within the Project's AoI, including residential buildings, schools, mosques, healthcare facilities, and cemeteries. The purpose of this evaluation was to determine the proximity of such receptors to the planned railway alignment and assess potential exposure to construction and operational phase impacts (e.g., noise, vibration, dust, and access constraints).

A total of 115 sensitive receptors were identified along the Project corridor. The spatial distribution of these receptors in relation to the Project alignment is summarized as follows:

- 34 receptors (30%) are located within 250 meters of the railway alignment,
- 48 receptors (42%) are located between 250–500 meters,
- 22 receptors (19%) are located between 500–1,000 meters,
- 11 receptors (9%) are located beyond 1,000 meters from the corridor.

Notably, several schools and mosques fall within 250 meters, particularly near urban sections such as Çayırova, Sabiha Gökçen Airport surroundings, and Arnavutköy districts. These receptors may require site-specific mitigation measures (e.g., temporary noise barriers, access controls, and stakeholder communication protocols).

A complete inventory including receptor type, coordinates, and distance from the alignment is presented in Appendix-5.

4.2.6 Infrastructure Facilities

4.2.6.1 Existing Waste Management in the Region

Municipal solid waste in the project region is managed under the authority of İstanbul Metropolitan Municipality (İBB) and Kocaeli Metropolitan Municipality (KBB), in accordance with national waste legislation. Waste collection, transportation, and disposal services are generally well-organized, with the majority of urban areas being covered by regular waste collection systems.

In Istanbul, solid waste is transferred through a network of intermediate stations and treated in landfills and composting facilities. Kocaeli has a similarly structured waste management system, featuring transfer stations and sanitary landfill sites. Industrial and hazardous waste is subject to stricter controls and is handled by licensed private operators under the supervision of the MoEUCC.

Recycling efforts are growing but remain limited in scale, primarily supported through informal collection networks and municipal pilot projects. Medical, e-waste, and construction waste streams are managed via specific authorized channels.

Overall, while the existing infrastructure provides adequate service coverage, challenges remain in expanding recycling capacity, improving segregation at source, and ensuring full compliance in rural and semi-urban areas

In the project region, solid waste management infrastructure consists of both landfill sites and solid waste transfer stations distributed across İstanbul and Kocaeli provinces. İstanbul hosts three major landfill sites with a combined capacity exceeding 14,000 tons/day, while Kocaeli operates two sites, one of which (Dilovası) has reached full capacity. Transfer stations are more numerous in İstanbul, particularly on the European side, with Yenibosna being the largest at 12,271 tons/day. Kocaeli has fewer transfer stations, primarily serving local municipalities. The distribution reflects higher waste generation and processing demand in İstanbul, especially in urbanized European districts [4].

Figure 4-10 presents the average daily waste capacity of landfill sites and waste transfer stations in İstanbul and Kocaeli provinces. As shown, İstanbul has a significantly higher capacity

[4] https://istac.istanbul/faaliyet-alanlarimiz/atik-yonetimi, https://www.izaydas.com.tr/

compared to Kocaeli, primarily due to the presence of large-scale facilities on the European side of the city.

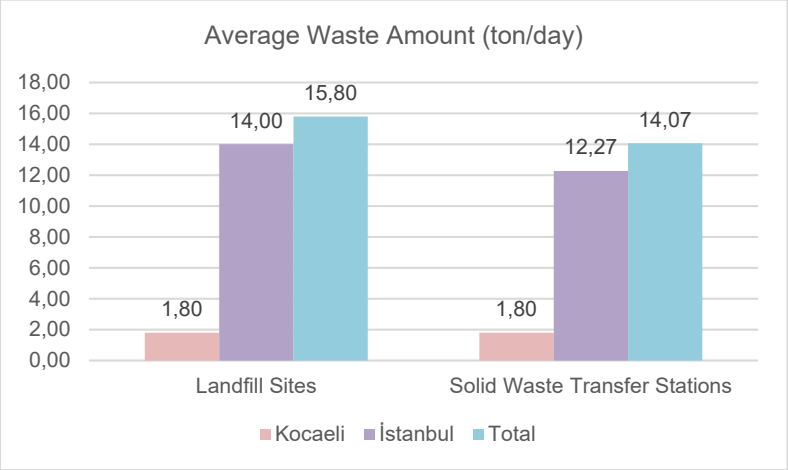


Figure 4-10 Daily Waste Disposal Capacity by Province (ton/day)

According to official statistics published by the Turkish Statistical Institute (TURKSTAT), a total of approximately 7,024,241 tonnes of waste was generated in Istanbul Province and 734,312 tonnes in Kocaeli Province in 2024 [5]. These wastes are managed through licensed waste treatment and disposal facilities in accordance with the provisions of the Waste Management Regulation and the Environmental Permit and License Regulation.

Existing waste management practices in the Project region are implemented in accordance with the relevant national legislation, in particular the Environmental Permit and License Regulation and the Waste Management Regulation, as detailed in Appendix 9.

4.2.6.2 Excavation Waste Storage Areas

Excavation waste generated in the project area is managed by the İstanbul and Kocaeli Metropolitan Municipalities under the Regulation on Control of Excavation Soil, Construction and Demolition Waste (OG No. 25406, 2004).

In İstanbul, Istanbul Environmental Protection and Waste Materials Recycling Industry and Trade Inc. (İSTAÇ) is responsible for collection, transport, and disposal, using a digitally monitored system. Licensed disposal areas—mainly rehabilitated quarries or degraded lands—are located throughout the city, including Odayeri, Çiftalan, Kömürcüoda, Seymen (European side), and Paşaköy, Aydınlı (Asian side) [6].

In Kocaeli, excavation waste is handled by the Department of Environmental Protection and Control, with designated sites distributed across districts. These include Ayhanlar (Gebze), İZAYDAŞ (Dilovası), Körfez Quarry, Alikahya (İzmit), Arslanbey (Kartepe), Sepetçiler (Başiskele), and İcadiye (Gölcük). All transport and disposal activities must be conducted by licensed haulers in full compliance with national regulations [7].

Across Istanbul, there are numerous licensed disposal and storage areas distributed throughout both the European and Asian sides. While a wide range of sites are available for the regulated management of excavation waste, only a limited number of them have very large storage

[5] ***Source:*** *https://data.tuik.gov.tr/Bulten/Index?p=Atik-Istatistikleri-2024-54134*

[6] *The complete list of authorized excavation waste disposal sites can be accessed via the following link: https://cevre.ibb.istanbul/wp-content/uploads/2023/04/AVRUPA-YAKASI-IZINLI-DEPOLAMA-ALANLARI.pdf. chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://cevre.ibb.istanbul/wp-content/uploads/2023/04/ANADOLU-YAKASI-IZINLI-DEPOLAMA-ALANLARI.pdf*

[7] *https://www.kocaeli.bel.tr/hizmet/hafriyat-bertaraf-hizmeti-159.html*

capacities and play a key role in meeting the city's long-term demand.

The largest licensed excavation waste storage areas in İstanbul are presented in Table 4-5, while the complete detailed list is provided in Appendix-11. The spatial relationship of these areas with the project site is illustrated in the satellite image given in Appendix 2.14. These sites constitute the primary officially permitted facilities for excavation material management within the metropolitan area.

Table 4-5 Major Licensed Excavation Storage Areas in Istanbul (by Capacity)

District	Storage Site Name	Capacity (m³)
Tuzla	Istanbul Leather Organised Industrial Zone	2,500,000
Arnavutköy	İSTAÇ – İmrahor Excavation Material Storage Area	9,761,211
Arnavutköy	İSTAÇ – Atalaylar Excavation Material Storage Area	11,770,483
Eyüpsultan	İSTAÇ – Çiftalan Excavation Material Storage Area	20,799,657
Silivri	İSTAÇ – Büyükkılıçlı Excavation Material Storage Area	2,916,925

According to information obtained from the Istanbul Metropolitan Municipality's website, the total capacity of storage areas for excess excavation material across Istanbul is approximately 49 million m3; however, there is no information available regarding the current utilisation and remaining capacity of these areas (see Appendix-11).

4.2.6.3 Water Usage

İstanbul's domestic and drinking water supply is managed by the İstanbul Water and Sewerage Administration (İSKİ) under the İBB. The İstanbul province's water is primarily sourced from surface water reservoirs, including major dams such as Ömerli, Terkos, Alibeyköy, Elmalı, Sazlıdere, and Büyükçekmece, along with regulated streams and groundwater wells. In 2022, approximately 60% of the province's total water supply came from dams, while the remaining 40% was provided by regulators and wells [8].

Water is treated at 14 drinking water treatment plants distributed across the province (See Figure 4-11). The largest facilities include the Ömerli, İkitelli, Kağıthane, and Terkos plants. These plants apply multistage treatment processes, including sedimentation, filtration, and disinfection, to ensure compliance with national standards for human consumption [9].

The treated water is distributed through an extensive pressurized pipe network, supplying both residential and industrial users. Water quality is regularly monitored by İSKİ in accordance with the Regulation on Water Intended for Human Consumption.



Figure 4-11 Distribution of İSKİ's Drinking Water Treatment Plants

[8] *https://www.iski.gov.tr/kurumsal/faaliyet-raporlari*
[9] *https://www.iski.gov.tr/su-kaynaklari*

Source: *https://iski.istanbul/kurumsal/iski-tesisleri/*

In Kocaeli, drinking and domestic water supply services are managed by the Kocaeli Water and Sewerage Administration (İSU), a subsidiary of the Kocaeli Metropolitan Municipality. The drinking water supply system in Kocaeli is primarily supported by the Yuvacık Dam, which serves as the province's main water source. Water from the dam is processed at the Yuvacık Drinking Water Treatment Plant, the largest in the province with a capacity of 480,000 m³/day and distributed across most of the city.

As of 2024, there are 13 active drinking water treatment plants operating in different districts of Kocaeli, ensuring adequate and safe water supply throughout the province in line with national drinking water standards [10]. The treated water from these facilities is distributed to residential, commercial, and industrial areas through a pressurized pipeline network. Water quality is routinely monitored by the Kocaeli Water and Sewerage Administration (İSU) to ensure consistent compliance with national health and safety standards throughout the entire supply system [11]. The Project is expected to have limited water demand, primarily associated with construction activities, and will not rely on or affect drinking water supply systems serving surrounding communities; therefore, no significant impacts on the availability of potable water are anticipated. Water supply and drinking water treatment infrastructure in İstanbul and Kocaeli provinces are summarized in Table 4-6.

Table 4-6 Water Supply and Drinking Water Treatment Infrastructure in İstanbul and Kocaeli

Property	İstanbul	Kocaeli
Responsible Authority	İSKİ	Kocaeli Water and Sewerage Administration (İSU)
Main Water Sources	Dams (Ömerli, Terkos, Elmalı, Sazlıdere, etc.), regulators, groundwater	Yuvacık Dam, Sapanca Lake (backup), springs, groundwater
Number of Drinking Water Treatment Plants (2024)	14	13
Largest Treatment Facility	Ömerli and İkitelli (large-capacity urban coverage)	Yuvacık DWTP (480,000 m³/day)
Water Quality Monitoring	Regular monitoring by İSKİ per national standards	Regular monitoring by İSU per national standards
Distribution System	Extensive pressurized pipeline network	Extensive pressurized pipeline network

4.2.6.4 Wastewater Management

In İstanbul, wastewater services are managed by the İSKİ. The city operates a highly developed and widespread sewer network serving both the European and Asian sides. As of 2024, İstanbul has 90 operational wastewater treatment plants of varying capacities and treatment levels. Key facilities include Ataköy, Ambarlı, Baltalimanı, Tuzla, and Büyükçekmece, which treat a significant share of the city's wastewater through advanced biological and tertiary processes (See Figure 4-12). Also Paşaköy Biological Wastewater Treatment Plant is located approximately 580m from the Project route, while the İSKİ Cumhuriyet Wastewater Treatment Plant is situated at approximately 672m. Effluent from these plants is discharged in accordance with national regulations, and sludge is managed via stabilization, composting, or disposal at licensed sites.

[10] *https://www.kocaeli.bel.tr/hizmet/icme-suyu-aritma-47.html and https://www.isu.gov.tr/icerik/detay.aspx?Id=300*
[11] *https://www.isu.gov.tr/faaliyet-raporlari*

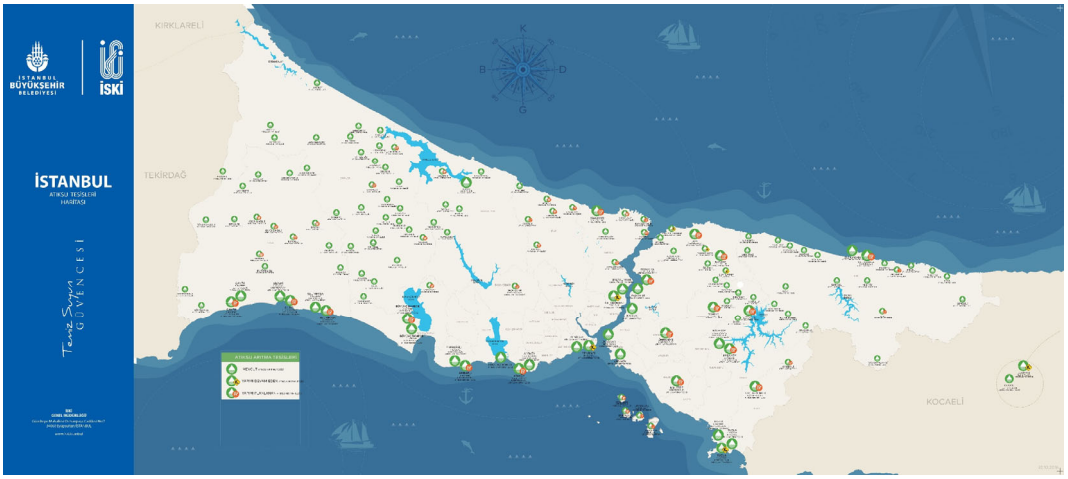


Figure 4-12 Distribution of İSKİ's Wastewater Treatment Plants
Source: *https://iski.istanbul/kurumsal/iski-tesisleri/*

In Kocaeli, wastewater collection and treatment are the responsibility of İSU (Kocaeli Water and Sewerage Administration). The province has a strong centralized system, particularly due to its dense industrial activity. Wastewater from residential, commercial, and industrial areas is collected through an integrated sewerage network and treated at 21 wastewater treatment plants as of 2024. Major facilities include the İzmit Central WWTP, and district-level plants in Gebze, Derince, and Körfez. These plants are designed to comply with the discharge limits defined in the Urban Wastewater Treatment Regulation, and effluent is monitored regularly before discharge into natural receiving bodies. Sludge produced during treatment is stabilized and sent to licensed landfill sites or used as soil conditioner where permitted. Wastewater management structures for İstanbul and Kocaeli provinces are summarized in Table 4-7.

Table 4-7 Wastewater Management Structures for İstanbul and Kocaeli

Property	İstanbul	Kocaeli
Responsible Authority	İSKİ	İSU
Number of WWTPs (2024)	90	21
Major WWTPs	Ataköy, Ambarlı, Tuzla, Baltalimanı	İzmit Central, Gebze, Derince, Körfez
Treatment Types	Biological, Advanced Biological, Tertiary	Biological, Secondary, Advanced
Effluent Monitoring	Regular, under national standards	Regular, under national standards
Sludge Management	Stabilized, composted or landfilled	Stabilized, landfilled or reused
Sewerage System Coverage	High (Urban + Industrial areas)	High (Urban + Industrial areas)

4.2.7 Biodiversity

Biodiversity studies undertaken within the scope of the İstanbul North Rail Crossing Project have been carried out in accordance with the requirements of ESS6. The assessment draws upon a combination of existing scientific literature, habitat and species reports, targeted field surveys, and expert judgment. Field methodologies were designed by specialists with expertise in key taxonomic groups and were tailored to identify and evaluate priority habitats, species of high conservation value, and legally protected areas present within the Project's AoI. These methodologies ensured a comprehensive understanding of potential biodiversity impacts, thereby informing appropriate mitigation and management strategies in line with ESS6 objectives.

The biodiversity impact assessment was undertaken separately for the construction and operation phases of the Project. Construction-phase impacts were defined in relation to habitat loss, habitat degradation, disturbance, fragmentation, pollution, and temporary restriction of fauna movement arising from site clearance, earthworks, access requirements, and associated construction activities.

The main objective of the baseline biodiversity study is to establish the baseline ecological

conditions through the analysis of habitat types, species distributions, and conservation values; to assess the magnitude and significance of impacts on species, habitats, and ecological processes during all phases of the Project; and to conduct a high-level assessment of cumulative impacts and impacts related to the Project's Associated Facilities.

4.2.7.1 Project Standards

The legal framework for the conservation and assessment of biological diversity applicable to the project is provided in Section 2. In addition to the provisions of the relevant section, the following provisions shall also be complied with within the scope of the Project.

National Guidelines

Protected Areas

- Important Bird Areas (IBA's) of Türkiye (Magnin and Yarar, 1997)
- Key Biodiversity Areas (KBA's) of Türkiye (Eken et al., 2006)
- 122 Important Plant Areas (IPA's) of Türkiye (Ozhatay et al., 2008)

Flora

- Flora of Türkiye and East Aegean Islands (Davis, 1965-1988)
- Turkish Plant Names (Baytop, 1994)
- Red Data Book of Turkish Plants (Ekim et al., 2000)

Fauna

- Pocket Book of Birds of Türkiye
- General and Turkish Zoogeography (Demirsoy, 2002)

International Standards and Guidelines

- ESS 6 (2017) Biodiversity Conservation & Sustainable Management of Living Natural Resource
- EU Habitats Directive (92/43/EEC)
- EU Birds Directive (2009/147/EC)

4.2.7.2 Methodology for Biodiversity Studies

4.2.7.2.1 Flora, Habitat and Ecosystems

In order to characterize the flora and vegetation structure along the proposed route of the İstanbul North Rail Crossing Project, and to identify any critical habitats or plant species of conservation concern, a systematic habitat-based sampling approach was applied. The primary objective of the study was to assess the ecological value of the route and inform biodiversity impact avoidance and minimization strategies in line with ESS6 (Biodiversity Conservation and Sustainable Management of Living Natural Resources).

The natural habitats surrounding the Project alignment are largely characterised by similar habitat types, and the target flora species predominantly occur within overlapping or closely associated habitat mosaics. The Project Area of Influence includes a diverse range of natural and modified habitats, freshwater bodies and slow flowing streams, riparian vegetation, wet and moist grasslands, mixed deciduous forests as natural habitats and plantation forest and recently cleared forest areas as modified habitats. In addition, the landscape contains agricultural lands, settlements of both urban and rural character, industrial and commercial areas, transportation infrastructure, construction and quarry sites, dams and other artificial water bodies, as well as scrub and pseudo-maquis vegetation.

Using high-resolution satellite imagery via Google Earth, representative sampling points were selected across all major habitat types observed along the 127 km long high-speed railway (HSR) corridor. To account for potential edge effects, a 500-meter buffer zone on both sides of the

corridor was included in the study area.

A total of 21 sampling points were selected based on the presence of diverse or sensitive habitat types, with prioritization given to natural habitats and areas potentially supporting rare or endemic species. The distribution of sampling stations by habitat type is as follows:

- 11 plots representing mesotrophic and eutrophic mixed deciduous forests,
- 6 plots within coniferous plantation forests,
- 2 plots along riverbanks representing gallery forests dominated by *Salix*, *Alnus*, *Betula*, and *Populus* species,
- 1 plot in association with a permanent mesotrophic lake and shoreline vegetation,
- 1 plot within moist and wet grasslands.

Note: Four planned stations (FF14, FF15, FF6, FF1) could not be surveyed due to restricted access in military zones or the absence of roads.

Field investigations were carried out between 27–28 June 2025 and 30 September – 01 October 2025 by Prof. Dr. Hayri Duman from the Department of Biology, Faculty of Science, Gazi University and M.Sc. Gamze Kaya. At each sampling location, detailed habitat descriptions were recorded and field notes were taken systematically. The floristic inventory was prepared based on species observed directly during field visits and supported by professional judgment.

The standard quadrat method (Sutherland, 2006) was used to estimate plant abundance, density, frequency, and distribution. Species were categorized in accordance with major taxonomic groups (*Pteridophyta*, *Gymnospermae*, *Angiospermae*), and listed by family following the phylogenetic order described in the *Flora of Türkiye*.

For each species, the following information was recorded:

- Turkish and English names (if available),
- Phytogeographical region,
- Endemism status and threat category (for endemic and rare species),
- Presence on Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) and Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) lists,
- EUNIS habitat classification,
- Abundance within the project area.

Plant identification was primarily based on Flora of Türkiye and the East Aegean Islands (Davis, 1965–1988) and supported by additional taxonomic sources. The Red Data Book of Turkish Plants (Ekim et al., 2000) was used to identify endemic and/or threatened species. Since this reference uses International Union for Conservation of Nature and Natural Resources (IUCN) 1994 categories, all threat statuses were updated in line with the IUCN 2001 criteria.

The assessment identified several local or regionally endemic, rare, or internationally protected species, as well as habitats with high conservation value. Locations with concentrations of these species or sensitive ecosystems were defined as “Ecologically Sensitive Areas (ESAs)”. These areas are particularly vulnerable to disturbance due to the presence of rare species or their ecological fragility.

The in-situ and ex-situ conservation recommendations for these areas have been developed within the Project’s Critical Habitat Assessment (CHA) and should be integrated into the lot specific Biodiversity Management Plan (BMP) and implemented accordingly.

4.2.7.2.2 Terrestrial Fauna

The main objective of this study was to identify and evaluate terrestrial fauna species (particularly vertebrates) along the proposed Çatalca–Gebze railway corridor. The survey aimed to characterize fauna diversity, identify conservation-priority species and habitats, and provide

baseline information for avoiding or minimizing biodiversity-related impacts, in line with international standards such as WB - ESS6.

The fauna assessment combined literature review with field surveys conducted during the biologically appropriate season for most vertebrate species. Species presence was recorded through both direct and indirect observations. All species were later assessed for conservation significance. Survey Planning:

- The project corridor is approximately 127 km in length.
- A total of 21 survey points were selected along the railway alignment using Google Earth imagery by Prof. Dr. Hayri Duman and Prof. Dr. Mustafa Sözen.
- Site selection was based on habitat diversity, representativeness, and vehicle accessibility.

Field surveys were conducted on June 28–29, 2025 by Prof. Dr. Mustafa Sözen from the Department of Biology at Zonguldak Bülent Ecevit University and M.Sc. Gamze Kaya. In addition, field studies were conducted between 1–30 June 2025 and 15 September – 15 October 2025 by M.Sc. Gamze Kaya and M.Sc. Edanur Bingöl. Survey methods included:

- Direct visual observations of fauna individuals,
- Indirect signs such as tracks, burrows, droppings, food remains, feathers, hair, vocalizations, and echolocation sound recordings etc.,
- Species-specific calls, particularly useful for amphibians,
- Photo-documentation and GPS recording of sightings.

Each survey point was examined for at least 45 minutes, walking across different microhabitats within the site. The period chosen ensured high visibility and activity for key faunal groups such as amphibians, reptiles, and mammals. Since bird migration in Türkiye occurs mainly in March–May, only a few migratory bird species were detected during the survey.

In addition to field observations, previous project experience and faunal records from the Marmara Region were considered to support species list development. Relevant reference projects include:

- Nakkas–Başakşehir Motorway Project
- Halkalı–Kapıkule Railway Project
- Canal İstanbul Project
- Northern Marmara Motorway and Connecting Roads
- Barrier Effect Study of the Yavuz Sultan Selim Bridge and Additional Motorways

These sources were used to validate the presence and distribution of fauna species and assess habitat importance.

Each identified species was evaluated for its conservation status using the following references:

- IUCN Red List (global and national assessments)
- Bern Convention Appendices
- Central Hunting Commission (MAK 2024–2025) Decisions
- CITES Appendices
- EU Habitats Directive Annexes

Special attention was given to endemic, rare, or legally protected species.

The terrestrial fauna inventory reflects a combination of direct field data and supporting literature. Species of conservation concern were identified, and recommendations were made for their protection or further monitoring. The survey results will inform mitigation planning and biodiversity management during the project lifecycle.

4.2.7.3 Biodiversity Study Area

In order to identify impacts of the Project on biodiversity and to conduct critical habitat

assessment, in line with the provisions of the WB - ESS6, the ESIA study area, which consists of a 500-m corridor extending on each side of the proposed route was considered as the Biodiversity Study Area. Some of the surveys carried out within the scope of Phase 1, were not carried out during the animals' active period and flowering period of plant species. Biodiversity field surveys covered the entire Biodiversity Study Area, in addition to which reference areas outside the Project footprint, and habitats with similar ecological features and carrying capacities were also considered. Therefore, further surveys were proposed in this respect. For this reason, Phase 2 studies were conducted covering all biodiversity issues and appropriate seasons. In Phase 2 of the Project biodiversity field surveys covered the entire Biodiversity Study Area, in addition to which reference areas outside the Project footprint, and habitats with similar ecological features and carrying capacities were also considered. In Phase 2 of the Project detailed flora and fauna sampling surveys were conducted at 21 Locations for Invertebrates, 21 Locations for Herpetofauna, 21 Locations for birds, and 21 Locations for Mammals, sampling Locations within the Biodiversity Study Area. These sampling points were selected considering habitat characteristics, as well as habitat preferences of flora and fauna species. Natural habitats and species that are of high conservation concern (CR, EN, VU, NT and those that require special conservation measures) were prioritized during field surveys. Ornithological surveys were conducted at vantage points, representing different habitats, and also along transect lines.

The map showing the sampling/observation points is provided in Appendix 6.1.In addition to the biodiversity baseline studies presented in this section, supplementary biodiversity studies were undertaken during 2025 and 2026 to further strengthen and update the Project biodiversity baseline, including additional seasonal flora, fauna, bird and geophyte surveys. The findings of these studies have been consolidated with the existing ESIA biodiversity information and are presented in Appendix 6.13, Supplementary Biodiversity Baseline Study. The supplementary study provides additional baseline information and screening-level biodiversity findings and does not replace the biodiversity assessment and management framework established under this ESIA and the ESMP.

Within the scope of the ESIA, sampling points were selected and field studies were conducted only within the impact area of the railway line corridor. No assessment was performed for the associated facilities at this stage. However, comprehensive studies covering both the railway line and all associated facilities will be conducted and included in the Final ESIA will be updated by AYGM as required once the Project design is finalized.

The in-situ and ex-situ conservation recommendations for these areas have been developed within the Project's CHA and should be integrated into the BMP and implemented accordingly.

4.2.7.4 Protected Areas

- The WB-ESS two different types of protected areas; Legally Protected and Internationally Recognized Areas of High Biodiversity Value. Legally Protected Areas as defined by ESS6 are those that meet the definition: "A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.", while Internationally Recognized Areas of high biodiversity value include World Heritage Natural Sites, Biosphere Reserves, KBAs, IBAs, Alliance for Zero Extinction Sites and Ramsar Wetlands of International Importance, among others. When a project is located within a legally protected or internationally recognized area, ESS6 sets requirements in addition to those that are related to critical habitat. Accordingly, it is required to: demonstrate that the proposed development in such areas is legally permitted,
- act in a manner consistent with any government recognized management plans for areas
- consult protected area sponsors and managers, affected communities, indigenous peoples and other stakeholders on the proposed project, as appropriate; and
- implement additional programs to promote and enhance conservation aims and impactive

management of the area.

In line with this approach, areas that have been designated a status under the Turkish protected area system, as well as areas designated as KBAs, Important Bird and Biodiversity Areas (IBAs) and Important Plant Areas (IPAs) were screened for the purpose of this ESIA.

Legally Protected Areas

The IUCN proposes the following definition for a protected area (IUCN, 2017), which today is widely used around the globe, and recognized as the definition of legally protected areas by ESS6:

> *"A protected area is a clearly defined geographical space, recognized, dedicated and managed, through legal or other impactive means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values."*

Legally protected areas constitute an integral part of biodiversity conservation efforts, as well as ecosystem services provided by ecological functions they convey. In Türkiye, Ministry of Agriculture and Forestry is the main official body responsible for development and implementation of national biodiversity conservation policies, action plans, designation of conservation areas, and many other related tasks conducted by its central and local directorates within the Ministry's organizational structure. IUCN Categories (Dudley et al.,2013) were adopted to restructure the Turkish Protected Area System in 2006 through the Biodiversity and Natural Resource Management Project undertaken by the Ministry's General Directorate of Nature Conservation and National Parks (DKMP) (Thomas, 2006). The IUCN Categories provide a global framework and is recognized by the Convention on Biological Diversity (CBD), with an initial objective of creating a common understanding of protected areas within and between countries. Categorization is done according to the primary management objectives for a protected area, based on the principles listed as following:

i) assignment to a category is a not a commentary on management effectiveness,
ii) the categories systems are international; national names for protected areas may vary, and
iii) all categories are important; and gradation of human intervention is implied.

Accordingly, legally protected areas in Türkiye, were re-classified under the 6 protected area management categories defined by the IUCN Guidelines, which identify the main reasons for management as the following:

I Strict protection [Ia) Strict nature reserve and Ib) Wilderness area]
II Ecosystem conservation and protection (i.e., National park)
III Conservation of natural features (i.e., Natural monument)
IV Conservation through active management (i.e., Habitat/species management area)
V Landscape/seascape conservation and recreation (i.e., Protected landscape(seascape)
VI Sustainable use of natural resources (i.e., Managed resource protected area)

Legally protected areas around the Project route and their IUCN categories are given in Table 4-8, and a map showing the locations of the protected areas with respect to the Project route is presented in Appendix-6.3.

Considering the distances between the railway route and the legally protected areas in the region, there will be no Project-related impacts on these areas.

The route crosses the Marmara Sea and Islands Special Environmental Protection Areas only with a bridge, meaning there's no land reclamation, dredging, piling, or other construction happening in the marine zone. Because the railway stays entirely above the sea, it doesn't interfere with marine or coastal ecosystems, and it doesn't block animal movements nor release substances that could harm water quality. With these measures, the project easily meets the mitigation requirements of ESS6. As a result, the assessment concluded that the project will not impact the biodiversity or conservation goals of the Special Environmental Protection Area.

The railway project's passage through the Feneryolu Wildlife Development Area has been evaluated with respect to potential impacts on biodiversity and habitat values. The alignment within this zone has been designed to run parallel to an existing road corridor, thereby avoiding new fragmentation of habitats or the introduction of additional disturbance beyond what is already present. Construction activities will remain confined to the modified and previously disturbed road corridor, with no encroachment into undisturbed habitats or sensitive ecological features of the Wildlife Development Area. By utilizing an existing linear infrastructure corridor, the project effectively avoids significant risks to species and ecosystems, in line with the ESS6 mitigation hierarchy. Accordingly, the assessment has concluded that the railway's passage through the Feneryolu Wildlife Development Area will have no effect on its biodiversity functions or conservation objectives.

Table 4-8 Legally Protected Areas near the Project Route

Protected Area	IUCN Protected Area Category	Distance to the Project Route (km)
Çilingöz Nature Park	V	45.77
Danamandıra Nature Park	V	25.97
Şamlar Nature Park	V	11.29
Göktürk Nature Park	V	2.87
Ayvabendi Nature Park	V	2.80
Fatih Çeşmesi Nature Park	V	6.25
Marmarcık Nature Park	V	2.15
Kömürcübent Nature Park	V	2.46
Fatih Rıfkı Atay Nature Park	V	3.85
Bentler Nature Park	V	3.32
Neşetsuyu Nature Park	V	4.11
Irmak Nature Park	V	5.91
Kirazlıbent Nature Park	V	6.35
M. Akif Ersoy Nature Park	V	5.31
Türkmenbaşı Nature Park	V	9.03
Park Orman Nature Park	V	9.82
Fatih Sultan Mehmet Nature Park	V	8.43
Mihribat Nature Park	V	11.98
Polonezköy Nature Park	V	5.05
Elmas Buru Nature Park	V	4.36
Avcıkoru Nature Park	V	6.43
Hacetderesi Nature Park	V	1.76
Değirmenburnu Nature Park	V	15.49
Dilburnu Nature Park	V	14.31
Büyükada Nature Park	V	13.71
Göztepe Nature Park	V	11.11
Beykoz Göknarlık Nature Reserve	V	3.86
Çilingöz Wildlife Development Areas	V	24.45
Feneryolu Wildlife Development Areas	V	Within the Area
Marmara Sea and Islands Special Environmental Protection Areas	V	Within the Area

4.2.7.5 Baseline Conditions

Baseline studies conducted in the Biodiversity Study Area as shown in Figure 8, rely on previously conducted studies, literature information on habitats and species, as well as direct observations and Project-specific data collected on site by field experts. Field methodologies developed by each of these experts and study results are presented in the previous sections. Some of the general methodologies for field surveys can be listed as the following:

- In determining sampling/vantage points, locations that represent different habitat types and those that had been identified to be significant to species were considered.
- Some of the flora and fauna species were recorded through direct observations.

Habitat Classification

The European Nature Information System (EUNIS) puts forward a system for identification and classification of European habitat types. Classification area is quite large including the entire European mainland and seas including islands that are close to the mainland (except for Cyprus, Iceland and Greenland), EU states' archipelagos (Canary Islands, Madeira Islands and Azore Islands) and the European mainland to the west of Ural Mountains that cover Türkiye and the Caucasus. The main objective of the EUNIS habitat classification is to create a European reference set of habitat types including a description of all types and hierarchical classification.

Habitats within the Biodiversity Study Area were evaluated in accordance with the EUNIS classification, which is useful in terms of not only relating the national classifications to international level, but in terms of corresponding EUNIS habitats to habitats listed in Annex I of Habitats Directive for "designation of special areas of conservation" and the European Red List of Habitats (Janssen, 2016) for the critical habitat assessment.

As part of the İstanbul North Rail Crossing Project, a total of seven distinct habitat types were identified within the project area, based on the EUNIS Level 3 classification. Of these, five are natural habitat types and two are modified (anthropogenically altered) habitats. Each natural habitat type supports different vegetation communities. However, these natural habitats are not continuous along the project corridor; they are generally fragmented and distributed in a discontinuous pattern. Natural habitat types of the Biodiversity Study Area, characteristic plant species of these habitats, related EUNIS codes, are presented in Table 4-9.

Table 4-9 Habitats of the Biodiversity Study Area

EUNIS Habitat Type	Habitat Name (EUNIS-compliant)	Habitat Characteristics
E3.4	Moist or wet utrophic and mesotrophic grassland	This habitat type is found in flat valley bottoms, riparian plains, and areas surrounding water sources where groundwater levels are high. Vegetation cover is nearly 100% but with low species diversity. Characteristic species mainly belong to the families Cyperaceae, Juncaceae, and Gramineae, along with a significant presence of Fabaceae species. These areas are typically used for grazing by livestock. Dominant species include *Juncus heldreichianus, Juncus inflexus, Ranunculus constantinopolitanus, Plantago lanceolata, Pulicaria dysenterica, Dipsacus laciniatus, Leucojum aestivum*, and *Conium maculatum*.
G1.1	Riparian galleries of *Alnus, Betula, Populus* and *Salix*	Found along high water table alluvial valley floors and stream corridors. Dominant tree species vary by stream; in some areas Salix alba dominates, while in others *Alnus glutinosa* prevails. Characteristic tree species include *Ulmus minor, Alnus glutinosa, Fraxinus angustifolia, Populus alba,* and *Salix alba*. The understorey includes shrubs such as *Rubus sanctus* and *Prunus spinosa*, and water-dependent herbaceous species such as *Juncus heldreichianus, Juncus inflexus, Carex pendula, Pulicaria dysenterica, Plantago lanceolata*, and *Dipsacus laciniatus.*
G1.A	Mixed deciduous forests of meso- and eutrophic sites	Represents the typical climax forests of the Northern Marmara region, provided there is no anthropogenic disturbance. Dominant deciduous trees include *Quercus frainetto, Q. petraea, Q. robur, Q. cerris, Tilia argentea, Castanea sativa, Corylus avellana,* and *Carpinus betulus*. The shrub layer features species like *Arbutus unedo, Ruscus aculeatus, Phillyrea latifolia, Ligustrum vulgare,* and *Jasminum fruticans*. Common herbaceous species include *Dactylis glomerata, Galanthus nivalis, Cyclamen coum, Oenanthe pimpinelloides, Ranunculus ficaria,* and *Sanguisorba minor*. Species dominance varies locally.
C1.2	Permanent mesotrophic lakes, ponds and pools	Represents natural and artificial ponds and lakes within the Project Area.
C3.2	Tall helophyte beds	Occurs along the margins of lakes and wetlands with tall, water-dependent vegetation. Dominant species include *Phragmites australis, Typha latifolia, Carex pendula,* and *Cyperus longus.*
G3.F	Conifer plantations	Conifer plantations are common in the Thrace region. Within the Project Area, plantation forests composed of *Pinus pinaster* and *Pinus pinea* are present. Although plantations were established on previously natural habitats, native species have been largely removed. Natural vegetation is suppressed and tree growth is often stunted. In terms of floristic composition, plantations show some resemblance to nearby deciduous mixed forests.
I1.2	Mixed crops of market gardens and horticulture	Although limited in extent along the Project route, this modified habitat type is characterized by cultivated lands, predominantly wheat and sunflower fields. Some orchards are also present with fruit trees such as quince, plum, and hazelnut.

Photographs of the natural and modified EUNIS habitat types of the Biodiversity Study Area are presented in Figure 4-13 and the Habitat Map of the study area is shown in Appendix 6.4.

Within the scope of the ESIA, EUNIS habitat types of the Biodiversity Study Area were conducted only within the impact area of the railway line corridor. No assessment was performed for the associated facilities at this stage. However, comprehensive studies covering both the railway line and all associated facilities will be conducted and included in the ESIA to be updated byAYGM as required once the Project design is finalized.



E3.4 Moist or wet utrophic and mesotrophic grassland



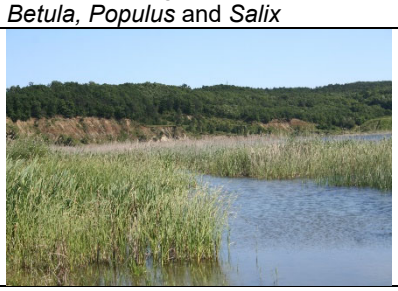
G1.1 Riparian galleries of *Alnus, Betula, Populus* and *Salix*



G1.A Mixed deciduous forests of meso- and eutrophic sites



C1.2 Permanent mesotrophic lakes, ponds and pools



C3.2 Tall helophyte beds



G3.F Conifer plantations



I1.2 Mixed crops of market gardens and horticulture

Figure 4-13 Habitats of the Biodiversity Study Area

4.2.7.6 Terrestrial Flora

This section outlines the scope, objectives, and methodology of the flora and vegetation survey conducted along the route of the İstanbul North Rail Crossing Project (“INRAIL”). The INRAIL Project aims to establish a missing high-capacity, heavy-duty rail connection between the European and Asian sides of İstanbul. The project entails the construction of a 127 km long double-track electrified and signaled railway line, crossing the Bosphorus via the YSS Bridge, connecting Çayırova station (Asian side) to Çatalca station (European side). Additional railway links will provide high-standard rail access to İstanbul Airport and a connection to Sabiha Gökçen Airport. The project is being implemented by AYGM under the MoTI of the Republic of Türkiye.

The primary objectives of the flora and vegetation study are as follows:

1. To identify plant species occurring or likely to occur along the project corridor, including native and conservation priority species;
2. To classify the main habitat types based on EUNIS Level 3 categories and to produce a habitat map;

3. To assess the presence of rare, locally endemic, or threatened species (according to IUCN categories CR, EN, and VU) and to develop appropriate in-situ and/or ex-situ conservation measures;
4. To identify any potential critical habitats under the EU Habitats Directive and to develop mitigation and enhancement strategies aimed at avoiding or minimizing project-related impacts on these habitats;
5. To determine potential negative impacts of the project on flora and to propose appropriate mitigation measures in line with ESS6.

The project corridor generally lies within the Mediterranean climate zone, although certain sections are influenced by Oceanic climatic conditions. As a result, vegetation types shaped by both Mediterranean and Oceanic climates are present across the project area. The route predominantly traverses natural mixed deciduous forests as well as plantation forests composed of *Pinus pinaster* and *Pinus pinea.* Natural habitats occupy approximately 30% of the total area along the project corridor. These natural vegetation zones are primarily characterized by mixed deciduous forest habitats. However, the natural habitats along the INRAIL project route are not continuous and appear in a fragmented pattern.

A two-day field survey was conducted along the Gebze–Çatalca corridor of the İstanbul North Rail Crossing Project in June 2025. As a result of this fieldwork, a total of 268 taxa at species and subspecies level, belonging to 68 different plant families, were recorded across the project area (see Table 2). Among these, two species — *Centaurea hermannii* and *Cirsium polycephalum* — are endemic to Türkiye, both with a regional distribution range.

In addition, four non-endemic but rare species were identified within the project footprint: *Ferulago confusa*, *Symphytum tuberosum* subsp. *nodosum*, *Lilium martagon*, and *Leucojum aestivum*. Furthermore, two plant species listed under CITES, *Cyclamen coum* and *Galanthus nivalis*, were also observed in the area.

As a result of the field surveys carried out within the project area, a total of six notable plant taxa were identified, including two regionally endemic species (*Centaurea hermannii* and *Cirsium polycephalum*) and four non-endemic but rare species (*Ferulago confusa*, *Symphytum tuberosum* subsp. *nodosum*, *Lilium martagon*, and *Leucojum aestivum*) (see Figure 4-14). In addition, Cyclamen coum, a species listed under CITES, was also recorded in the project area.

One of the regionally endemic species, *Cirsium polycephalum*, is distributed predominantly in the Marmara Region, especially around the İstanbul area. It typically inhabits forest clearings, shrublands (friganas), and steppe habitats. These habitat types are increasingly under pressure from land use changes, leading to significant habitat loss. As a result, *Cirsium polycephalum* is classified as “Critically Endangered (CR)” on the IUCN Red List at the global level.

The second regionally endemic species, *Centaurea hermannii*, is primarily found in deciduous oak forests of the Marmara Region. Due to its restricted range and limited population size, it is classified as “Endangered (EN)” on the IUCN Red List.

Ferulago confusa and *Symphytum tuberosum* subsp. *nodosum*, although not endemic, are considered rare due to their limited distribution, being confined to the Thrace region of Türkiye. Both species are assessed as “Vulnerable (VU)” at the national level.

Lilium martagon and *Leucojum aestivum*, which are not endemic but are included in the CITES list due to the commercial export of their bulbs, are found in deciduous forest habitats and wetlands within the Marmara and Western Black Sea Regions. These two species are also categorized as “Vulnerable (VU)” nationally under IUCN criteria.

The list of the flora species around the Project Are is submitted in Appendix 6.2.

Detailed information on critical species, including risk assessments, conservation objectives, mitigation measures, monitoring protocols, assigned responsibilities, resources, training

requirements, and a checklist for implementation have to be documented in the BMP in accordance with ESS6, with provisions for regular review and adaptive management.

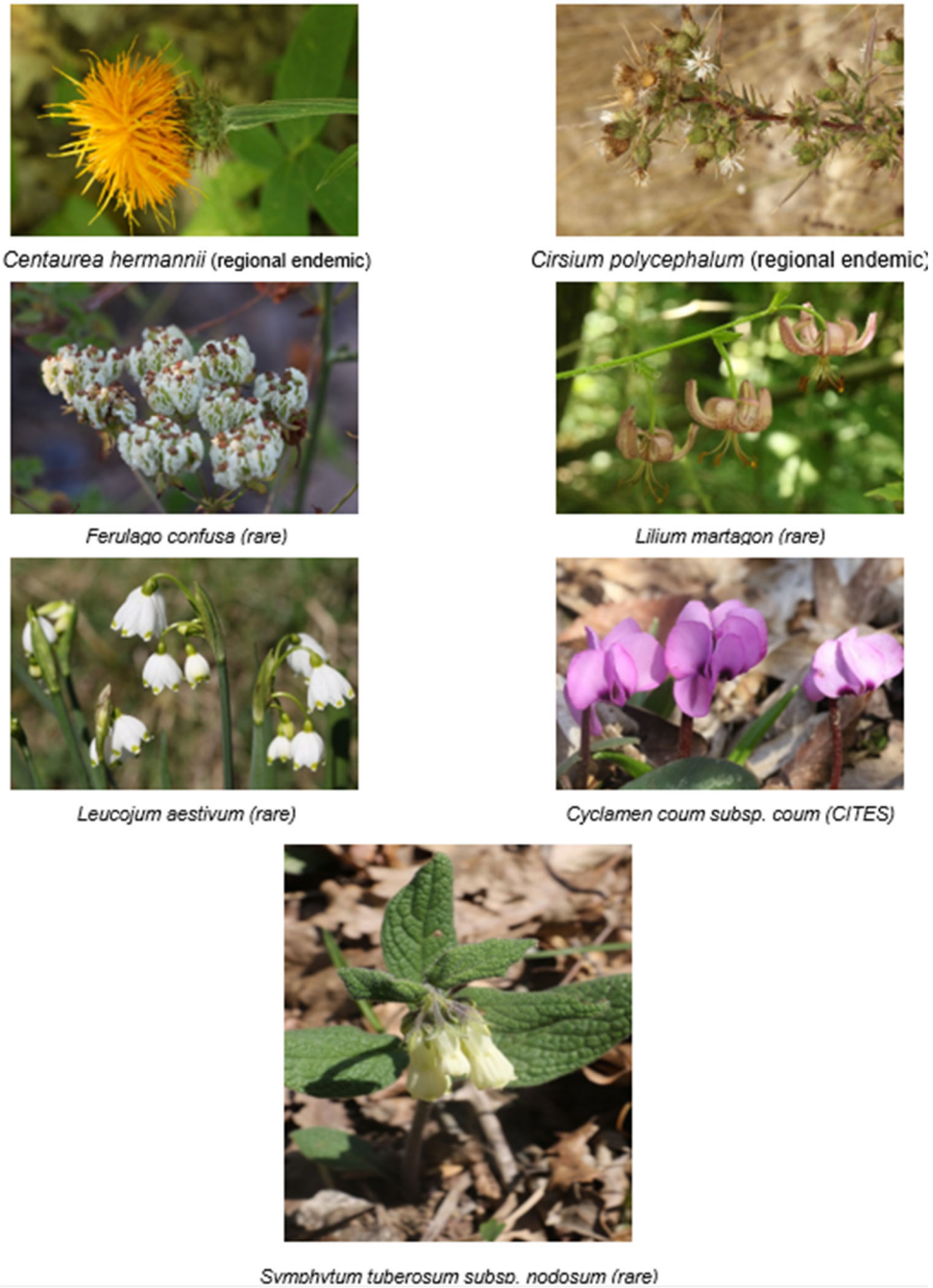


Figure 4-14 Endemic and Rare Plant Species

4.2.7.7 Terrestrial Fauna

Fauna studies conducted as part of biodiversity assessments aim to identify the habitat types present within a project area, the animal species occupying these habitats, and key species of conservation concern, including those that are rare, endemic, or legally protected. These studies contribute to understanding the ecological sensitivity of the area and provide a scientific basis for planning and managing the area while conserving biodiversity.

The objective of this study is to identify and assess terrestrial fauna species present within the proposed route of the İstanbul North Rail Crossing Project. The project area is located in the

Marmara Region, extending between Çatalca District (İstanbul Province) and Gebze District (Kocaeli Province).

Descriptions of the area's vegetation and habitat types are provided in the flora section of this report.

4.2.7.7.1 Baseline Conditions and Terrestrial Fauna Studies

The İstanbul North Rail Crossing Project is located in the Marmara Region and involves the construction of a 127 km railway line extending between Çatalca District (İstanbul Province) and Gebze District (Kocaeli Province). The railway alignment branches off from the Marmaray Line at Çayırova, passes near Sabiha Gökçen Airport, then turns north to cross the Bosphorus via the YSS Bridge, reaches İstanbul Airport, and finally connects to the Halkalı–Kapıkule Line at Çatalca.

To minimize E&S impacts, the project includes various engineering structures along its alignment: 3 single-track TBM tunnels (totaling 19,560 m), 19 double-track NATM tunnels (totaling 21,547 m), 11 cut-and-cover tunnels (totaling 5,329 m), and 29 viaducts (totaling 14,687 m). In total, approximately 56 km of the railway (about 41 km of tunnels and 15 km of viaducts) has been designed to traverse the landscape in a way that reduces potential impacts on biodiversity and natural habitats.

The planned railway corridor mostly runs parallel to the Northern Marmara Motorway and serves as a strategic connection between Europe and Asia via the YSS Bridge. Some sections of the alignment pass through agricultural lands, residential areas, oak and pine forests, and a wetland area located to the north of Lake Büyükçekmece.

The terrestrial fauna survey was conducted by Prof. Dr. Mustafa Sözen from the Department of Biology, Faculty of Science, Zonguldak Bülent Ecevit University, on June 28–29, 2025. During the survey period, the weather was partly cloudy to overcast, and temperatures ranged between 26°C and 32°C.

4.2.7.7.2 Invertebrates

Odonata (Dragonflies and Damselflies)

Although several Odonata (dragonflies and damselflies) species were observed during the field survey, it is acknowledged that different species have varying flight periods throughout the year. Therefore, in order to develop a comprehensive species list for the Project area, the *Atlas of the European Dragonflies and Damselflies* (Boudot and Kalkman, 2015) was consulted. Based on this source, a total of 51 Odonata species were identified as potentially occurring within the study area (See Appendix 6.5).

According to Boudot and Kalkman (2015), four of these species are listed as endangered or protected under the Bern Convention and/or the EU Habitats Directive (See Appendix-6.6). Global distribution maps of these species are provided in Figure 4-15, Figure 4-16, Figure 4-17, ad Figure 4-18.

- *Cordulegaster picta*: Historical records from the project area mostly date prior to 1990. However, it is still included in the list due to its documented presence in nearby locations with current distribution.
- *Gomphus flavipes*: Likewise, records from the project area are from before 1990, and the species is considered very unlikely to be currently present, but has been retained in the list due to its past presence.
- *Sympetrum depressiusculum*: Although no point records exist within the project boundary, its occurrence both to the east and west of the area suggests the possibility of its presence in the intermediate region and thus it has also been included.

Detailed information on critical species, including risk assessments, conservation objectives, mitigation measures, monitoring protocols, assigned responsibilities, resources, training

requirements, and a checklist for implementation have to be documented in the BMP in accordance with ESS6, with provisions for regular review and adaptive management. Photographs of selected Odonata species are presented in Figure 4-19.

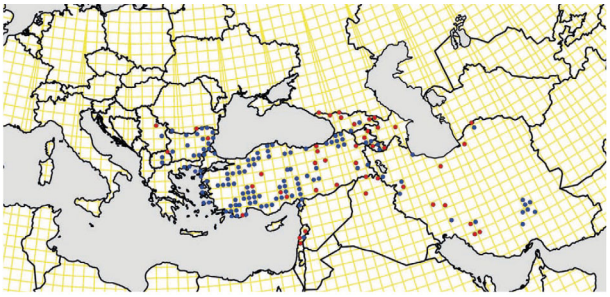


Figure 4-15 World distribution of *Cordulegaster insignis* (12)

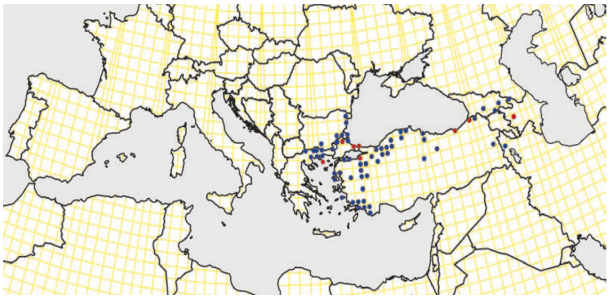


Figure 4-16 World distribution of *Cordulegaster picta* (13)

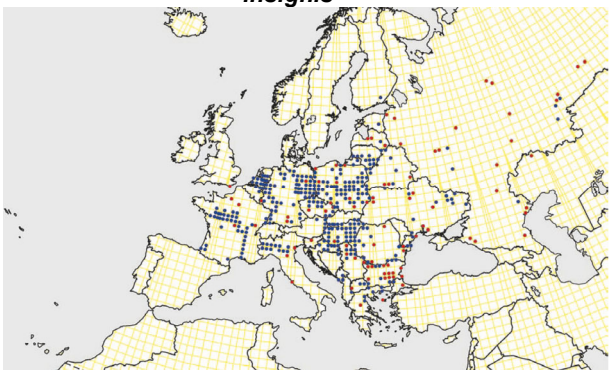


Figure 4-17 World distribution of *Gomphus flavipes* (14)

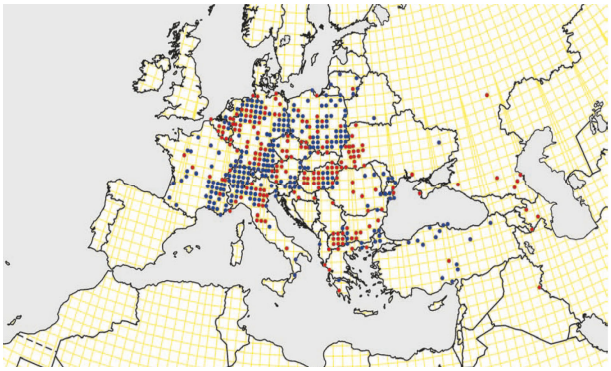


Figure 4-18 World distribution of *Sympetrum depressiusculum* (15)



12 *Red dots indicate records prior to 1990, while blue dots indicate records after 1990*
13 *Red dots indicate records prior to 1990, while blue dots indicate records after 1990*
14 *Red dots indicate records prior to 1990, while blue dots indicate records after 1990*
15 *Red dots indicate records prior to 1990, while blue dots indicate records after 1990*

Figure 4-19 Some Odonata species from the Project site [16]

Lepidoptera (Butterflies)

Due to the varied flight periods of many butterfly species, conducting a comprehensive butterfly inventory based solely on a two-day field survey in June is not feasible. Therefore, to compile as complete a list of butterfly species as possible for the Project area, the species list presented in Appendix-6.7 was developed by reviewing İstanbul records available on platforms such as trakel.org and adamerkelebek.org. These platforms contain tens of thousands of photographic records contributed by hundreds of observers. Species were selected based on their likelihood of occurrence within the Project's route and habitat structure.

None of the butterfly species identified for the Project area are endemic or classified as endangered. According to the IUCN global Red List, four species are categorized as Near Threatened (NT), while one species is listed under the national conservation status.

Detailed information on critical species, including risk assessments, conservation objectives, mitigation measures, monitoring protocols, assigned responsibilities, resources, training requirements, and a checklist for implementation have to be documented in the BMP in accordance with ESS6, with provisions for regular review and adaptive management.



Figure 4-20 Some butterfly species from the Project site [17]

4.2.7.7.3 Amphibians

Amphibians are species dependent on aquatic environments for reproduction, although some spend the majority of their lives on land. Along the railway corridor, several permanent water bodies are present, including water channels and creeks near Lake Büyükçekmece, small creeks crossed by the railway, and a lake located within Study Point 18. Due to the summer timing of the

[16] *a. Calopteryx splendens, b. Libellula fulva, c. Pernis apivorus, d. Onychogomphus forcipatus, e. Libellula depressa, f. Lestes dryas, g. Platycnemis pennipes, h. Coenagrion scitulum.*

[17] *a. Limenitis reducta, b. Vanessa atalanta, c. Argynnis pandora, d. Hipparchia syriaca, e. Aporia crataegi, f. Melitaea didyma, g. Coenonympha arcania, h. Papilio machaon, i. Iphiclides podalirius, j. Ochlodes sylvanus, k. Melanargia galathea, l. Colias crocea, m. Polyommatus icarus.*

field survey, some amphibian specimens were directly observed during the assessment.

A total of 11 probable amphibian species at the Project site are listed in Appendix-6.8. Two of these species are endemic; however, none are currently classified under the threatened categories by the IUCN. The IUCN assessment for *Ommatotriton nesterovi* has not yet been completed (Not Evaluated - NE).

Study Point 21, located north of Lake Büyükçekmece, contains swampy areas and creeks that appear to retain water throughout the amphibian breeding season. Similarly, at Study Point 18, the railway crosses a lake that provides suitable aquatic habitat for amphibians. Additionally, a swampy area and creeks near Study Point 21 also represent important habitats for amphibians. These three locations are considered particularly significant for amphibian conservation.

According to the Bern Convention Appendices, five amphibian species at the Project site are listed in "*Appendix II (Strictly Protected Fauna Species)*", while the remaining six species are included in "*Appendix III (Protected Fauna Species)*". Furthermore, under the EU Habitats Directive, five species are listed in *"Annex IV"*, one species in *"Annex V"*, and two species in Annex III.

Detailed information on critical species, including risk assessments, conservation objectives, mitigation measures, monitoring protocols, assigned responsibilities, resources, training requirements, and a checklist for implementation have to be documented in the BMP in accordance with ESS6, with provisions for regular review and adaptive management.

4.2.7.7.4 Reptiles

A total of 30 reptile species is considered likely to occur within the Project area and are presented in Appendix 6.9. None of these species are endemic. However, *Testudo graeca* (Spur-thighed tortoise) is listed as Vulnerable (VU) on the IUCN Red List and was directly observed at multiple locations within the study area.

Based on the Bern Convention Appendices, 19 reptile species found within the Project site are listed under *"Appendix II (Strictly Protected Fauna Species)",* and 10 species are listed under *"Appendix III (Protected Fauna Species)"*.

According to the EU Habitats Directive, 19 species are included in Annex IV (Animal and plant species of Community interest in need of strict protection), and three species are listed in Annex II (Animal and plant species of Community interest whose taking in the wild and exploitation may be subject to management measures).

Due to the high summer temperatures during the field survey, relatively few reptile species were directly observed. Only *Testudo graeca*, *Ablepharus kitaibelii*, *Lacerta viridis*, *Ophisops elegans*, and *Natrix natrix* were recorded through direct sightings (Figure 4-21). All other species were identified based on habitat suitability, previous records, and scientific literature.

Detailed information on critical species, including risk assessments, conservation objectives, mitigation measures, monitoring protocols, assigned responsibilities, resources, training requirements, and a checklist for implementation have to be documented in the BMP in accordance with ESS6, with provisions for regular review and adaptive management.



Figure 4-21 Some reptile species observed at project area [18]

4.2.7.7.5 Birds

Field surveys were conducted on June 28–29, 2025, by Prof. Dr. Mustafa Sözen. Given the timing of the study fell outside the spring bird migration season, only a few migratory bird species were directly observed. However, data from a prior ornithological study conducted by Prof. Sözen on March 4–5, 2020, for the Halkalı–Kapıkule Railway Project, which coincides partially with the current project route, were integrated into the assessment. During the earlier study, 34 migratory bird species were directly recorded. In total, 255 bird species are considered potentially present in the project area, including resident and migratory species (See Appendix 6.10).

The project area is located on the main bird migration corridor of Türkiye. Each year during spring, millions of birds migrate from Africa to Europe through the Bosphorus Strait, particularly over the area where the Yavuz Sultan Selim Bridge is located. Due to this, a high number of migratory species were included in the project bird list. However, this does not imply permanent residency; many are passage migrants only briefly present during seasonal movements.

Istanbul is known as one of the world's most important bottlenecks for bird migration. Each spring and autumn, a spectacular passage of medium and large soaring species, including nearly 50% of the European population of White Storks, alongside Black Storks and tens of thousands of raptors such as the Lesser Spotted Eagle, Honey Buzzard, and Short-toed Snake Eagle take place. These species rely on thermal air currents to glide across the Bosphorus, while songbirds—including various warblers, flycatchers, and thrushes—move in vast numbers through the city's green patches. These migrants utilize Istanbul’s diverse landscape as vital "stopover" sites. The dense northern forests like Belgrad or Polonezköy provide essential cover and food for passerines, while the agricultural fields and meadows of Şile, Arnavutköy and Çatalca districts offer resting grounds.

Medium and large soaring migrant activity, while occurring everywhere across the Istanbul bottleneck, concentrates at approximately 10 km band from Şile to Terkos in the spring. Two landfills in Şile and Arnavutköy districts are also attractive rest and refuel areas for these species. Autumn migration is less concentrated than spring, but generally the southern coastline is favoured, especially by White Stork. Çatalca and Büyükçekmece fields are significant in autumn.

The city’s complex network of wetlands supports a high diversity of waterbirds, acting as both breeding grounds and wintering sites. On the European side, the freshwater ecosystems of Terkos, Büyükçekmece, and Küçükçekmece, along with the Sazlıdere basin, provide important

[18] *a.Testudo graeca, b. Lacerta viridis, c. Ophisops elegans, d. Natrix natrix, e. Ablepharus kitaibelii.*

habitats for waterbird species. To the east, the coastal marshes of Şile and the Tuzla Kamil Abduş Lagoon are indispensable for shorebirds and waders. These wetlands form a chain that sustains resident populations and wintering waterfowl.

None of the recorded bird species within the project area are endemic. In terms of conservation status based on the IUCN Red List, 4 species are classified as Vulnerable (VU), 3 species as Endangered (EN), and 1 species as Critically Endangered (CR). An additional 12 species are assessed as Near Threatened (NT), while the remaining species fall under the Least Concern (LC) category.

According to the Bern Convention, 171 of the recorded species are listed under Annex II (Strictly Protected Fauna Species), and 75 species are listed under Annex III (Protected Fauna Species). In accordance with the National Hunting Regulation (MAK) for the 2024–2025 period, 49 species are included in Annex I, which comprises protected game animals, and 26 species are included in Annex II, indicating species whose hunting is permitted for limited periods.

Regarding international trade regulations, 3 species are listed in *"Appendix I"* and 3 species in *"Appendix II"* of the CITES. Under the EU Birds Directive, 87 species are listed in *Annex I* (requiring special conservation measures), 15 in *Annex IIA*, 38 in *Annex IIB*, 2 in *Annex IIIA*, and 13 in *Annex IIIB*.

In addition to direct field observations conducted in June 2025, the assessment incorporated data from previous field surveys conducted in March 2020, wintering bird studies around Büyükçekmece and Küçükçekmece Lakes, online databases such as eBird, and relevant scientific literature. These multiple data sources were used to create a comprehensive and robust bird species list for the project area.

Detailed information on critical species, including risk assessments, conservation objectives, mitigation measures, monitoring protocols, assigned responsibilities, resources, training requirements, and a checklist for implementation have to be documented in the BMP in accordance with ESS6, with provisions for regular review and adaptive management.

Within the scope of the ESIA, field surveys for birds were conducted only within the impact area of the railway line corridor. No surveys were carried out of the associated facilities at this stage.



Figure 4-22 Some birds photographed at the Project site [19]

4.2.7.7.6 Mammals

Although no mammal individuals were directly observed during the field surveys conducted for the Project, various indirect signs, including burrows and footprints, were recorded, indicating the presence of mammalian fauna in the area. Based on the general habitat characteristics of the Project site and existing distribution data, 70 probable mammal species were identified as likely to occur within the Project area (See Appendix 6.11).

Consultations were undertaken with the competent local authority, the General Directorate of Nature Conservation and National Parks (DKMP), in relation to the Project. Updated information was obtained from DKMP regarding the Wildlife Development Area (YHGS) and the Belgrad Forest sections of the Project area. In particular, current information on roe deer, red deer, and otter was obtained.

- At observation points located within the Wildlife Development Area (YHGS), Belgrad Forest, and the ecological bridge section, mammal activity was recorded as relatively low. Observations indicated that mammal movement in these areas was generally oriented

[19] *a. Motacilla alba, b. Ardeola ralloides, c. Pernis apivorus, d. Carduels carduelis, e. Pica pica, f. Circus cyaneus, g. Hieraaetus pennatus, h. Lullula arborea, i. Circus aeruginosus, j. Phylloscopus trochilus, k. Merops apiaster, l. Acrocephalus arundinaceus, m. Ciconia ciconia*

towards the south.

- The Feneryolu Wildlife Development Area has largely lost its functional role as a wildlife enhancement area due to intensive human pressures. Roe deer (Capreolus capreolus) populations have declined markedly and are now reportedly limited to one or two family groups, mainly due to traffic noise, vehicle collisions, and attacks by domestic dogs. In this context, restricting construction during the breeding season (March/May–August) is considered essential. In addition, forest regeneration works undertaken in some roe deer nesting areas have inadvertently affected sensitive habitats, highlighting the need for effective coordination among relevant local authorities.
- According to consultations with local authorities, stream corridors constituting important habitat for the Eurasian otter (Lutra lutra) require ecological rehabilitation in order to improve habitat quality, restore ecological connectivity, and support the species' long-term viability.

According to the supplementary surveys, within the Büyükçekmece Lake basin, was identified as an important area for boar and jackal, particularly due to the presence of wetland-associated habitats. The northern part of Belgrad Forest was also considered suitable habitat for golden jackals. It was reported that a family group occurs in this area, and that their vocalisations can be heard during the evening. Within the Sabiha Gökçen Airport – YSS Bridge section of the Project, a relatively high number of mammal signs were recorded, indicating that the area is actively used by mammals.

Among these, *Nannospalax turcicus* and *Microtus fingeri* are endemic to Türkiye, and *Talpa martinorum* is considered regionally endemic, with a limited geographic range.

Regarding their global conservation status, two species are classified as Vulnerable (VU) and two as Endangered (EN) on the IUCN Red List. The remaining species are either listed as Least Concern (LC) or have not yet been evaluated (NE).

According to the Bern Convention, 31 of these species are included in Annex II, which lists strictly protected fauna species, while 15 are listed in Annex III, indicating species subject to protection. The remaining 30 species are not covered by the Bern Convention.

Under the National Hunting Regulation (MAK 2024–2025), 2 mammal species are listed in Annex I, which includes game animals under protection, while 4 species are included in Annex II, which allows limited hunting during specified seasons.

According to the CITES Appendices, 2 species are listed in *"Appendix I"*, covering species threatened with extinction and requiring the highest level of protection; 1 species is listed in *"Appendix II"*, which includes species not necessarily threatened but whose trade must be controlled; and 2 species are included in *"Appendix III"*, which lists species protected in at least one country that has requested assistance from other Parties in regulating trade.

Finally, in accordance with the EU Habitats Directive, 13 species are listed in Annex II, which comprises species requiring the designation of special conservation areas; 6 species are in Annex IV, which includes species in need of strict protection; and 2 species are included in Annex V, referring to species whose exploitation may be regulated.

In summary, although direct sightings were not recorded during the limited field effort, the presence of signs and availability of suitable habitats strongly suggest that the Project area supports a relatively diverse mammal community, including species of conservation concern and endemics. Further monitoring is recommended to confirm actual species presence and, if necessary, to develop species-specific mitigation measures.

Detailed information on critical species, including risk assessments, conservation objectives, mitigation measures, monitoring protocols, assigned responsibilities, resources, training requirements, and a checklist for implementation have to be documented in the BMP in

accordance with ESS6, with provisions for regular review and adaptive management.

Within the scope of the ESIA, field surveys for mammals were conducted only within the impact area of the railway line corridor. No surveys were carried out for the associated facilities at this stage.



Figure 4-23 Some mammal signs photographed at the Project site [20]

4.2.7.8 Invasive Alien Species

The CBD defines invasive alien species as species whose introduction and/or spread outside their natural past or present distribution threatens biological diversity. Invasive Alien Species occur across all taxonomic groups—including animals, plants, fungi, and microorganisms—and can impact all types of ecosystems.

According to the IUCN, invasions by alien species have caused significant degradation with negative impacts on biodiversity and local livelihoods. Therefore, projects that may inadvertently introduce Invasive Alien Species must be screened for their potential risks, and appropriate preventive measures must be implemented. Under WB-ESS6, projects with potential for introducing alien species require a comprehensive risk assessment. Because eradication of Invasive Alien Species once established demands considerable effort and resources, prevention is recognized as the first and most critical step in management.

At the global level, the Global Invasive Species Programme and the IUCN Species Survival Commission's Global Invasive Species Database lead international cooperation to minimize the spread and impact of Invasive Alien Species and to conserve biodiversity. The Global Invasive Species Database is currently developing the Global Register of Introduced and Invasive Species, which provides validated and annotated country-level inventories of introduced and invasive species.

In Türkiye, extensive marine Invasive Alien Species datasets exist, while studies on terrestrial Invasive Alien Species are relatively limited. A Global Environment Facility funded project led by the DKMP focuses on preventing, detecting, controlling, and managing Invasive Alien Species in key marine biodiversity areas. In line with recent European Union legislation on Invasive Alien Species (Regulation 1143/2014), which mandates a coordinated response by member states to threats posed by invasive species to biodiversity and ecosystem services, similar initiatives are

[20] *a. Nannospalax turcicus mounds, b. Talpa europaea/martinorum burrow, c. Canis aureus foot print, d. Microtus sp. burrow*

planned for inland water and terrestrial ecosystems.

Research indicates that approximately 1.5% of plant species in Türkiye are exotic (Arslan et al., 2015), although a comprehensive alien plant list is still lacking. Türkiye is a member of the European and Mediterranean Plant Protection Organization (EPPO), an intergovernmental organization that coordinates plant health protection by developing international strategies to regulate and prevent the introduction and spread of pests through its A1 and A2 pest lists. Species recorded in the EPPO list of invasive alien plants and present in Türkiye include *Acroptilon repens, Ailanthus altissima, Ambrosia artemisiifolia, Carpobrotus edulis, Cortaderia selloana, Cyperus esculentus, Paspalum distichum, Opuntia ficus-indica, Oxalis pes-caprae,* and *Sicyos angulatus*. Additionally, *Azolla filiculoides* and *Rhododendron ponticum* are listed in the EPPO Observation List of invasive alien plants, while *Miscanthus sinensis*, on the EPPO Alert List, is also recorded within Türkiye's flora (Arslan et al., 2015).

The use of nitrogenous fertilizers in agricultural areas, destruction caused by plowing, manure of farm animals (feces), and transfer of seeds by vehicles can lead to an increase in the number of individuals of some species. These species are called "opportunists". The plants that are common in agricultural areas, roadsides, and around agricultural structures are the species.

The Project area is located within the Marmara Region, which is known to be ecologically sensitive and particularly vulnerable to the spread of Invasive Alien Species. Field surveys conducted along the proposed route identified the presence of several Invasive Alien Species, including:

- *Ailanthus altissima* (Tree of heaven) (See Figure 4-26),
- *Robinia pseudoacacia* (Black locust) (See Figure 4-28),
- *Phytolacca americana* (American pokeweed) (See Figure 4-25),
- *Buddleja japonica* (See Figure 4-27),
- *Xanthium strumarium* subsp. *strumarium* (Common cocklebur) (See Figure 4-24).



Figure 4-24 *Xanthium strumarium* (Invasive Alien Species)



Figure 4-25 *Phytolacca americana* (Invasive Alien Species)



Figure 4-26 *Ailanthus altissima* (Invasive Alien



Figure 4-27 *Buddleja japonica* (Invasive Alien

Species) **Species)**



Figure 4-28 *Robinia pseudoacacia* (Invasive Alien Species)

These species have shown an increase in population density in the region and are actively threatening natural habitats through competitive displacement of native flora. If unmanaged, project activities may unintentionally contribute to the further spread and establishment of these species.

To minimize the risk of facilitating Invasive Alien Species propagation during construction and operational phases, the following measures are recommended:

- Prevention before fruiting: Individuals of fruit-bearing Invasive Alien Species species should be manually removed from the project footprint before reaching fruiting stages to prevent seed dispersal. Removed biomass should be safely incinerated at a designated site to avoid further spread.
- Eradication of woody Invasive Alien Species: For perennial and woody Invasive Alien Species such as *Ailanthus altissima*, *Robinia pseudoacacia*, and *Buddleja japonica*, mechanical removal of individuals—preferably with the root system intact—should be performed using appropriate equipment (e.g., backhoe/JCB). Care should be taken to prevent regrowth or vegetative propagation from root fragments.
- Follow-up and monitoring: Regular monitoring should be conducted to detect new occurrences or regrowth. Adaptive management strategies should be developed in accordance with findings.

Several invasive alien fauna species are known to occur in the Marmara Region. In the context of the Project, four invasive alien vertebrate species were considered during the assessment.

Among bird species, three invasive alien species have been recorded in the İstanbul region: *Psittacula krameri* (Rose-ringed Parakeet), *Psittacula eupatria* (Alexandrine Parakeet), and *Acridotheres tristis* (Common Myna). However, these species are typically restricted to urban parks and green spaces and were not observed along the project corridor. Therefore, they are not considered relevant to the project's direct impact zone and are not included in the species list for further action.

Podarcis sicula (Italian Wall Lizard), an invasive reptile species, has not been directly observed during field surveys; however, Vantage Point 21 contains habitat characteristics suitable for the species. Considering the potential presence of this species within suitable microhabitats, it has been included in the invasive alien species list for the project.

Trachemys scripta (Pond Slider), another invasive alien species frequently introduced through the pet trade, has become increasingly widespread in aquatic ecosystems across Türkiye. While not recorded during field surveys, Vantage Points 21 and 18 include aquatic habitats that may support this species. Therefore, the potential for its presence must be taken into consideration.

Currently, no invasive alien amphibian or mammal species have been recorded or are expected to occur in the project area.

An effective Invasive Alien Species Management Procedure has to be addressed within the framework of the BMP to be prepared in compliance with WB-ESS6. Training on Invasive Alien Species has to be provided to all relevant project personnel to raise awareness, enable early identification, and ensure effective management and prevention measures are implemented throughout the project lifecycle.

Within the scope of the ESIA, field surveys for Invasive Alien Species were conducted only within the impact area of the railway line corridor. No surveys were carried out for the associated facilities at this stage. However, comprehensive surveys covering both the railway line and all associated facilities will be conducted and included in the Final ESIA.

4.2.7.9 Critical Habitat Assessment (CHA)

4.2.7.9.1 Introduction

The purpose of this CHA is to evaluate the biodiversity values within and surrounding the proposed Project area in accordance with the requirements of ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. The CHA aims to determine whether the Project is located within or near areas considered as critical habitat, as defined by ESS6, and to ensure that potential impacts on biodiversity and ecosystem services are appropriately identified, assessed, and managed.

ESS6 recognizes that protecting and conserving biodiversity is essential for sustainable development and underlines the importance of maintaining ecosystem services upon which affected communities and economies depend. This assessment therefore supports informed decision-making by identifying the presence of habitats with high biodiversity value, including those supporting:

- Threatened or endangered species;
- Endemic or restricted-range species;
- Migratory or congregatory species;
- Unique or threatened ecosystems;
- Ecologically significant areas critical for the survival of species or the maintenance of ecosystem functions.

In line with the mitigation hierarchy (avoidance, minimization, restoration, and offset), the CHA provides a scientific basis for developing project-specific biodiversity management and mitigation measures. These measures aim to avoid impacts on critical habitats wherever possible and, where avoidance is not feasible, to ensure that development is consistent with ESS6 objectives, including no net loss or net gain of biodiversity values, as appropriate.

4.2.7.9.2 Objectives of the CHA

The primary objective of the CHA is to identify and assess the presence and extent of natural and critical habitats within the Project's AoI, in line with the requirements of ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources. This assessment supports biodiversity-informed project planning and ensures that project activities are consistent with the conservation objectives of ESS6.

The specific objectives of the CHA are to:

- Identify and classify terrestrial and aquatic habitats within the Project area according to ESS6 definitions of modified, natural, and critical habitats.
- Determine the presence of critical habitat triggers, such as:
  - Critically endangered and endangered species;

- Endemic and restricted-range species;
- Migratory and congregatory species;
- Threatened or unique ecosystems;

- Key biodiversity features essential for maintaining ecological processes and functions.
- Evaluate the biodiversity sensitivity and conservation value of habitats potentially impacted by the Project.
- Support application of the mitigation hierarchy by informing avoidance, minimization, restoration, and offset measures for biodiversity impacts.
- Inform the development of the Project's BMP and any necessary offset strategy, ensuring compliance with ESS6.
- Guide stakeholder engagement by identifying species and habitats of conservation concern that may be important to local communities, conservation authorities, or scientific stakeholders.
- Through these objectives, the CHA aims to ensure that the Project's planning, design, and implementation align with best practices for biodiversity conservation and sustainable use of natural resources, while minimizing risk to critical ecosystems and species.

4.2.7.9.3 Scope and Methodology

Scope of the Assessment

This CHA covers the Project's AoI, which includes the direct footprint of the proposed development, associated facilities (e.g., access roads, railway lines, pipelines), and surrounding areas potentially affected by direct, indirect , and cumulative impacts. The spatial extent of the assessment has been defined to capture ecologically relevant features, particularly those related to habitat connectivity, species movement, ecosystem services, and ecological boundaries beyond the project site.

The CHA addresses:

- Classification of habitats as modified, natural, or critical according to ESS6 definitions;
- Identification of species and ecosystems of conservation concern;
- Mapping of priority biodiversity features, including those potentially qualifying as critical habitat;
- Assessment of baseline ecological conditions, biodiversity values, and ecosystem functions;
- Evaluation of project-related risks to biodiversity, with a focus on critical habitat triggers.

Methodology

The CHA was developed through an integrated approach combining desktop analysis, field surveys, and expert consultation, consistent with ESS6 guidance and international best practices. The following steps were undertaken:

1. **Literature Review and Secondary Data Collection**
   - Compilation of existing biodiversity data from published scientific literature, EIA, government reports, IUCN Red List, GBIF, BirdLife International, and relevant national conservation databases.
   - Review of previous ecological studies conducted in or near the Project area.
2. **Geospatial Analysis**
   - Use of high-resolution satellite imagery, topographic and land use maps, and GIS tools to characterize habitat types, vegetation cover, and ecological connectivity.
   - Identification of legally protected areas, IBAs, KBAs, Ramsar Sites, Natura 2000 sites (if applicable), and other designated biodiversity areas.
3. **Field Surveys**

- Targeted biodiversity fieldwork to confirm the presence of critical habitat features, including floral and faunal surveys, habitat condition assessments, and species-specific searches (e.g., for endangered or migratory species).
- Seasonal considerations included where relevant to capture temporal ecological patterns (e.g., breeding, migration, dormancy).

4. **Critical Habitat Screening and Assessment**
   - Systematic application of ESS6 criteria to screen for critical habitat triggers.
   - Evaluation of the likelihood and significance of the Project affecting these triggers.
   - Classification of habitat types according to their ecological integrity and conservation importance.
5. **Limitations and Uncertainties**
   - Acknowledgment of data gaps, limitations in field access (if applicable), and ecological uncertainties, with recommendations for further studies where required.

This methodology ensures that the CHA is transparent, evidence-based, and aligned with the precautionary principle, supporting robust biodiversity risk assessment and informed decision-making under ESS6.

4.2.7.9.4 Regulatory and Policy Framework

The CHA has been developed in accordance with the applicable international standards, national legislation, and institutional policies related to biodiversity conservation and habitat protection. This section outlines the key regulatory and policy instruments guiding the assessment.

International Frameworks

World Bank Environmental and Social Standard 6 (ESS6):

ESS6 of the ESF requires that projects avoid adverse impacts on biodiversity and habitats, particularly in critical habitats and legally protected or internationally recognized areas. Where avoidance is not feasible, the standard mandates implementation of measures to minimize and mitigate biodiversity risks and impacts, with an emphasis on achieving no net loss and, where possible, net gain of biodiversity in critical habitat areas.

International Union for Conservation of Nature (IUCN) Red List of Threatened Species:

The IUCN Red List provides global conservation status assessments for species, serving as a key reference for determining species of concern and critical habitat triggers under ESS6.

Key Biodiversity Areas (KBAs) and Important Bird Areas (IBAs):

The assessment considers overlap or proximity to KBAs and IBAs, which may contribute to the identification of critical habitats due to the presence of globally significant biodiversity values.

Convention on Biological Diversity (CBD):

The CBD promotes the conservation of biological diversity, sustainable use of its components, and fair and equitable sharing of the benefits arising out of the utilization of genetic resources. The CHA contributes to national and international commitments under the CBD.

Convention on the Conservation of Migratory Species of Wild Animals (CMS):

If the project intersects known migratory routes, the CHA accounts for the conservation needs of migratory species, especially those protected under the CMS and related agreements such as AEWA (Agreement on the Conservation of African-Eurasian Migratory Waterbirds).

Ramsar Convention on Wetlands:

If the project area includes or is near a Ramsar site or a wetland with equivalent value, additional protection standards are applied consistent with Ramsar guidance.

National Legal and Institutional Framework (tailored per country — example below for Türkiye)

National Nature Conservation Legislation:

The assessment is aligned with national laws concerning protected areas, species conservation, forestry, and EIA. These include Environmental Law No. 2872, Forest Law No. 6831, National Parks Law No. 2873.

National Red List and Species Protection Directives:

National threat classifications, species protection statuses, and habitat mapping are used to complement global references.

Environmental Impact Assessment (EIA) Regulation:

The CHA is integrated into the national EIA process, ensuring consistency with legal requirements for biodiversity baseline assessment, impact evaluation, and mitigation planning.

4.2.7.9.5 Project Lender or Institutional Policies

This CHA has been prepared in alignment with the WB's ESF, which governs the environmental and social risk management of projects financed by the Bank. In particular, the assessment responds to the requirements set out under ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.

ESS6 recognizes the importance of maintaining biodiversity and ecosystem services, especially in areas considered natural or critical habitat. Under ESS6, projects situated in or near critical habitats are subject to strict conservation and management standards, and must demonstrate that:

- No viable alternatives to project location exist;
- Project activities will not lead to measurable adverse impacts on key biodiversity features or the ecological processes supporting them;
- The project will not result in a net reduction in the population of any recognized endangered or critically endangered species;
- Mitigation measures are designed to achieve no net loss or net gain of biodiversity, where feasible.

As part of the WB's ESF, the following standards and guidance are also relevant to this rail project:

- ESS1: Assessment and Management of E&S Risks and Impacts: Requires integrated risk and impact assessments, including biodiversity considerations, to inform project design and decision-making.
- WB EHSGs: Provides sector-specific and general guidance for minimizing environmental risks, including those related to habitat disturbance, construction-phase impacts, and pollution.
- WB Good Practice Note on Critical Habitat and Biodiversity: Offers guidance on determining critical habitat, identifying priority biodiversity features, and applying the mitigation hierarchy in a manner consistent with ESS6.
- ESCP: The findings of this CHA will inform the biodiversity-related commitments defined in the ESCP for the Project, including any requirements for BMPs, monitoring programs, or habitat offsets.
- WB Guidance Note on Protected Areas: Provides guidance on the assessment and management of potential project impacts on legally protected and internationally recognized areas, including requirements related to avoidance, stakeholder engagement, and coordination with relevant authorities, in line with ESS6.

As the WB is the financing institution for this rail project, compliance with the ESF and specifically with ESS6 critical habitat provisions is mandatory. This CHA plays a key role in identifying the

presence of critical habitat, evaluating potential impacts, and guiding the development of mitigation strategies to ensure that the project adheres to international biodiversity conservation standards throughout its lifecycle.

4.2.7.9.6 National Biodiversity and Environmental Legislation

The CHA has been developed in compliance with relevant Turkish environmental and conservation legislation, including:

- Environmental Law No. 2872: Establishes the framework for EIA, requiring biodiversity evaluations and protection measures.
- National Parks Law No. 2873: Governs the designation and protection of national parks, nature parks, nature reserves, and wildlife development areas.
- Forest Law No. 6831: Protects state forest lands and associated biodiversity features.
- Regulation on the Protection of Wetlands (Official Gazette No. 25818): Protects natural wetlands and areas of ecological significance.
- Biodiversity and National Biological Diversity Strategy and Action Plan (BSAP): Developed under the CBD, the BSAP outlines national priorities for the conservation and sustainable use of biodiversity.

Protected areas and species listed in the Official Gazette on the Protection of Wild Fauna and Flora and national Red Lists have been considered in this assessment. Additionally, the CHA aligns with spatial planning policies and regional development plans where ecological conservation zones are defined.

4.2.7.9.7 Definitions of Critical Habitat

Under the ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources, critical habitat is defined as areas with high biodiversity value that meet one or more of the following internationally recognized criteria. These areas require heightened protection due to their ecological importance, species richness, or support for globally significant biodiversity features.

ESS6 defines critical habitat as follows:

Critical Habitat is a subset of both natural and modified habitats that deserves particular attention. It includes areas with high biodiversity value, including:

- Habitat of significant importance to critically endangered and/or endangered species;
- Habitat of significant importance to endemic and/or restricted-range species;
- Habitat supporting globally significant concentrations of migratory species and/or congregatory species;
- Highly threatened and/or unique ecosystems; and
- Ecological functions or characteristics that are needed to maintain the viability of the biodiversity values described above.

These criteria are interpreted using international and national data sources such as the IUCN Red List of Threatened Species, BirdLife International, KBAs, IBAs, and other globally recognized databases. Critical habitats may also include legally protected areas, Ramsar Sites, UNESCO World Heritage Sites, or other internationally or nationally designated areas, depending on their ecological attributes.

According to ESS6, projects that may affect critical habitats must:

- Avoid adverse impacts on critical habitat where possible;
- Where avoidance is not feasible, implement measures to achieve no net loss of biodiversity;

- Demonstrate that the proposed development is not expected to lead to a measurable reduction in the population or range of any species qualifying the area as critical habitat;
- Maintain or enhance ecological processes supporting critical habitat features;
- Engage experts and relevant stakeholders to ensure that assessments and mitigation measures are robust and science-based.

The identification of critical habitat is a central component of the CHA and serves as a basis for determining project design constraints, mitigation strategies, and conservation obligations.

4.2.7.9.8 Methodology

This section outlines the methodology adopted to identify, assess, and determine the presence of critical habitat within the AoI of the proposed railway project, in line with the requirements of the ESS6: Biodiversity Conservation and Sustainable Management of Living Natural Resources.

The approach integrates desktop studies, field surveys, geospatial analysis, and expert consultations, and is based on the precautionary principle and the mitigation hierarchy (avoidance, minimization, restoration, offsetting).

4.2.7.9.9 Overview of the Approach

The CHA for the railway project was designed to:

- Classify habitats as modified, natural, or critical, per ESS6 definitions;
- Identify the presence of critical habitat triggers, including threatened species, migratory corridors, and unique ecosystems;
- Evaluate biodiversity sensitivities along the proposed railway alignment and associated facilities;
- Provide a robust ecological baseline to inform the design and routing of the railway infrastructure;
- Support the application of the mitigation hierarchy in biodiversity management planning.

The methodology follows guidance from:

- WB ESS6 Guidance Note;
- IFC PS6 and GN6 (where applicable);
- IUCN Red List and KBAs methodologies.

4.2.7.9.10 Species of Conservation Concern and Protected Areas

This section summarizes the presence of legally protected areas, internationally recognized areas, and the occurrence of species of conservation concern within the Project's AoI, based on both secondary data sources and primary field observations conducted during the CHA.

Protected Areas

Several protected areas and ecologically significant sites are located within or adjacent to the AoI of the proposed railway project. These include:

Nationally designated areas, such as:

- Feneryolu Wildlife Development Area
- Marmara Sea and Islands Special Environmental Protection Area

Internationally recognized areas, such as:

- Boğaziçi Important Nature and Bird Area
- Büyükçekmece Lake Important Nature and Bird Area
- Kilyos Dunes Important Nature and Plant Area
- Ömerli Basin Important Nature and Plant Area

- Pendik Valley Important Nature Area
- North Boğaziçi Important Plant Area

Key Biodiversity Areas (KBAs), such as:

- Bosphorus KBA
- Pendik Valley KBA
- Büyükcekmece Lake KBA

These areas serve as habitats for endangered and endemic species and provide essential ecological services, such as wildlife corridors, breeding grounds, and feeding areas for migratory species. The proximity of the railway alignment to these areas has been evaluated to identify potential direct and indirect impacts, such as habitat fragmentation, disturbance from noise and vibration, and barrier effects.

4.2.7.9.11 Species of Conservation Concern

Species of high conservation concern were identified based on a combination of:

- IUCN Red List assessments (Critically Endangered [CR], Endangered [EN], and Vulnerable [VU] species);
- National Red Lists and legally protected species;
- Field survey results, which confirmed the presence or potential presence of threatened, endemic, migratory, or congregatory species;
- Distribution data from databases such as GBIF, BirdLife International, and national inventories.

Field observations confirmed the presence of several potential critical habitat trigger species along or near the proposed railway corridor. These include:

- *Cirsium polycephalum* (IUCN: CR; Observation)
- *Ferulago confusa* (IUCN: CR; Observation)
- *Centautrea hermannii* (IUCN: EN; Observation)
- *Lilium martagon* (IUCN: VU; Observation)
- *Leucojum aestivum* (IUCN: VU; Observation)
- *Symphytum tuberosum* subsp. *nodosum* (IUCN: VU; Observation)
- *Cyclamen coum* (CITES; Observation)
- *Ornithogalum pascheanum* (Regional endemic; Literature)
- *Crocus pestalozzae* (IUCN: VU; Literature)
- *Galanthus plicatus* subsp. *byzantinus* (Regional endemic; Literature)
- *Aurinia uechtritziana* (IUCN: VU; Bosphorus KBA)
- *Centaurea hermannii* (IUCN: EN; Bosphorus KBA)
- *Isatis arenaria* (IUCN: EN; Bosphorus KBA)
- *Lathyrus undulatus* (IUCN: VU; Bosphorus KBA)
- *Trifolium pachycalyx* (IUCN: DD; Bosphorus KBA)
- *Colchicum micranthum* (IUCN: EN; Pendik Valley KBA)
- *Testudo graeca* (IUCN: VU; Bosphorus KBA; Observation, Büyükcekmece Lake KBA)
- *Testudo hermanni* (IUCN: NT; Bosphorus KBA; Observation, Büyükcekmece Lake KBA)
- *Emys orbicularis* (IUCN: NT; Bosphorus KBA; Observation, Büyükcekmece Lake KBA)
- *Pelecanus crispus* (IUCN: NT; Observation)
- *Branta ruficollis* (IUCN: VU; Observation, Büyükcekmece Lake KBA)
- Aythya ferina (IUCN: VU; Observation, Büyükcekmece Lake KBA)
- Aythya nyroca (IUCN: NT; Observation, Büyükcekmece Lake KBA)
- *Neophron percnopterus* (IUCN: EN; Observation)
- *Aegypius monachus* (IUCN: NT; Observation)
- *Circus macrourus* (IUCN: NT; Observation)

- *Clanga clanga* (IUCN: VU; Observation)
- *Aquila nipalensis* (IUCN: EN; Observation)
- *Aquila heliaca* (IUCN: VU; Observation)
- *Falco vespertinus* (IUCN: NT; Observation)
- *Haematopus ostralegus* (IUCN: NT; Observation)
- *Vanellus vanellus* (IUCN: NT; Observation)
- *Calidris ferruginea* (IUCN: NT; Observation)
- *Limosa limosa* (IUCN: NT; Observation)
- *Numenius arquata* (IUCN: NT; Observation)
- *Larus armenicus* (IUCN: NT; Observation)
- *Streptopelia turtur* (IUCN: VU; Observation)
- *Anthus pratensis* (IUCN: NT; Observation)
- *Turdus iliacus* (IUCN: NT; Observation)
- *Ciconia ciconia* (IUCN: LC; Observation, Bosphorus KBA)
- *Ciconia nigra* (IUCN: LC; Observation, Bosphorus KBA)
- *Larus cachinnans* (IUCN: LC; Observation, Bosphorus KBA, Büyükcekmece Lake KBA)
- *Larus melanocephalus* (IUCN: LC; Observation, Bosphorus KBA, Büyükcekmece Lake KBA)
- *Larus ridibundus* (IUCN: LC; Observation, Bosphorus KBA)
- *Phalacrocorax aristotelis* (IUCN: LC; Observation, Bosphorus KBA)
- *Phalacrocorax carbo* (IUCN: LC; Observation, Bosphorus KBA)
- *Puffinus yelkouan* (IUCN: VU; Bosphorus KBA)
- *Hydrocoloeus minutus* (IUCN: LC; Obervation, Büyükcekmece Lake KBA)
- *Miniopterus schreibersii* (IUCN: NT; Observation)
- *Rhinolophus euryale* (IUCN: NT; Observation)
- *Barbastella barbastellus* (IUCN: NT; Observation)
- *Myotis bechsteinii* (IUCN: NT; Observation)
- *Myotis capaccinii* (IUCN: VU; Observation)
- *Nyctalus lasiopterus* (IUCN: VU; Observation)
- *Spermophilus citellus* (IUCN: EN; Observation)
- *Lutra lutra* (IUCN: NT; Observation)
- *Vormela peregusna* (IUCN: VU; Observation)

4.2.7.9.12 Critical Habitat Screening and Determination

The CHA applied WB ESS6 criteria to evaluate whether any areas along the railway alignment qualify as critical habitat. Field surveys and desktop reviews identified several species of conservation concern within the AoI, recognized under national legislation and/or the IUCN Red List. While some may act as potential trigger species under ESS6, none meet the quantitative thresholds (e.g., ≥5% of the global population) to be designated as critical habitat.

Identified species include:

- *Cirsium polycephalum* (CR)
- *Ferulago confusa* (CR)
- *Centautrea hermannii* (EN)
- *Lilium martagon* (VU)
- *Leucojum aestivum* (VU)
- *Symphytum tuberosum* subsp. *nodosum* (VU)

Although thresholds are not met, critical habitats have been delineated for their conservation. Appendix-6.12 contains eight maps showing these areas.

In line with the precautionary approach, the Project will:

- Collect seeds for deposit at the TÜBİTAK National Seed Gene Bank prior to construction.

- Implement biodiversity monitoring during construction and operation.
- Apply adaptive management if new risks emerge.

The railway alignment follows an existing road corridor, avoiding new habitat clearance or fragmentation. The corridor lies in a previously modified landscape with existing disturbance, so additional significant impacts on fauna movement or habitat connectivity are not expected. No new wildlife corridors will be intersected.

4.2.7.9.13 Limitations

The field surveys along the project corridor were conducted in June, which limited the detection of certain early spring geophyte species. As a result, some species that typically flower and are identifiable in late winter to early spring could not be recorded during the initial surveys. To address this limitation, an additional field survey may be conducted in February to assess the presence of regionally endemic geophytes, specifically Ornithogalum pascheanum Speta, *Galanthus plicatus* Bieb. subsp. *byzantinus* (Baker) Beck, and *Crocus pestalozzae* Boiss

4.2.8 Baseline Environmental Measurements

Environmental measurements in the project area and/or its surroundings will be conducted by ÇINAR Laboratories Group, which holds a Competency Certificate issued by MoEUCC and is accredited by the Turkish Accreditation Agency (TÜRKAK). These measurements will be carried out as specified in Table 4-10 and each environmental assessment will be interpreted considering national regulations and international standards.

Table 4-10 Number of Environmental Measurements and Analyses

Parameter	Number of Sampling Points	Relevant Regulation for Assessment
PM_{10} (24-hour)	13	Regulation on the Control of Industrial Source Air Pollution (Official Gazette Date: 03.07.2009, Official Gazette Number: 27277) WBG General and Sectoral EHSG (WHO Air Quality Guideline Values) (2007)
$PM_{2.5}$ (24-hour)	13	Regulation on the Control of Industrial Source Air Pollution (Official Gazette Date: 03.07.2009, Official Gazette Number: 27277) WBG General and Sectoral EHSGs (WHO Air Quality Guideline Values) (2007)
Noise (48 hours)	13	Environmental Noise Control Regulation (Official Gazette Date: 30.11.2022, Official Gazette Number: 32029) WBG General and Sectoral EHSGs (2007)
Surface Water Quality	4	Surface Water Quality Regulation (Official Gazette Date: 30.11.2012, Official Gazette Number: 28483)
Groundwater Quality	5	Regulation on the Protection of Groundwater Against Pollution and Deterioration (Official Gazette Date: 07.04.2012, Official Gazette Number: 28257) or; Regulation on Water for Human Consumption (Official Gazette Date: 17.02.2005, Official Gazette Number: 25730)
Soil Quality	12	Regulation on the Control of Soil Pollution and Contaminated Sites with Point Sources (Official Gazette Date: 08.06.2010, Official Gazette Number: 27605)

In addition to the environmental measurements and analyses conducted by ÇINAR Laboratory within the Project's AoI, data obtained from the Northern Marmara Motorway Project have also been used as reference to characterize the baseline environmental conditions of the Project area. The methodologies employed, locations of sampling and measurement points, results obtained, and the corresponding assessment reports are comprehensively presented in the attached Baseline Environmental Measurement and Analysis Report (see Appendix-3).

4.3 Baseline Social Conditions

4.3.1 Methodology

4.3.1.1 Identification of Social Impact Area

The socio-economic analysis covers the İstanbul region (TR1) (is also the name of the sub region

(TR10), and province (TR100)), as well as Kocaeli province (TR421). Kocaeli province (TR421) is part of Kocaeli sub region (TR42) with Sakarya (TR422), Düzce (TR423), Bolu (TR424), and Yalova (TR425), which are located within Eastern Marmara region (TR4) [21].

In this structure, İstanbul and Kocaeli are provinces, and metropolitan municipalities; while Gebze, Çayırova, Tuzla, Pendik, Sultanbeyli, Sancaktepe, Çekmeköy, Beykoz, Sarıyer, Eyüp, Arnavutköy, and Çatalca are districts and metropolitan district municipalities.

While defining the Project's social impact area, the AoI corridor has been taken as a reference. The local population residing in the settlements within this corridor is considered as directly affected Project-Affected Parties (PAPs). A total of 53 settlements (see Table 4-14) that are in direct contact with the corridor have been identified. These PAPs may include landowners, formal and informal users of privately owned land, as well as formal and informal users of public land, who may be subject to physical and economic displacement due to land acquisition by the Project. However, in order to definitively identify these PAPs, the Project's land requirements within the corridor must be clearly defined. Since the land requirements cannot be definitively defined at this stage, it is not possible to carry out a study directly targeting these PAPs.

4.3.1.2 Identification of Stakeholders

Stakeholders are identified progressively based on the defined social impact area. The definition and categorization of stakeholders align with internationally recognized standards.

Project-Affected Parties (PAP): Local communities that are subject to risks or adverse impacts on their environment, health, livelihoods, or socio-economic conditions as a result of project activities.

Local communities and local administrators in the 53 settlements intersecting with the AoI are considered as PAP (see Appendix-7.1 Stakeholder List and Appendix-7.2 The Map of Settlements Intersecting with AoI). These PAPs are anticipated to be directly affected by the general impacts of the project. Land, housing, and business owners and/or partners/shareholders, as well as formal and informal users (especially for common areas such as pasturelands / grazing areas) of these areas who are likely to be subject to physical and economic displacement due to the project's land acquisition, will be included among the PAPs.

Other Interested Parties (OIP): These can include local authorities, non-governmental organizations (NGOs), civil society organizations (CSO), and other groups that may have an interest in the project or could be impacted indirectly.

All parties that may have an interest in the project, including local CSOs and media outlets, have been considered as OIP in the context of the SEP. However, they are not affected by the environmental and social impacts of the project, and are thus not subject to further discussion in the ESIA.

Disadvantaged/Vulnerable Individuals or Groups (DVIG): As defined under the World Bank ESF, "disadvantaged or vulnerable" project-affected individuals or groups are those who, by virtue of factors such as age, gender, race, ethnicity, religion, physical, mental or other disability, social, civic or health status, sexual orientation, gender identity, economic disadvantage, indigenous status, and/or dependence on unique natural resources, may be more likely to be adversely affected by the Project's impacts and/or more limited than others in their ability to benefit from project opportunities. Such individuals or groups may also face barriers to fully participating in consultation processes and may therefore require specific or tailored engagement and support measures, taking into account age-related considerations, including elderly persons and minors, and circumstances where individuals may be separated from their family, community, or other

[21] *Republic of Türkiye, Ministry of Industry and Technology, Development Agencies. https://ka.gov.tr/en/development-agencies. Access date: April 2025.*

support networks.

In determining the DVIG category, two criteria have been applied: the first being "*individuals who may be more likely to be adversely affected by the project impacts or more limited than others in their ability to take advantage of the project's benefits*" and the second being "*Project-affected individuals or groups that may face particular challenges in accessing project information, participating in consultations, or benefiting from project opportunities*". The first criterion is directly associated with the project impacts emphasized in the ESIA and ESMP documents, while the second criterion relates to communication challenges as defined in the SEP. Certain DVIG groups have been classified as DVIGs based on both first and second criteria.

This ESIA focuses solely on whether certain individuals or groups are disproportionately exposed to the impacts of the project compared to others. According to this definition, the vulnerable DVIGs identified in this ESIA are as follows:

- Female household heads
- Elderlies (including living-alone individuals)
- Households facing economic hardship
- Persons with disabilities

The other vulnerable groups considered in line with ESS10 are these;

- Illiterates
- Non-Turkish speaker
- The groups considered as DVIGs both due to project impacts and ESS10 requirements are as follows: Female household heads
- Elderlies (including living-alone individuals)
- Persons with disabilities.

4.3.1.3 Scope

In order to assess the socio-economic impacts of the Project, baseline information was collected. This information was included demographic characteristics at the household level within the project area, identification of vulnerable groups, concerns about the Project, and preferred communication methods. Similar data were also obtained through interviews with mukhtars and community meetings at the settlement level. Interviews will be held with both local and national NGOs&CSOs, local administrations, project-related institutions, development agencies, and local media representatives.

During consultations with stakeholders classified under the other, particularly NGOs&CSOs, data were collected to identify vulnerable groups and assess the extent to which they may have been affected by the Project.

Baseline assessment activities werecarried out in 53 settlements located within 12 districts of İstanbul and Kocaeli provinces that intersect with the Project AoI. These settlements had been identified as areas with potential exposure to the social risks and impacts of the Project, although the specific land acquisition requirements had not yet been finalized.

To ensure equitable and meaningful participation, the social research was designed with a strong emphasis on inclusivity. In addition to proportional sampling based on number of household, special adjustments were made to include settlements with low populations but high relevance to the Project, particularly those located near the intended alignment.

4.3.1.4 Research Methodology

A social research methodology had been defined for the area designated as the social impact area.

From the outset of the study, the methods used as data collection techniques for the social impact

assessment were also considered as tools for information dissemination. During each interview, the interviewees were provided with information about the Project, the route was shown on a map, and an information brochure was distributed. Although these activities were not direct information disclosure efforts, they nevertheless played a role in introducing the Project to stakeholders.

This methodology and the distribution of stakeholders to be engaged are as follows.

A household survey was conducted in the settlements located within the corridor. The population of this survey consists of the total number of households in the 53 settlements intersecting by the corridor. According to the sampling method explained under section Sampling, a total of 837 household interviews were planned. Their distribution is provided in Table 4-14 and Table 4-15.

- The areas highlighted in color (dark yellow) indicate settlements that intersect with key components such as structural works (see Table 4-14 and Table 4-15.). Some of these settlements also intersected with previous projects (e.g., Northern Marmara Motorway, İstanbul New Airport, Nakkaş Motorway, Halkalı–Ispartakule–Çerkezköy Railway Line, Sarıyer–Kilyos Tunnel Project) which were constructed in these areas.

Since this distribution was created statistically based on number of households, it has some limitations. The relevant statistical data were obtained from Turkish Statistical Institute (TurkStat), the official statistical institute of Türkiye. The most important issue in sampling was settlements which are intersected by the project route either through the center or within their boundaries, i.e. heavily impacted, but which have comparatively small populations. For example, although the project route intersects the most densely populated area of a settlement, the population of that settlement is relatively small compared to the total population. As a result, its representation in the overall sample is limited. This makes it more difficult to fully understand the project impacts on settlements that may be more affected but are underrepresented in the sample due to their small population size. To address this gap, in-depth interviews will also be conducted in these settlements. These settlements are shown in the Table 415.

- To ensure representation of settlements with low population, the sample size was increased from the minimum required 766 to 837 to avoid fractional allocation during distribution and to guarantee a minimum of 4 samples per settlement.
- For each of these settlements, an interview was planned to be conducted with a local representative (mukhtar or council member) to carry out a settlement-level survey.
- Interviews were planned to be conducted with NGOs&CSOs categorized under OIP. The table provided with Table 4-11 lists the NGOs&CSOs located within the corridor. The primary criterion applied in selecting NGOs&CSOs is their representation of parties that may have an interest in the Project. Among these, priority has been given to representing disadvantaged groups, local and culturally sensitive communities, local solidarity associations, and stakeholder groups related to environmental awareness and transportation/travel.
- In addition to the OIP interviews conducted in May, institutional stakeholders related to project components (such as airports and Northern Marmara Highway), local governments, NGOs&CSOs working for public benefit, local media outlets, and development agencies will also participate in stakeholder consultations.
- The household survey and local leader (mukhtar) survey were planned to provide quantitative data for the study. In-depth interviews and other face-to-face meetings was planned to serve as sources of qualitative data.
- Public consultation meeting: Socially inclusive participation was sought through engagement with local authorities and community-based organizations during the planning and organization of consultation meetings. Venue selection prioritized places that can accommodate larger groups, such as coffeehouses, community centers, and wedding halls. Each meeting had at least 10 participants. Additional measures were implemented

to ensure the participation of women. Qualitative data obtained from face-to-face interviews with stakeholders classified under the OIP category served as key data sources for the preparation of the ESIA and ESMP documents.

- Focus group discussion (FGD): More intensive consultation sessions were conducted with key subgroups among the PAPs. These included women, youth, farmers, traders, and others, depending on the specific characteristics of each settlement. Care was taken to select venues where the target group (men and women alike) can easily access and feel comfortable. Each meeting included a minimum of 8 and a maximum of 14 participants.
- In depth interviews: Meetings with NGO&CSO representatives and/or members wereconducted using a semi-structured interview form.
- A map was planned to also be provided to show the types of settlements along the project corridor, along with the locations where primary social data will be collected.

The full list of local CSOs is provided below (see Table 4-11). From among these, selections were planned to be made to represent each disadvantaged or interest group, and in-depth interviews or FGDs will be organized accordingly.

Table 4-11 Local CSOs located within the AoI-Intersecting Settlements

Name of the CSO	Turkish	Location
Gebze Hearing-Impaired Education, Culture, Youth and Sports Club Association /	Gebze İşitme Engelliler Eğitim Kültür Gençlik ve Spor Kulübü Derneği	Gebze / Kocaeli
Gebze Hacı Bektaş Veli Culture and Solidarity Association	Gebze Hacı Bektaşi Veli Kültür ve Dayanışma Derneği	Cumhuriyet / Gebze / Kocaeli
Association for Services to Çayırova District	Çayırova İlçesine Hizmet Derneği	Cumhuriyet / Gebze / Kocaeli
Gebze Cumhuriyet and Adem Yavuz Neighborhoods Beautification and Sustainability Association	Gebze Cumhuriyet ve Adem Yavuz Mahalleleri Güzelleştirme ve Yaşatma Derneği	Cumhuriyet / Gebze / Kocaeli
Çayırova Mukhtars Association	Çayırova Muhtarlar Derneği	Şekerpınar / Çayırova / Kocaeli
Çayırova Şekerpınar Development and Guidance Association	Çayırova Şekerpınar Gelişim ve Rehberlik Derneği	Şekerpınar / Çayırova / Kocaeli
Tuzla Social Solidarity and Education Association	Tuzla Sosyal Dayanışma ve Eğitim Derneği	Aydınlı / Tuzla / İstanbul
Association for the Educational Activities of the Hearing Impaired	İşitme Engelliler Eğitim Faaliyetleri Derneği	Aydınlı / Tuzla / İstanbul
Pendik Mukhtars Association	Pendik Muhtarlar Derneği	Kurna / Pendik / İstanbul
Çekmeköy Mukhtars Association	Çekmeköy Muhtarlar Derneği	Nişantepe / Çekmeköy / İstanbul
Ömerli Cultural Heritage Protection and Development Association	Ömerli Kültür Değerleri Koruma ve Geliştirme Derneği	Ömerli / Çekmeköy / İstanbul
Çekmeköy Nature Conservation and Sustainability Association	Çekmeköy Doğayı Koruma ve Yaşatma Derneği	Reşadiye / Çekmeköy / İstanbul
Beykoz Öğümce Village Culture, Solidarity and Assistance Association	Beykoz Öğümce Köyü Kültür Dayanışma ve Yardımlaşma Derneği	Öğümce / Beykoz / İstanbul
Gümüşdere Village Beautification and Solidarity Association	Gümüşdere Köyü Güzelleştirme ve Dayanışma Derneği	Gümüşdere / Sarıyer / İstanbul
Uskumruköy Nature Protectors and Animal Lovers Association	Uskumruköy Doğayı Koruyanlar ve Patileri Sevenler Derneği	Uskumruköy / Sarıyer / İstanbul
Arnavutköy Association for Persons with Disabilities	Arnavutköy Engelliler Derneği	Arnavutköy / İstanbul
Bolluca Solidarity and Assistance Association	Bolluca Yardımlaşma ve Dayanışma Derneği	Bolluca / Arnavutköy / İstanbul
Arnavutköy İmrahor Neighborhood Solidarity Association	Arnavutköy İmrahor Mahallesi Dayanışma Derneği	İmrahor / Arnavutköy / İstanbul
İstanbul Airport Reporters Association	İstanbul Havalimanları Muhabirleri Derneği	Tayakadın / Arnavutköy / İstanbul
Tourism, Transport and Travel Agencies Association	Turizm Ulaştırma ve Seyahat Acenteleri Derneği	Tayakadın / Arnavutköy / İstanbul
Tourism, Transport and Travel Agencies Association	Turizm Ulaştırma ve Seyahat Acenteleri Derneği	Tayakadın / Arnavutköy / İstanbul
Çatalca İzzettin Village Education and Culture Association	Çatalca İzzettin Köyü Eğitim ve Kültür Derneği	İzzettin / Çatalca / İstanbul
Çatalca Thrace-Rumelia Culture and Solidarity Association	Çatalca Trakya Rumeli Kültür ve Dayanışma Derneği	Ferhatpaşa / Çatalca / İstanbul

Name of the CSO	Turkish	Location
Association for Combating Disability	Engelle Mücadele Derneği	Ferhatpaşa / Çatalca / İstanbul
Çatalca Mukhtars Association	Çatalca Muhtarlar Derneği	Kaleiçi / Çatalca / İstanbul
"Bir Nefes" Nature and Green Conservation Association	Bir Nefes Doğayı ve Yeşili Koruma Derneği	Kaleiçi / Çatalca / İstanbul

In addition to these local CSOs, the following NGOs&CSOs that operate nationwide but have their headquarters in İstanbul have also been included in the stakeholder list. This stakeholder group will also be important due to their capacity to represent disadvantaged groups and parties that may have an interest in the Project.

- Association for Solidarity for Equality / Eşitlik İçin Dayanışma Derneği
- İstanbul Association for Solidarity with Families of Persons with Disabilities / İstanbul Engelli Aileleri ile Dayanışma Derneği
- Mor Çatı Women's Shelter Foundation / Mor Çatı Kadın Sığınağı Vakfı
- Turkish Marine Environment Protection Association / Deniz Temiz Derneği (TURMEPA)
- İstanbul Violence Prevention and Monitoring Center / İstanbul Şiddet Önleme ve İzleme Merkezi (İstanbul ŞÖNİM)
- Foundation for the Protection and Promotion of the Environment and Cultural Heritage / Çevre ve Kültür Değerlerini Koruma ve Tanıtma Vakfı (ÇEKÜL)
- World Wide Fund for Nature / İstanbul Branch Office

In addition to the interviews conducted within the scope of the draft studies, the following institutions listed as stakeholders but not reached for interviews due to various reasons will also be included in the study (see Table 4-12).

Table 4-12 Additional Meetings with OIP

Location	Category	Stakeholder
İstanbul / Tuzla	OIP / Local administrative unit	Tuzla Municipality
İstanbul / Pendik	OIP / Local administrative unit	Pendik District Governorate
İstanbul / Beyoğlu	OIP / Local administrative unit	İBB
İstanbul / Fatih	OIP / Local administrative unit	İstanbul Governorship
İstanbul / Beykoz	OIP / Local administrative unit	Beykoz District Governorship
İstanbul / Beykoz	OIP / Local administrative unit	Beykoz Municipality
İstanbul / Çekmeköy	OIP / Institutions Related to Project Components	Yavuz Sultan Selim Bridge and Northern Peripheral Highway Operation
İstanbul / Arnavutköy	OIP / Institutions Related to Project Components	İstanbul Airport Operator İGA
İstanbul / Kurtköy	OIP / Institutions Related to Project Components	Sabiha Gökçen Airport Operator HEAŞ
İstanbul / Beyoğlu	OIP / Development agencies	İstanbul Development Agency
Ankara	OIP / State organization	Republic of Türkiye Ministry of Interior Disaster and Emergency Management Authority (AFAD)

Local media outlets are among the parties that may have an interest in the Project. The full list of local newspapers in the region is provided within Appendices of SEP documents. The methodology, techniques, tools to be applied during the social research, their relation to stakeholder groups, and the designed objectives have been summarized in Table 4-13.

Table 4-13 Summary of Social Research Methodology

Stakeholder Group	Stakeholder Name	Research Methodology	Research Type	Research Tool	Location	Planned Number of Participants	Will disadvantaged / sensitive groups be included / prioritized? Which ones?
PAP	Local residents / Household heads	Quantitative	Household survey	Household questionnaire	53 settlements within the AoI	837	Yes. Priority will be given to women who are household heads living alone.

Stakeholder Group	Stakeholder Name	Research Methodology	Research Type	Research Tool	Location	Planned Number of Participants	Will disadvantaged / sensitive groups be included / prioritized? Which ones?
PAP	Local representative	Quantitative	Settlement survey	Mukhtar questionnaire	53 settlements within the AoI	53	No
PAP	Local residents	Qualitative	Community survey	Semi structured interview form	A total of 9 meetings, with at least one in each settlement Beykoz/Cumhuriyet Beykoz/Paşamandıra Beykoz/Ali Bahadır Sarıyer/Uskumruköy Sarıyer/Gümüşdere Eyüpsultan/Odayeri Eyüpsultan/Işıklar Arnavutköy/Tayakadın Çatalca/Nakkaş	With at least 10 participants per meeting, the total participation will be approximately 100.	Yes. Priority will be given to individuals affected by previous projects.
OIP	Local CSO	Qualitative	FGD	Unstructured questionnaire	7 or 8 number of meetings will be held, each including at least one CSO representing each interest group and/or disadvantaged group (Culture & Arts, Occupational Groups, Urban & Development, Environment, Disabled, Ethnic Groups, Women, Local Communities).	With at least 10 participants, total attendance will be between 70 and 80 people.	Yes. - Disabled individuals - Ethnic identities - Women
OIP	Nationwide NGO	Qualitative	In-depth interview	Semi structured interview form	Various places in İstanbul	For each in-depth interview, there will be at least one representative from an institution, with a total participation of between 12 and 15 individuals.	Yes. - Disabled individuals - Ethnic identities - Women
OIP	Local administrative unit	Qualitative	In-depth interview	Semi structured interview form	Tuzla, Pendik, Fatih, Beykoz	For each in-depth interview, there will be at least one representative from an institution, with a total participation of between 6 and 8 individuals.	No
OIP	Institutions Related to Project Components	Qualitative	In-depth interview	Semi structured interview form	Kurtköy, Çekmeköy, Arnavutköy	For each in-depth interview, there will be at least one representative from an institution, with a total participation of between 3 and 5 individuals.	No
OIP	Development agencies State organization	Qualitative	In-depth interview	Semi structured interview form	Beyoğlu / Ankara	For each in-depth interview, there will be at least one representative	No

Stakeholder Group	Stakeholder Name	Research Methodology	Research Type	Research Tool	Location	Planned Number of Participants	Will disadvantaged / sensitive groups be included / prioritized? Which ones?
						from an institution, with a total participation of between 4 and 6 individuals.	
OIP	Local media	Qualitative	In-depth interview	Semi structured interview form	European side of İstanbul / Anatolian side of İstanbul / Kocaeli	For each in-depth interview, there will be at least one representative from an institution, with a total participation of between 6 and 8 individuals.	No

4.3.1.5 Sampling

As the primary research tool in the social impact assessment was designed as a household survey, the total number of households was used as the population (N) for sampling purposes instead of the total population. For these purposes; Cochran's sample size formula was preferred for large populations, as it provides a statistically reliable estimate of the required sample size based on desired confidence level and margin of error, regardless of the total population size. It is particularly effective when the population exceeds 10,000.

Cochran's formula for sample size calculation for a finite population

$$n = \frac{N.Z^2.p.(1-p)}{(N-1).e^2 + Z^2.p.(1-p)}$$

- **n:** Required sample size
- **N:** Population size (169,862 households)
- **Z:** Z-score 1.96 for 95% confidence level
- **p:** Estimated proportion (0.5 is often used if the proportion is unknown)
- **e:** Margin of error (0.05 for 5%)

So;

$$n = \frac{169{,}862.(1.96)^2.0.5.(1-0.5)}{(169{,}862-1).(0.05)^2 + (1.96)^2.0.5.(1-0.5)} = \mathbf{383}$$

This number can be used as 169,862 households for a 95% confidence level and a 5% margin of error.

Given that the sample is distributed across settlements, a design effect has been incorporated to account for the potential increase in variance resulting from a sampling design that deviates from simple random sampling. Assuming a design effect of 2, the minimum required sample size is calculated as 766. The sample size was increased to 837 to avoid fractional allocation during distribution and to ensure a minimum of 4 samples per settlement.

In the distribution of the sample (n) to be implemented during the fieldwork across the settlements, a distribution based on number of household was used (See Table 4-14).

Table 4-14 Population figures of AoI-Intersecting Settlements[22], TurkStat 2024[23]

	Province	District	Settlement	Population	District Average Household Size	Number of Households in the Settlement
1	Kocaeli	Gebze	Cumhuriyet	10,038	3.33	3,014
2	Kocaeli	Çayırova	Yeni Mahalle	21,192	3.4	6,233
3	Kocaeli	Çayırova	Şekerpınar	2,847	3.4	837
4	İstanbul	Tuzla	Aydıntepe	27,173	3.12	8,709
5	İstanbul	Tuzla	İstasyon	26,338	3.12	8,442
6	İstanbul	Tuzla	Aydınlı	72,942	3.12	23,379
7	İstanbul	Pendik	Sanayi	2,999	3.17	946
8	İstanbul	Pendik	Kavakpınar	65,879	3.17	20,782
9	İstanbul	Pendik	Güllübağlar	19,001	3.17	5,994
10	İstanbul	Pendik	Şeyhli	19,684	3.17	6,209
11	İstanbul	Pendik	Harmandere	9,947	3.17	3,138
12	İstanbul	Pendik	Ramazanoğlu	2,427	3.17	766
13	İstanbul	Pendik	Kurtköy	38,756	3.17	12,226
14	İstanbul	Pendik	Yenişehir	65,637	3.17	20,706
15	İstanbul	Pendik	Emirli	252	3.17	79
16	İstanbul	Pendik	Kurna	1,154	3.17	364
17	İstanbul	Pendik	Kurtdoğmuş	614	3.17	194
18	İstanbul	Sultanbeyli	Mecidiye	21,859	3.85	5,678
19	İstanbul	Sultanbeyli	Akşemsettin	13,886	3.85	3,607
20	İstanbul	Sancaktepe	Paşaköy	1,758	3.49	504
21	İstanbul	Çekmeköy	Nişantepe	12,546	3.18	3,945
22	İstanbul	Çekmeköy	Ömerli	5,702	3.18	1,793
23	İstanbul	Çekmeköy	Reşadiye	2,887	3.18	908
24	İstanbul	Çekmeköy	Hüseyinli	849	3.18	267
25	İstanbul	Beykoz	Cumhuriyet	1,966	3.09	636
26	İstanbul	Beykoz	Bozhane	464	3.09	150
27	İstanbul	Beykoz	Öğümce	493	3.09	160
28	İstanbul	Beykoz	Paşamandıra	1,374	3.09	445
29	İstanbul	Beykoz	Ali Bahadır	781	3.09	253
30	İstanbul	Beykoz	Anadolu Feneri	687	3.09	222
31	İstanbul	Beykoz	Poyrazköy	881	3.09	285
32	İstanbul	Sarıyer	Garipçe	370	2.87	129
33	İstanbul	Sarıyer	Rumeli Feneri	4,074	2.87	1,420
34	İstanbul	Sarıyer	Demirciköy	1,698	2.87	592
35	İstanbul	Sarıyer	Uskumruköy	10,197	2.87	3,553
36	İstanbul	Sarıyer	Gümüşdere	2,519	2.87	878
37	İstanbul	Sarıyer	Kısırkaya	378	2.87	132
38	İstanbul	Eyüpsultan	Çiftalan	187	3.05	61
39	İstanbul	Eyüpsultan	Ağaçlı	731	3.05	240
40	İstanbul	Eyüpsultan	Odayeri	229	3.05	75
41	İstanbul	Eyüpsultan	Işıklar	549	3.05	180
42	İstanbul	Eyüpsultan	İhsaniye	185	3.05	61
43	İstanbul	Arnavutköy	Bolluca	8,446	3.76	2,246
44	İstanbul	Arnavutköy	İmrahor	12,088	3.76	3,215
45	İstanbul	Arnavutköy	Tayakadın	3,716	3.76	988
46	İstanbul	Arnavutköy	Baklalı	866	3.76	230

[22] *The list has been prepared based on the east-to-west alignment of the settlements intersecting with the AoI.*

[23] *Population information: Population of municipalities, villages, and quarters. Address Based Population Registration System Results (ABPRS) of TurkStat. https://biruni.tuik.gov.tr/medas/?kn=95&locale=en.*
District Average Household Size: Average size of households. ABPRS of TurkStat. https://biruni.tuik.gov.tr/medas/?kn=95&locale=en.
Number of Households in the Settlement: Total number of households. ABPRS of TurkStat. https://biruni.tuik.gov.tr/medas/?kn=95&locale=en.

	Province	District	Settlement	Population	District Average Household Size	Number of Households in the Settlement
47	İstanbul	Arnavutköy	Dursunköy	433	3.76	115
48	İstanbul	Arnavutköy	Boyalık	758	3.76	202
49	İstanbul	Arnavutköy	Yassıören	675	3.76	180
50	İstanbul	Çatalca	Nakkaş	803	2.63	305
51	İstanbul	Çatalca	İzzettin	1,304	2.63	496
52	İstanbul	Çatalca	Ferhatpaşa	28,400	2.63	10,798
53	İstanbul	Çatalca	Kaleiçi	7,617	2.63	2,896
				539,236		**169,862**

Based on the data provided in Table 4-14, the distribution of the total sample size by settlement is presented in Table 4-15. Due to population size, settlements represented by 0 and 1 were subject to adjustments in the sample distribution while preserving the overall proportionality. These modifications are also presented in Table 4-15.

Table 4-15 Sampling values of AoI-Intersecting Settlements-

	Province	District	Settlement	Proportion in the sample	Value to be taken in the sample	Adjusted value
1	Kocaeli	Gebze	Cumhuriyet	1.86	14	14
2	Kocaeli	Çayırova	Yeni Mahalle	3.93	30	30
3	Kocaeli	Çayırova	Şekerpınar	0.53	4	4
4	İstanbul	Tuzla	Aydıntepe	5.04	39	39
5	İstanbul	Tuzla	İstasyon	4.88	37	37
6	İstanbul	Tuzla	Aydınlı	13.53	104	104
7	İstanbul	Pendik	Sanayi	0.56	4	4
8	İstanbul	Pendik	Kavakpınar	12.22	94	94
9	İstanbul	Pendik	Güllübağlar	3.52	27	27
10	İstanbul	Pendik	Şeyhli	3.65	28	28
11	İstanbul	Pendik	Harmandere	1.84	14	14
12	İstanbul	Pendik	Ramazanoğlu	0.45	3	4
13	İstanbul	Pendik	Kurtköy	7.19	55	55
14	İstanbul	Pendik	Yenişehir	12.17	93	93
15	İstanbul	Pendik	Emirli	0.05	0	4
16	İstanbul	Pendik	Kurna	0.21	2	4
17	İstanbul	Pendik	Kurtdoğmuş	0.11	1	4
18	İstanbul	Sultanbeyli	Mecidiye	4.05	31	31
19	İstanbul	Sultanbeyli	Akşemsettin	2.58	20	20
20	İstanbul	Sancaktepe	Paşaköy	0.33	2	4
21	İstanbul	Çekmeköy	Nişantepe	2.33	18	18
22	İstanbul	Çekmeköy	Ömerli	1.06	8	4
23	İstanbul	Çekmeköy	Reşadiye	0.54	4	4
24	İstanbul	Çekmeköy	Hüseyinli	0.16	1	4
25	İstanbul	Beykoz	Cumhuriyet	0.36	3	4
26	İstanbul	Beykoz	Bozhane	0.09	1	4
27	İstanbul	Beykoz	Öğümce	0.09	1	4
28	İstanbul	Beykoz	Paşamandıra	0.25	2	4
29	İstanbul	Beykoz	Ali Bahadır	0.14	1	4
30	İstanbul	Beykoz	Anadolu Feneri	0.13	1	4
31	İstanbul	Beykoz	Poyrazköy	0.16	1	4
32	İstanbul	Sarıyer	Garipçe	0.07	1	4
33	İstanbul	Sarıyer	Rumeli Feneri	0.76	6	6
34	İstanbul	Sarıyer	Demirciköy	0.31	2	4
35	İstanbul	Sarıyer	Uskumruköy	1.89	14	14
36	İstanbul	Sarıyer	Gümüşdere	0.47	4	4
37	İstanbul	Sarıyer	Kısırkaya	0.07	1	4
38	İstanbul	Eyüpsultan	Çiftalan	0.03	0	4

	Province	District	Settlement	Proportion in the sample	Value to be taken in the sample	Adjusted value
39	İstanbul	Eyüpsultan	Ağaçlı	0.14	1	4
40	İstanbul	Eyüpsultan	Odayeri	0.04	0	4
41	İstanbul	Eyüpsultan	Işıklar	0.10	1	4
42	İstanbul	Eyüpsultan	İhsaniye	0.03	0	4
43	İstanbul	Arnavutköy	Bolluca	1.57	12	12
44	İstanbul	Arnavutköy	İmrahor	2.24	17	17
45	İstanbul	Arnavutköy	Tayakadın	0.69	5	5
46	İstanbul	Arnavutköy	Baklalı	0.16	1	4
47	İstanbul	Arnavutköy	Dursunköy	0.08	1	4
48	İstanbul	Arnavutköy	Boyalık	0.14	1	4
49	İstanbul	Arnavutköy	Yassıören	0.13	1	4
50	İstanbul	Çatalca	Nakkaş	0.15	1	4
51	İstanbul	Çatalca	İzzettin	0.24	2	4
52	İstanbul	Çatalca	Ferhatpaşa	5.27	40	40
53	İstanbul	Çatalca	Kaleiçi	1.41	11	11
					766	**837**

4.3.1.6 Implementations

As part of the social impact assessment studies carried out specifically for the project, activities were conducted in three phases. The details of the completed interviews are presented under this section Table 4-16, while the details of the interviews that could not be conducted are provided in Section Limitations (see Table 4-17).

- The first of these involved stakeholder consultations conducted in 12-13-14 and 15 May 2025, which were limited to OIPs. These activities also served as a preparation for the studies to be conducted at the level of local communities and local leaders (mukhtars). During this study, the project components and route were presented to participants in digital format in all interviews. Photographs were taken during the interviews with the consent of the participants (see Appendix-7.8 Photographs taken during the interviews).
- The second phase of the social study was conducted between July 11 and July 20, 2025, through face-to-face interviews in 53 settlements intersecting with AoI. With an emphasis on the participation of local people and local authorities, local CSOs were also included in the scope. Structured questionnaire forms were used during household and mukhtar surveys, while separate semi-structured question forms were applied for community-level meetings and NGOs&CSO. During the interviews, the project information brochure (see Appendix-7.9 Informative Brochure) was distributed to participants, and a preliminary information session about the project was conducted. In addition, an A0-sized map showing the project and its route (along with a digital version when appropriate) was presented to the participants. In this way, the project route was intended to be visually communicated to the participants. Photographs were taken during the interviews with the consent of the participants (see Appendix-7.8 Photographs taken during the interviews). At the local level, household interviews, as specified in the Methodology section, not only provided data for the ESIA, but also helped to ensure local community participation. Additionally, mukhtar interviews, also planned to support community engagement, were carried out. The sample initially set to include 837 households for the household interviews was limited to 802 households. Of the 53 mukhtar interviews planned to be conducted by face to face - one in each settlement- a total of 48 were completed. Among these, 10 interviews were conducted remotely, while the remaining 38 were held face-to-face. Additionally, 5 mukhtars declined to participate due to the several reasons such as timing. Most of the interviews with CSOs could not be carried out (please refer to Limitations section through Table 4-17). As for the public consultation meetings, the meetings planned in 9 settlements were conducted; however, the number of participants in these meetings remained limited. To strengthen representativeness, 2 additional settlements were

included. Given the relatively small size of the groups, these meetings were classified as focus group discussions rather than large-scale public consultation meetings. In total, 11 FGDs were carried out across the settlements.

- The third phase of the social study was conducted through face-to-face interviews between July 21 and 23 in the districts intersecting with AoI. Within the scope of this study, the following objectives were targeted: 1) ensuring the participation of stakeholders who could not be interviewed during the first phase, 2) securing the involvement of local media organizations, and 3) facilitating the participation of NGOs&CSOs at both local and national levels. Nevertheless, some of the planned interviews/meetings could not be completed at this stage due to various reasons. The details are provided in the Limitations section.
- Remedial measures; Following the completion of all face-to-face interviews in the field, some interviews were conducted remotely at the special request of the participants. For example, interviews with 10 mukhtars) and one NGO were carried out via phone or online meetings. Prior to these interviews, project information materials and maps were sent to their email addresses or mobile phones to provide preliminary information. The final date for the completion of these activities was August 4, 2025 (see also Appendix-7.7 Minutes of Meetings (MoM)).

Completed interviews since May 2025 are presented via Table 4-16. All the items are listed in time-line order. Details of the works including participants' details based on duty, tenure, gender and age are given via Appendix-7.7: Minutes of Meetings (MoM).

Table 4-16 Completed social studies -May 2025-June 2025

Stakeholder identification	Stakeholder	Date (dd.mm.yyyy)	Type of interview	Number of participant(s)
OIP Local government body	Çayırova Municipality	12.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Çayırova Municipality	12.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Çayırova District Governorate	12.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Çayırova District Directorate of Agriculture and Forestry	12.05.2025	Field visit Face to face interview	1 participant
OIP Project component-related institution	Turkish State Railway (TCDD) İzmit Maintenance Directorate	12.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Kocaeli Metropolitan Municipality - Department of Transportation	12.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Kocaeli Governorship	12.05.2025	Field visit Face to face interview	1 participant
OIP Development Agency	East Marmara Development Agency	12.05.2025	Field visit Face to face interview	1 participant
OIP State institution	AFAD Akfırat Service Building	13.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Tuzla District Governorate	13.05.2025	Field visit Face to face interview	1 participant

OIP Local government body	Pendik Municipality	13.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Çekmeköy Municipality	13.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Çekmeköy District Governorate	13.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Sancaktepe Municipality	13.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Sancaktepe District Governorate	13.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Sultanbeyli Municipality & Sultanbeyli District Governorate	13.05.2025	Field visit Face to face interview	2 participants
OIP Project component-related institution	TCDD 1st Regional Directorate	14.05.2025	Field visit Face to face interview	1 participant
OIP State institution	DSİ 14th Regional Directorate	14.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Arnavutköy Municipality	15.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Çatalca Municipality	15.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Eyüpsultan District Governorate	15.05.2025	Field visit Face to face interview	1 participant
OIP Project component-related institution	Istanbul Airport	15.05.2025	Field visit Face to face interview	1 participant
OIP Local government body	Sarıyer District Governorate	15.05.2025	Field visit Face to face interview	1 participant
OIP CSO / Cooperatives / Associations	Pendik Culture, Arts, and Sports Club	12.07.2025	Field Visit Face to Face Interview	1 participant
OIP CSO / Cooperatives / Associations	Ömerli Cultural Heritage Preservation and Promotion Association	17.07.2025	Field Visit Face to Face Interview	2 participants
PAP	Sancaktepe / Paşaköy Neighborhood Local Residents	17.07.2025	Field Visit FGD[24]	7 participants

[24] *Aimed Public Consultation Meetings could not be conducted. Instead, they were implemented as FGDs with a limited number of participants. These FGDs were carried out in place of the Public Consultation Meetings. From a methodological perspective, FGDs are not considered an alternative to Public Consultation Meetings. However, participants who had been informed in advance about the meetings were not turned away on the grounds that 'the number of participants is insufficient for a Public Consultation Meetings. Rather, FGDs were organized with those present, as turning them away could have been perceived as an inappropriate and discourteous approach from the stakeholders' perspective.*

PAP	Beykoz / Cumhuriyet Neighborhood Local Residents	18.07.2025	Field Visit FGD	3 participants
PAP	Beykoz / Paşamandıra Neighborhood Local Residents	18.07.2025	Field Visit FGD	4 participants
PAP	Beykoz / Ali Bahadır Neighborhood Local Residents	18.07.2025	Field Visit FGD	2 participants
PAP	Sarıyer / Uskumruköy Neighborhood Local Residents	19.07.2025	Field Visit FGD	4 participants
PAP	Sarıyer / Gümüşdere Neighborhood Local Residents	19.07.2025	Field Visit FGD	3 participants
PAP	Eyüpsultan / Ağaçlı Neighborhood Local Residents	19.07.2025	Field Visit FGD	7 participants
PAP	Eyüpsultan / Odayeri Neighborhood Local Residents	19.07.2025	Field Visit FGD	2 participants
PAP	Eyüpsultan / Işıklar Neighborhood Local Residents	19.07.2025	Field Visit FGD	5 participants
PAP	Arnavutköy / Tayakadın Neighborhood Local Residents	19.07.2025	Field Visit FGD	6 participants
PAP	Çatalca / Nakkaş Neighborhood Local Residents	20.07.2025	Field Visit FGD	3 participants
PAP	53 settlements intersecting with Project route	Between 11.07.2025 and 20.07.2025	Field Visit Household Questionnaire	802 household
PAP	53 settlements intersecting with Project route	Between 11.07.2025 and 04.08.2025	Field Visit Mukhtar Questionnaire	48 mukhtar
OIP Local media	Gebze Gazetesi	21.07.2025	Field Visit Face to Face Interview	1 participant
OIP Local government bodies	Tuzla Municipality	21.07.2025	Field Visit Face to Face Interview	1 participant
OIP Local government bodies	Pendik District Governorate	21.07.2025	Field Visit Face to Face Interview	1 participant
OIP Local media	Tünaydın Gazetesi	21.07.2025	Field Visit Face to Face Interview	1 participant
OIP Project component-related institution	Sabiha Gökçen Airport Operations (HEAŞ)	21.07.2025	Field Visit Face to Face Interview	3 participants
OIP Local government bodies	Beykoz Municipality	22.07.2025	Field Visit Face to Face Interview	3 participants
OIP Local government bodies	Beykoz District Governor's Office	22.07.2025	Field Visit Face to Face Interview	1 participant
OIP NGO / Cooperatives / Associations	Environmental Organizations Solidarity Association-CEKUD	22.07.2025	Field Visit Face to Face Interview	1 participant
OIP Local government bodies	İBB	22.07.2025	Field Visit Face to Face Interview	3 participants
OIP NGO / Cooperatives / Associations	Mor Çatı Women's Shelter Foundation	22.07.2025	Online Meeting	1 participant
OIP State institution	İstanbul Provincial Directorate of Disaster and Emergency Management	23.07.2025	Field Visit Face to Face Interview	2 participants
OIP Development agency	İstanbul Development Agency	23.07.2025	Field Visit Face to Face Interview	1 participant

OIP State organization	İstanbul Violence Prevention and Monitoring Center ŞÖNİM)	23.07.2025	Field Visit Face to Face Interview	1 participant
OIP State organization	İBB Women's Center	23.07.2025	Field Visit Face to Face Interview	1 participant
OIP CSO / Cooperatives / Associations	Çatalca Women's Cooperative	23.07.2025	Field Visit Face to Face Interview	2 participants
OIP CSO / Cooperatives / Associations	Arnavutköy Association for Persons with Disabilities	23.07.2025	Field Visit Face to Face Interview	1 participant
OIP CSO / Cooperatives / Associations	Giresun Province and Districts Solidarity Association	23.07.2025	Field Visit Face to Face Interview	1 participant

4.3.1.7 Limitations

During the fieldwork, some planned meetings could not be held due to the reasons indicated with Table 4-17 below. The most significant disruptions occurred during the NGO process. Many associations that appeared to be open and active through official channels were, in fact, no longer operating. This became apparent only during the fieldwork. In this sense, the planning conducted through desk-based studies did not align with actual field conditions.

Table 4-17 Limitations within the social studies July, 2025

Stakeholder identification	Planned meeting	Alternative stakeholder meeting, if any	Limitations / Current conditions
OIP / CSO / DVIG / People with handicapped	Gebze Association for the Education, Culture, Youth and Sports of the Hearing Impaired	Arnavutköy Disabled People Association	The association has been closed due to fraudulent activities.
OIP / CSO / DVIG/ Female	Becerikli Eller Association	Çatalca Kadın Kooperatifi	Becerikli Eller Association did not want to help.
OIP / CSO / DVIG / Female	Yerini Bil Association for Empowering Girls		The association did not provide assistance as they do not operate locally and have no activities along the route.
OIP / CSO / Culturally sensitive groups	Çekmeköy Nişantepe Roma Association for Solidarity and Mutual Aid	None	The association could not be reached.
OIP / CSO / Culturally sensitive groups	Çatalca Balkan and Roma Culture, Arts, and Solidarity Association	None	The association could not be reached.
OIP / CSO / Logistic related activities	İstanbul Public Transportation Workers' Mutual Aid and Solidarity Association	None	The association stated that they were not involved in any work related to rail systems and declined to meet.
OIP / CSO / Commerce related activities	İmrahor Neighborhood Tradesmen Solidarity Association	None	The contact information provided during fieldwork for the association was invalid and could not be reached.
OIP / CSO / Environment & Ecology	Association for the Support of the Environment and Ecological Life	None	The address and contact number of the NGO could not be accessed.
OIP / CSO / Environment & Ecology	Uskumruköy Nature Conservationists and Animal Lovers Association	None	The address and contact number of the NGO could not be accessed.
OIP / NGO / DVIG / People with handicapped	Marmara Association for People with Disabilities	None	Gebze Newspaper reported that the association is not active.
OIP / CSO / DVIG / People with handicapped	Istanbul Association for the Solidarity of Families with Disabilities	None	The association's address was visited, but it was determined to be inactive. Attempts to reach them by phone were also unsuccessful.
OIP / CSO / DVIG / Female	Atlas Women Producers Association	None	The Atlas Women Producers Association has changed its name to Atlas Solidarity Association. The association's address was visited, but it was

Stakeholder identification	Planned meeting	Alternative stakeholder meeting, if any	Limitations / Current conditions
			found to be inactive. It was also not reachable by phone.
OIP / NGO / Environment & Ecology	Turkey Marine Environment Protection Association (TURMEPA)	None	The association was visited, and the board of directors was in a meeting. An informational email about the project along with the questionnaire used during the meetings was sent. A response via email is awaited.
OIP / NGO / DVIG / People with handicapped	Bize Engel Yok Association	None	They could not be reached. Instead of the association, an insurance company appears at the address. Contact was attempted via email, but no response was received.
OIP / NGO / Environment & Ecology	Foundation for the Protection and Promotion of Environment and Cultural Values (ÇEKÜL)	None	They stated that the timing was not convenient and declined to participate in an online meeting.
OIP / NGO / Environment & Ecology	World Wide Fund for Nature	None	An informational email about the project along with the questionnaire used during the meetings was sent. A response via email is awaited.
OIP / NGO / DVIG / Female	Turkish Women's Union Association Bakırköy Branch	İBB Women's Services	There was no data regarding whether the association exists. They could not be reached.
OIP / NGO / Environment & Ecology	Environmental Foundation	Environmental Organizations Solidarity Association (CEKUD)	They have changed their address. There is no new address available. The old address still shows ÇEKUD.
OIP / Local government body	Istanbul Governorship	None	They were called by phone, but an appointment could not be made. The Provincial Planning Unit stated they could not assist and advised contacting the deputy governor. However, contact could not be established.
OIP / Local media	Bizim Anadolu Gazetesi	None	They were called by phone, but an appointment could not be made.
OIP / Local media	Yeniçağ Gazetesi	None	The interview was declined from the very beginning of the appointment request.
OIP / Local media	Hürses Gazetesi	None	The interview was declined from the very beginning of the appointment request.
OIP / Local media	Bakırköy Gazetesi	None	Bakırköy Newspaper office was visited, but it was closed.
OIP / Project components related organization	İGA İstanbul Airport	None	Information was requested via email to IGA to provide assistance. An informational email about the project along with the questionnaire used during the meetings was sent. A response via email is awaited.
OIP / Project components related organization	YSS-Northern Marmara Highway Operations	None	Information was requested via email from the operator. An informational email about the project along with the questionnaire used during the meetings was sent. A response via email is awaited.
PAP / Local representative	İstanbul Pendik Ramazanoğlu mukhtarship	None	Due to his opposition to the projects carried out in the region, they declined the interview request both during and after the fieldwork.
PAP / Local representative	İstanbul Sarıyer Rumeli Feneri mukhtarship	None	He declined the interview without providing any reason. The project information document was sent via WhatsApp, but no response was received.
PAP / Local representative	İstanbul Sarıyer Uskumruköy mukhtarship	None	She declined the interview stating she busy. A follow-up call was made later for a phone interview, but there was no answer. The project information document was sent via WhatsApp, but no response was received.
PAP / Local representative	İstanbul Arnavutköy Bolluca mukhtarship	None	He did not wish to participate in the interview during the fieldwork. Later, when called again for a phone interview, he expressed distrust towards studies conducted over the phone. The project information document was sent via WhatsApp, but no response was received.
PAP / Local representative	İstanbul Arnavutköy Baklalı mukhtarship	None	He declined the interview without providing any reason. A follow-up call was made later for a phone interview, but there was no answer. The project information document was sent via WhatsApp, but no response was received.

4.3.2 Administrative structure

The locations of the project route and its components are situated from east to west across Kocaeli Province, the Asian side of İstanbul, and the European side of İstanbul.

At the beginning of the 1970s, European Statistics Office (Eurostat) set up the Nomenclature of territorial units for statistics (NUTS) classification as a single, coherent system for dividing up the European Union (EU) territory to produce regional statistics [25].

- NUTS 1: major socio-economic regions
- NUTS 2: basic regions for the application of regional policies
- NUTS 3: small regions for specific diagnoses

To meet the demand for statistics at a local level, Eurostat maintains a system of Local Administrative Units (LAUs) compatible with NUTS. These LAUs are the building blocks of the NUTS and comprise the municipalities and communes of the EU [26].

The use of NUTS in Türkiye has started within the scope of the National Programmes for the Adoption of the European Union Acquis (NPAA) [27], adopted by the decision of the Council of Ministers dated March 19, 2001, and the Accession Partnership Document adopted at the Environmental Council dated March 8, 2001, prepared by the European Commission. Within this framework, Statistical Regional Units were defined in Türkiye with the study started in 2001 under the coordination of the under secretariat of State Planning Organization (DPT) and the Turkish Statistical Institute (TurkStat), and this classification entered into force by the Decision of the Council of Ministers dated August 28, 2002 [28].

Türkiye has constituted seven geographical regions, 12 NUTS region, 26 sub-region 81 provinces, 922 districts, 32,282 quarters, 18,240 villages, 23,787 affiliated settlements, 51 provincial municipalities, 30 metropolitan municipalities, 403 district municipalities, and 519 metropolitan district municipalities in accordance with administrative structure under local authority units [29]. It should be noted that these data are updated concurrently with changes in administrative structures.

In this structure, İstanbul and Kocaeli are both province, and metropolitan municipalities; while Gebze, Çayırova, Tuzla, Pendik, Sultanbeyli, Sancaktepe, Çekmeköy, Beykoz, Sarıyer, Eyüp, Arnavutköy, and Çatalca are both districts and metropolitan district municipalities.

- **TR, State:** Türkiye
- **TR1, NUTS 1, Region, İstanbul:** İstanbul province
- **TR4, NUTS 1, Region, Eastern Marmara:** Bursa, Eskişehir, Bilecik, Kocaeli, Sakarya, Düzce, Bolu, and Yalova provinces
- **TR10, NUTS 2 Sub region, İstanbul sub region:** İstanbul province
- **TR42, NUTS 2 Sub region, Kocaeli sub region:** Kocaeli, Sakarya, Düzce, Bolu, and Yalova provinces
- **TR100, NUTS 3 Province:** İstanbul
- **TR421, NUTS 3 Province:** Kocaeli
- **Sub-province Level, Districts**

---

[25] *European Commission, Eurostat. NUTS. https://ec.europa.eu/eurostat/web/nuts. Access date: July 2025.*

[26] *European Commission, Eurostat. LAU, https://ec.europa.eu/eurostat/web/nuts/local-administrative-units. Access date: July 2025.*

[27] *Republic of Türkiye, Ministry of Foreign Affairs Directorate for EU Affairs, NPAA, https://www.ab.gov.tr/58_en.html. Access date: July 2025.*

[28] *Republic of Türkiye Ministry of Industry and Technology General Directorate of Development Agencies. Classification of Statistical Regional Units in Development Planning. https://ka.gov.tr/sayfalar/kalkinma-planlamasinda-istatistiki-bolge-birimleri-siniflandirmasi--24. Access date: July 2025.*

[29] *Republic of Türkiye Ministry of Interior Inventory of Local Authority Units, https://www.e-icisleri.gov.tr/Anasayfa/MulkiIdariBolumleri.aspx. Access date: July 2025.*

- **İstanbul, the Asian side (east to west):** Tuzla, Pendik, Sultanbeyli, Sancaktepe, Çekmeköy, and Beykoz
- **İstanbul, the European side (east to west):** Sarıyer, Eyüp, Arnavutköy, and Çatalca
- **Kocaeli:** Gebze and Çayırova

- **LAU, Municipalities**
  - **Metropolitan Municipalities:** İstanbul, and Kocaeli
  - **Metropolitan District Municipalities:**
    - **İstanbul, the Asian side (east to west):** Tuzla, Pendik, Sultanbeyli, Sancaktepe, Çekmeköy, and Beykoz
    - **İstanbul, the European side (east to west):** Sarıyer, Eyüp, Arnavutköy, and Çatalca
    - **Kocaeli:** Gebze and Çayırova

There are no villages or towns in the districts. With the 'Law on the Establishment of Metropolitan Municipalities in Thirteen Provinces and Twenty-Six Districts and the Amendment of Certain Laws and Decree Laws', which entered into force in the Official Gazette dated 6 December 2012 and numbered 2848930, the villages and towns in İstanbul and Kocaeli provinces were registered as "neighborhoods" to the districts' municipality to which they were attached. Detailed explanations for rural and urban settlement types are also provided separately under the relevant section.

Table 4-18 provides all settlements intersecting with the AoI, including 2 provinces, 12 districts, and 53 neighborhoods in total. The settlements are categorized based on their administrative affiliation (province and district) and listed in alphabetical order. It should also be noted that there are two neighborhoods with the same name "Cumhuriyet": one is Cumhuriyet neighborhood in Beykoz district of İstanbul Province, and the other is located in Gebze district of Kocaeli Province.

Table 4-18 Settlements Intersecting with the AoI (Province, District, and Neighborhood), TurkStat, 2024

Province	District	Neigborhood	Total population
İstanbul	**-**	**-**	**15,701,602**
İstanbul Province	**Arnavutköy District**	**-**	**344,868**
İstanbul	Arnavutköy	Baklalı	866
İstanbul	Arnavutköy	Bolluca	8,446
İstanbul	Arnavutköy	Boyalık	758
İstanbul	Arnavutköy	Dursunköy	433
İstanbul	Arnavutköy	İmrahor	12,088
İstanbul	Arnavutköy	Tayakadın	3,716
İstanbul	Arnavutköy	Yassıören	675
İstanbul Province	**Beykoz District**	**-**	**245,440**
İstanbul	Beykoz	Ali Bahadır	781
İstanbul	Beykoz	Anadolu Feneri	687
İstanbul	Beykoz	Bozhane	464
İstanbul	Beykoz	Cumhuriyet	1,966
İstanbul	Beykoz	Öğümce	493
İstanbul	Beykoz	Paşamandıra	1,374
İstanbul	Beykoz	Poyrazköy	881
İstanbul Province	**Çatalca District**	**-**	**80,399**
İstanbul	Çatalca	Ferhatpaşa	28,400
İstanbul	Çatalca	İzzettin	1,304
İstanbul	Çatalca	Kaleiçi	7,617
İstanbul	Çatalca	Nakkaş	803
İstanbul Province	**Çekmeköy District**	**-**	**306,739**
İstanbul	Çekmeköy	Hüseyinli	849

[30] *Arslan, R. K. (2025). Metropolitan Municipality Elections After Law No. 6360. SSD Journal, 10(49), 277–291. https://doi.org/10.5281/zenodo.15206247. https://www.ssdjournal.org/index.php/pub/article/view/757. Access date: June 2025.*

Province	District	Neigborhood	Total population
İstanbul	Çekmeköy	Nişantepe	12,546
İstanbul	Çekmeköy	Ömerli	5,702
İstanbul	Çekmeköy	Reşadiye	2,887
İstanbul Province	**Eyüpsultan District**	**-**	**420,706**
İstanbul	Eyüpsultan	Ağaçlı	731
İstanbul	Eyüpsultan	Çiftalan	187
İstanbul	Eyüpsultan	Işıklar	549
İstanbul	Eyüpsultan	İhsaniye	185
İstanbul	Eyüpsultan	Odayeri	229
İstanbul Province	**Pendik District**	**-**	**749,356**
İstanbul	Pendik	Emirli	252
İstanbul	Pendik	Güllübağlar	19,001
İstanbul	Pendik	Harmandere	9,947
İstanbul	Pendik	Kavakpınar	65,879
İstanbul	Pendik	Kurna	1,154
İstanbul	Pendik	Kurtdoğmuş	614
İstanbul	Pendik	Kurtköy	38,756
İstanbul	Pendik	Ramazanoğlu	2,427
İstanbul	Pendik	Sanayi	2,999
İstanbul	Pendik	Şeyhli	19,684
İstanbul	Pendik	Yenişehir	65,637
İstanbul Province	**Sancaktepe District**	**-**	**502,077**
İstanbul	Sancaktepe	Paşaköy	1,758
İstanbul Province	**Sarıyer District**	**-**	**342,582**
İstanbul	Sarıyer	Demirciköy	1,698
İstanbul	Sarıyer	Garipçe	370
İstanbul	Sarıyer	Gümüşdere	2,519
İstanbul	Sarıyer	Kısırkaya	378
İstanbul	Sarıyer	Rumeli Feneri	4,074
İstanbul	Sarıyer	Uskumruköy	10,197
İstanbul Province	**Sultanbeyli District**	**-**	**369,193**
İstanbul	Sultanbeyli	Akşemsettin	13,886
İstanbul	Sultanbeyli	Mecidiye	21,859
İstanbul Province	**Tuzla District**	**-**	**301,400**
İstanbul	Tuzla	Aydınlı	72,942
İstanbul	Tuzla	Aydıntepe	27,173
İstanbul	Tuzla	İstasyon	26,338
Kocaeli	**-**	**-**	**2,130,006**
Kocaeli	**Çayırova District**	**-**	**157,503**
Kocaeli	Çayırova	Şekerpınar	2,847
Kocaeli	Çayırova	Yeni Mahalle	21,192
Kocaeli	**Gebze District**	**-**	**411,800**
Kocaeli	Gebze	Cumhuriyet	10,038

4.3.3 Population structure

4.3.3.1 General population figures

Development agencies of these regions are İstanbul Development Agency [31] (İSTKA) (for İstanbul), and Eastern Marmara Development Agency (MARKA) [32] (for Kocaeli sub region,

31 *İstanbul Development Agency, https://www.istka.org.tr/, Access date: June 2025.*
32 *Eastern Marmara Development Agency, http://www.marka.org.tr/, Access date: June 2025.*

including Kocaeli province), respectively.

When population density [33] data is examined, the population density in Türkiye is 111, in İstanbul it is 2,934, and in Kocaeli it is 623 [34].

The up-to-date demographic data [35],[36] including the settlements intersecting with the AoI, has been provided by Table 4-19.

Table 4-19 Up to date Population Information, TurkStat, 2024

Code	NUTS Level	Name	Total population	Population density (persons per km²)	Total number of households	Average household size	Annual population growth rate (‰)
TR	**State**	**Türkiye**	**85,664,944**	**111**	**26,599,261**	**3.11**	**3.42**
TR1	**NUTS-1 Level / Region**	**İstanbul Province**	**15,701,602**	**2,934**	**4,855,719**	**3.13**	**2.91**
İstanbul Province	**Sub-province Level / District**	**Arnavutköy District**	**344,868**	**NA**	**89,784**	**3.76**	**25.87**
İstanbul	Arnavutköy[37] District	Baklalı Neigborhood	866	NA	230	3.77	NA
İstanbul	Arnavutköy District	Bolluca Neigborhood	8,446	NA	2,246	3.76	NA
İstanbul	Arnavutköy District	Boyalık Neigborhood	758	NA	202	3.75	NA
İstanbul	Arnavutköy District	Dursunköy Neigborhood	433	NA	115	3.77	NA
İstanbul	Arnavutköy District	İmrahor Neigborhood	12,088	NA	3,215	3.76	NA
İstanbul	Arnavutköy District	Tayakadın Neigborhood	3,716	NA	988	3.76	NA
İstanbul	Arnavutköy District	Yassıören Neigborhood	675	NA	180	3.75	NA
İstanbul Province	**Sub-province Level / District**	**Beykoz District**	**245,440**	**NA**	**77,382**	**3.09**	**-0.84**
İstanbul	Beykoz District	Ali Bahadır Neigborhood	781	NA	253	3.09	NA
İstanbul	Beykoz District	Anadolu Feneri Neigborhood	687	NA	222	3.09	NA
İstanbul	Beykoz District	Bozhane Neigborhood	464	NA	150	3.09	NA
İstanbul	Beykoz District	Cumhuriyet Neigborhood	1,966	NA	636	3.09	NA
İstanbul	Beykoz District	Öğümce Neigborhood	493	NA	160	3.08	NA
İstanbul	Beykoz District	Paşamandıra Neigborhood	1,374	NA	445	3.09	NA
İstanbul	Beykoz District	Poyrazköy Neigborhood	881	NA	285	3.09	NA
İstanbul Province	**Sub-province Level / District**	**Çatalca District**	**80,399**	**NA**	**30,212**	**2.63**	**4.89**
İstanbul	Çatalca District	Ferhatpaşa Neigborhood	28,400	NA	10,798	2.63	NA
İstanbul	Çatalca District	İzzettin Neigborhood	1,304	NA	496	2.63	NA
İstanbul	Çatalca District	Kaleiçi Neigborhood	7,617	NA	2,896	2.63	NA
İstanbul	Çatalca District	Nakkaş Neigborhood	803	NA	305	2.63	NA
İstanbul Province	**Sub-province Level / District**	**Çekmeköy District**	**306,739**	**NA**	**93,994**	**3.18**	**22.86**
İstanbul	Çekmeköy District	Hüseyinli	849	NA	267	3.18	NA

33 Population density: Population per one square kilometer. In the calculation of population density indicator, the land surface area excluding "inland water bodies (natural and dam lakes, rivers and continental shelves, etc.)" is used according to international definitions. TurkStat Metadata of Address Based Population Registration System (ABPRS). https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1#data0. Access date: June 2025.

34 TurkStat, The Results of Address Based Population Registration System, 2024. Population of province/district centers and towns/villages by province and sex, and population density, 2024. https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2024-53783. Access date: June 2025.

35 TurkStat, The Results of Address Based Population Registration System, 2024.

36 TurkStat, The Results of Address Based Population Registration System, 2024.Access date: July 2025

37 The settlements within the table are listed alphabetically according to their affiliated provinces and/or districts.

Code	NUTS Level	Name	Total population	Population density (persons per km²)	Total number of households	Average household size	Annual population growth rate (‰)
		Neigborhood					
İstanbul	Çekmeköy District	Nişantepe Neigborhood	12,546	NA	3,945	3.18	NA
İstanbul	Çekmeköy District	Ömerli Neigborhood	5,702	NA	1,793	3.18	NA
İstanbul	Çekmeköy District	Reşadiye Neigborhood	2,887	NA	908	3.18	NA
İstanbul Province	**Sub-province Level / District**	**Eyüpsultan District**	**420,706**	**NA**	**134,627**	**3.05**	**1.22**
İstanbul	Eyüpsultan District	Ağaçlı Neigborhood	731	NA	240	3.05	NA
İstanbul	Eyüpsultan District	Çiftalan Neigborhood	187	NA	61	3.07	NA
İstanbul	Eyüpsultan District	Işıklar Neigborhood	549	NA	180	3.05	NA
İstanbul	Eyüpsultan District	İhsaniye Neigborhood	185	NA	61	3.03	NA
İstanbul	Eyüpsultan District	Odayeri Neigborhood	229	NA	75	3.05	NA
İstanbul Province	**Sub-province Level / District**	**Pendik District**	**749,356**	**NA**	**231,897**	**3.17**	**7.48**
İstanbul	Pendik District	Emirli Neigborhood	252	NA	79	3.19	NA
İstanbul	Pendik District	Güllübağlar Neigborhood	19,001	NA	5,994	3.17	NA
İstanbul	Pendik District	Harmandere Neigborhood	9,947	NA	3,138	3.17	NA
İstanbul	Pendik District	Kavakpınar Neigborhood	65,879	NA	20,782	3.17	NA
İstanbul	Pendik District	Kurna Neigborhood	1,154	NA	364	3.17	NA
İstanbul	Pendik District	Kurtdoğmuş Neigborhood	614	NA	194	3.16	NA
İstanbul	Pendik District	Kurtköy Neigborhood	38,756	NA	12,226	3.17	NA
İstanbul	Pendik District	Ramazanoğlu Neigborhood	2,427	NA	766	3.17	NA
İstanbul	Pendik District	Sanayi Neigborhood	2,999	NA	946	3.17	NA
İstanbul	Pendik District	Şeyhli Neigborhood	19,684	NA	6,209	3.17	NA
İstanbul	Pendik District	Yenişehir Neigborhood	65,637	NA	20,706	3.17	NA
İstanbul Province	**Sub-province Level / District**	**Sancaktepe District**	**502,077**	**NA**	**140,638**	**3.49**	**18.64**
İstanbul	Sancaktepe District	Paşaköy Neigborhood	1,758	NA	504	3.49	NA
İstanbul Province	**Sub-province Level / District**	**Sarıyer District**	**342,582**	**NA**	**112,435**	**2.87**	**-4.86**
İstanbul	Sarıyer District	Demirciköy Neigborhood	1,698	NA	592	2.87	NA
İstanbul	Sarıyer District	Garipçe Neigborhood	370	NA	129	2.87	NA
İstanbul	Sarıyer District	Gümüşdere Neigborhood	2,519	NA	878	2.87	NA
İstanbul	Sarıyer District	Kısırkaya Neigborhood	378	NA	132	2.86	NA
İstanbul	Sarıyer District	Rumeli Feneri Neigborhood	4,074	NA	1,420	2.87	NA
İstanbul	Sarıyer District	Uskumruköy Neigborhood	10,197	NA	3,553	2.87	NA
İstanbul Province	**Sub-province Level / District**	**Sultanbeyli District**	**369,193**	**NA**	**94,360**	**3.85**	**23.27**
İstanbul	Sultanbeyli District	Akşemsettin Neigborhood	13,886	NA	3,607	3.85	NA
İstanbul	Sultanbeyli District	Mecidiye Neigborhood	21,859	NA	5,678	3.85	NA
İstanbul Province	**Sub-province Level / District**	**Tuzla District**	**301,400**	**NA**	**92,390**	**3.12**	**26.21**
İstanbul	Tuzla District	Aydınlı Neigborhood	72,942	NA	23,379	3.12	NA
İstanbul	Tuzla District	Aydıntepe Neigborhood	27,173	NA	8,709	3.12	NA
İstanbul	Tuzla District	İstasyon Neigborhood	26,338	NA	8,442	3.12	NA
TR42	**NUTS-2 Level / Sub region**	**Kocaeli sub region**	**4,287,376**	**217**	**1,326,947**	**3.12**	**11**

Code	NUTS Level	Name	Total population	Population density (persons per km²)	Total number of households	Average household size	Annual population growth rate (‰)
TR421	**NUTS-3 Level / Province**	**Kocaeli**	**2,130,006**	**623**	**650,469**	**3.2**	**12.8**
Kocaeli Province	**Sub-province Level / District**	**Çayırova District**	**157,503**	**NA**	**45,765**	**3.4**	**27.04**
Kocaeli	Çayırova District	Şekerpınar Neigborhood	2,847	NA	837	3.4	NA
Kocaeli	Çayırova District	Yeni Mahalle Neigborhood	21,192	NA	6,233	3.4	NA
Kocaeli Province	**Sub-province Level / District**	**Gebze District**	**411,800**	**NA**	**121,443**	**3.33**	**10.65**
Kocaeli	Gebze District	Cumhuriyet Neigborhood	10,038	NA	3,014	3.33	NA

As part of the social field study, a total of 802 face-to-face interviews were conducted in a household survey carried out in 53 settlements intersecting with the AoI. The total population of the surveyed households was 2,901 individuals. The distribution of the population by settlement is provided in Table 4-20.

As shown in Table 4-20, based on the population data obtained from household surveys conducted in 53 settlements, the five most populous settlements are Aydınlı, Kavakpınar, Yenişehir, Kurtköy, and Aydıntepe. This situation is almost parallel to the official population data provided by TurkStat. Among the 53 settlements intersecting with the AoI, are the five most populous settlements are Aydınlı, Kavakpınar, Yenişehir, Kurtköy, and Ferhatpaşa (see Table 4-20).

In line with Table 4-20, the 12 settlements represented by a low population (between 3 and 10 people) are listed in ascending order of population as follows: Odayeri, Boyalık, İhsaniye, Yassıören, İzzettin, Çiftalan, Garipçe, Kısırkaya, Ali Bahadır, Anadolu Feneri, Paşaköy, and Demirciköy. Referring to official population data provided by TurkStat (see Table 4-20), there are nine settlements with a current population below 500. These are in ascending order of population: İhsaniye, Çiftalan, Odayeri, Emirli, Garipçe, Kısırkaya, Dursunköy, Bozhane, and Öğümce. Due to field limitations caused by low-density population areas, it was not possible to reach the planned number of households. In other words, in areas that are already sparsely populated, it was also challenging to reach the targeted sample size.

The average household size, calculated based on the total population of the households that participated in the household interviews, is 3.62. Out of the 53 settlements, 26 have an average household size below (between 1.50 and 3.55) this overall average (3.62). The average household sizes of the remaining settlements are above (between 3.75 and 6.00) the AoI average (3.62). The settlements closest to the average value are Kurtdoğmuş (3.60) and Aydınlı (3.61) (see Table 4-20).

Table 4-20 Population Figures, Household Survey, July 2025 (N:2,901 / 802)

#	Settlement	Total Population	Number of Household Questionnaire Completed	Average household size
1	İstanbul/Tuzla Aydınlı	383	106	3.61
2	İstanbul/Pendik Kavakpınar	378	95	3.98
3	İstanbul/Pendik Yenişehir	270	94	2.87
4	İstanbul/Pendik Kurtköy	199	56	3.55
5	İstanbul/Tuzla Aydıntepe	153	43	3.56
6	İstanbul/Sultanbeyli Mecidiye	129	31	4.16
7	İstanbul/Sultanbeyli Akşemsettin	125	29	4.31
8	Kocaeli/Çayırova Yeni Mahalle	121	31	3.9
9	İstanbul/Tuzla İstasyon	114	37	3.08
10	İstanbul/Pendik Güllübağlar	109	27	4.04
11	İstanbul/Pendik Şeyhli	105	28	3.75
12	İstanbul/Çekmeköy Nişantepe	74	19	3.89

#	Settlement	Total Population	Number of Household Questionnaire Completed	Average household size
13	İstanbul/Pendik Harmandere	67	16	4.19
14	İstanbul/Sarıyer Uskumruköy	55	13	4.23
15	İstanbul/Arnavutköy İmrahor	51	9	5.67
16	Kocaeli/Gebze Cumhuriyet	47	14	3.36
17	İstanbul/Çatalca Ferhatpaşa	42	17	2.47
18	İstanbul/Arnavutköy Tayakadın	28	7	4
19	İstanbul/Çekmeköy Reşadiye	24	4	6
20	İstanbul/Pendik Ramazanoğlu	23	5	4.6
21	İstanbul/Sarıyer Gümüşdere	20	4	5
22	İstanbul/Arnavutköy Bolluca	19	5	3.8
23	İstanbul/Pendik Kurna	18	4	4.5
24	İstanbul/Pendik Kurtdoğmuş	18	5	3.6
25	İstanbul/Çatalca Kaleiçi	16	6	2.67
26	İstanbul/Beykoz Paşamandıra	15	4	3.75
27	İstanbul/Çatalca Nakkaş	15	4	3.75
28	İstanbul/Çekmeköy Hüseyinli	15	4	3.75
29	İstanbul/Pendik Sanayi	15	4	3.75
30	Kocaeli/Çayırova Şekerpınar	15	5	3
31	İstanbul/Arnavutköy Baklalı	14	4	3.5
32	İstanbul/Beykoz Bozhane	14	4	3.5
33	İstanbul/Çekmeköy Ömerli	14	4	3.5
34	İstanbul/Eyüpsultan Ağaçlı	13	4	3.25
35	İstanbul/Sarıyer Rumeli Feneri	13	3	4.33
36	İstanbul/Arnavutköy Dursunköy	12	3	4
37	İstanbul/Beykoz Cumhuriyet	12	4	3
38	İstanbul/Beykoz Öğümce	12	4	3
39	İstanbul/Beykoz Poyrazköy	12	4	3
40	İstanbul/Eyüpsultan Işıklar	12	4	3
41	İstanbul/Pendik Emirli	12	3	4
42	İstanbul/Beykoz Ali Bahadır	10	4	2.5
43	İstanbul/Beykoz Anadolu Feneri	10	4	2.5
44	İstanbul/Sancaktepe Paşaköy	10	4	2.5
45	İstanbul/Sarıyer Demirciköy	10	2	5
46	İstanbul/Sarıyer Kısırkaya	9	3	3
47	İstanbul/Arnavutköy Yassıören	8	2	4
48	İstanbul/Çatalca İzzettin	8	3	2.67
49	İstanbul/Eyüpsultan Çiftalan	8	3	2.67
50	İstanbul/Sarıyer Garipçe	8	3	2.67
51	İstanbul/Arnavutköy Boyalık	7	2	3.5
52	İstanbul/Eyüpsultan İhsaniye	7	3	2.33
53	İstanbul/Eyüpsultan Odayeri	3	2	1.5
	Total	**2,901**	**802**	**3.62**

Based on the information provided by household representatives who participated in the interviews (July, 2025), household sizes were examined. According to these data, the most common household size is 4 (see Table 4-21). In this distribution, single-person households account for approximately 8%. The smallest household size is 1, while households with 11 members also exist, albeit rarely.

Households with 3 (21.95%) and 4 members (25.31%) together account for nearly 47% of the total number of households (802). This distribution shows similar characteristics to the household patterns observed in the districts and provinces to which the settlements are affiliated.

Table 4-21 Household size (Persons), Household Survey, July 2025 (N: 802)

Household size (persons)	Number of households	% of households
1	64	7.98
2	151	18.83
3	176	21.95
4	203	25.31
5	125	15.59
6	48	5.99
7	17	2.12
8	8	1.00
9	2	0.25
10	7	0.87
11	1	0.12
Total	802	100.00

In the interviews conducted with mukhtars representing 48 out of the 53 settlements, the total number of households reported for these settlements was 182,869. The population data reported by the mukhtars differ from the officially published figures (TurkStat). This discrepancy was negligible in some settlements (e.g Eyüpsultan Çiftalan, Beykoz Öğümce, Eyüpsultan Işıklar, Çekmeköy Hüseyinli, and Sarıyer Kısırkaya). In other settlements (e.g Arnavutköy Boyalık, Pendik Yenişehir, Sultanbeyli Akşemsettin, Pendik Kurtdoğmuş, and Pendik Emirli), there are discrepancies between the official figures and the data provided by the mukhtars, ranging from 1.5 to 2 times. This discrepancy may be related to the absence of household-level data at the neighborhood level in official records. The official population of the neighborhood was divided by the average household size of the district to which the neighborhood belongs, in order to estimate the number of households at the neighborhood level(see Table 4-22).

Table 4-22 Household number, Mukhtar Survey, June 2025 (N:48)

Settlements	Calculated Number of Households based on TurkStat 2024 data	Mukhtar survey
Arnavutköy Baklalı	230	Rejected
Arnavutköy Bolluca	2,246	Rejected
Arnavutköy Boyalık	202	400
Arnavutköy Dursunköy	115	164
Arnavutköy İmrahor	3,215	3,000
Arnavutköy Tayakadın	988	1,500
Arnavutköy Yassıören	180	160
Beykoz Ali Bahadır	253	300
Beykoz Anadolu Feneri	222	317
Beykoz Bozhane	150	175
Beykoz Cumhuriyet	636	550
Beykoz Öğümce	160	150
Beykoz Paşamandıra	445	650
Beykoz Poyrazköy	285	350
Çatalca Ferhatpaşa	10,798	12,000
Çatalca İzzettin	496	300
Çatalca Kaleiçi	2,896	3,250
Çatalca Nakkaş	305	280
Çekmeköy Hüseyinli	267	250
Çekmeköy Nişantepe	3,945	2,000
Çekmeköy Ömerli	1,793	2,500
Çekmeköy Reşadiye	908	1,200
Eyüpsultan Ağaçlı	240	200
Eyüpsultan Çiftalan	61	65
Eyüpsultan Işıklar	180	168
Eyüpsultan İhsaniye	61	40
Eyüpsultan Odayeri	75	100
Pendik Emirli	79	120

Settlements	Calculated Number of Households based on TurkStat 2024 data	Mukhtar survey
Pendik Güllübağlar	5,994	5,670
Pendik Harmandere	3,138	2,600
Pendik Kavakpınar	20,782	23,000
Pendik Kurna	364	150
Pendik Kurtdoğmuş	194	300
Pendik Kurtköy	12,226	18,000
Pendik Ramazanoğlu	766	Rejected
Pendik Sanayi	946	800
Pendik Şeyhli	6,209	6,000
Pendik Yenişehir	20,706	40,000
Sancaktepe Paşaköy	504	450
Sarıyer Demirciköy	592	500
Sarıyer Garipçe	129	110
Sarıyer Gümüşdere	878	450
Sarıyer Kısırkaya	132	150
Sarıyer Rumeli Feneri	1,420	Rejected
Sarıyer Uskumruköy	3,553	Rejected
Sultanbeyli Akşemsettin	3,607	6,500
Sultanbeyli Mecidiye	5,678	5,300
Tuzla Aydınlı	23,379	20,000
Tuzla Aydıntepe	8,709	7,000
Tuzla İstasyon	8,442	5,500
Çayırova Şekerpınar	837	700
Çayırova Yeni Mahalle	6,233	5,500
Gebze Cumhuriyet	3,014	4,000
Total	**169,863**	**182,869**

4.3.3.2 Gender distribution

4.3.3.2.1 Legal framework

Women in Türkiye were granted the right to vote and stand for election in 1934. The Constitution of the Republic of Türkiye[38] guarantees equality between women and men and obliges the State to take the necessary measures to ensure that this equality is realized in practice. The Turkish Civil Code[39] further regulates equal rights within the family, including women's rights to acquire, own, and manage property.

Türkiye is a party to key international agreements aimed at eliminating discrimination against women. The country ratified the Convention on the Elimination of All Forms of Discrimination against Women (CEDAW) in 1986[40] and withdrew its reservations to Articles 15 and 16 of the Convention in 1999. Türkiye also endorsed the Beijing Declaration and Platform[41] for Action in

[38] *Constitution of the Republic of Turkey (1982). https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=2709&MevzuatTur=1&MevzuatTertip=5. Access date: December 2025*

[39] *Turkish Civil Code (No. 4721). https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=4721&MevzuatTur=1&MevzuatTertip=5. Access date: December 2025*

[40] *Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), UN Treaty Series https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-8&chapter=4&clang=_en. Access date: December 2025*

[41] *UN Women. (2015). Beijing Declaration and Platform for Action. https://www.unwomen.org/en/digital-library/publications/2015/01/beijing-declaration. Access date: December 2025*

1995 and acceded to the Optional Protocol[42] to CEDAW in 2002.

The establishment of institutional mechanisms for gender equality began in the late 1980s. In 1987, the Advisory Board on Policies for Women was established within the State Planning Organization[43] to promote gender awareness in public policies. In 1990, the General Directorate on the Status of Women[44] was established as the main governmental body responsible for coordinating policies and activities related to gender equality.

Various policy documents and action plans have been developed to promote gender equality. The National Action Plan on Gender Equality (2009–2013)[45] aimed to reduce gender-based inequalities in areas such as education, health, poverty, and participation in decision-making processes. In addition, the 12th Development Plan[46] identifies women's empowerment, the prevention of discrimination, and equal access to rights and opportunities as key policy objectives.

Violence Prevention and Monitoring Centers (ŞÖNİM)[47] have been operating since 2012 under Law No. 6284, with the aim of delivering protective and preventive services in a holistic manner in the fight against violence against women and domestic violence. ŞÖNİMs provide psychosocial and legal support to survivors of violence and strengthen coordination among relevant institutions.

Calls related to services for families, women, children, persons with disabilities, the elderly, families of martyrs, veterans, and relatives of veterans are received through the ALO 183 Combatting Violence Hotline of the call centers[48] of the Ministry of Family and Social Services, and guidance and counseling services are provided accordingly. In addition, reports of neglect, abuse, and violence, as well as precautionary notifications aimed at preventing so-called honor and custom-related killings, are also received. Taking into account the urgency of the situation, such cases are reported to the Emergency Response Team Supervisor in the province where the incident has occurred and/or to law enforcement authorities. The Emergency Response Team assesses the case and, where necessary, coordinates with police or gendarmerie units to ensure that intervention is carried out as quickly as possible.

Other policy frameworks adopted in Türkiye include the National Strategy and Action Plan on Women's Empowerment (2018–2023)[49], the National Action Plan on Combating Violence against Women (2016–2020), and the National Action Plan on Women's Employment (2016–2018). These frameworks focus on increasing women's participation in economic and social life and addressing gender-based violence.

---

[42] *Optional Protocol to the Convention on the Elimination of All Forms of Discrimination Against Women, UN Treaty Series. https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-8-b&chapter=4&clang=_en. Access date: December 2025*

[43] *Sixth Five-Year Development Plan (1990–1994), Presidency of Strategy and Budget, Turkey. https://www.sbb.gov.tr/wp-content/uploads/2022/07/Altinci_Bes_Yillik_Kalkinma_Plani-1990-1994.pdf. Access date: December 2025*

[44] *Ministry of Family and Social Services – Legislation. https://www.aile.gov.tr/ksgm/mevzuat/. Access date: December 2025*

[45] *Ministry of Family and Social Services – Women's Empowerment Strategy Document and Action Plans. https://www.aile.gov.tr/ksgm/ulusal-eylem-planlari/kadinin-guclenmesi-strateji-belgesi-ve-eylem-planlari/. Access date: December 2025*

[46] *Twelfth Development Plan (2024–2028), Presidency of Strategy and Budget, Turkey. https://www.sbb.gov.tr/wp-content/uploads/2023/12/On-Ikinci-Kalkinma-Plani_2024-2028_11122023.pdf. Access date: December 2025*

[47] *Ministry of Family and Social Services – ŞÖNİM (Violence Prevention and Monitoring Centers) Contact Information. https://www.aile.gov.tr/iletisim/bakanlik-iletisim-bilgileri/sonim/. Access date: December 2025.*

[48] *ALO 183 Hotline Service Areas.https://alo183.aile.gov.tr/alo183pages/hizmet-alani/. Access date: December 2025*

[49] *National Action Plans for Combating Violence Against Women, Ministry of Family and Social Services. https://www.aile.gov.tr/ksgm/ulusal-eylem-planlari/kadina-yonelik-siddetle-mucadele-ulusal-eylem-planlari/. Access date: December 2025*

Türkiye signed the Council of Europe Convention on Preventing and Combating Violence against Women and Domestic Violence (the Istanbul Convention) on 11 May 2011[50], becoming the first country to do so. The Convention aimed to prevent violence against women and domestic violence, protect victims, and prosecute perpetrators. However, Türkiye withdrew from the Istanbul Convention by a Presidential decision in March 2021[51]. The National Action Plan on Combating Violence against Women (2021–2025)[52], announced in the same period, does not explicitly refer to the concept of gender equality or the Istanbul Convention.

The protection of human rights in Türkiye is ensured under Article 90 of the 1982 Constitution, which gives international human rights treaties duly put into force precedence over domestic laws[53]. Fundamental rights and freedoms are guaranteed under the Constitution, and national institutions such as the Human Rights and Equality Institution of Türkiye[54] and the Ombudsman Institution[55] are responsible for monitoring and promoting the protection of human rights.

The key documents, national legislative provisions, and related practices forming the basis for gender equality are summarized below:

- Constitution of the Republic of Türkiye
- Turkish Civil Code
- Labor Law (Principle of equal treatment (Article 5))
- Human Rights and Equality Law, Articles 3 and 6
- Article 105(2) of the Turkish Penal Code
- Republic of Türkiye Prime Ministry Circular No. 2010/14 on Increasing Women's Employment and Promoting Equal Opportunities (KEİG)
- Grand National Assembly of Türkiye Commission on Equal Opportunities for Women and Men (KEFEK)
- Republic of Türkiye Ministry of Family and Social Services General Directorate on the Status of Women National Action Plan on Combating Violence against Women (2021-2025)
- Republic of Türkiye Ministry of Family and Social Services General Directorate on the Status of Women Women's Shelters Guide
- Republic of Türkiye Ministry of Interior General Command of Gendarmerie Prevention of Domestic Violence against Women Project
- Republic of Türkiye Ministry of Interior General Directorate of Security Women Support Application (KADES)
- Republic of Türkiye Ministry of Family and Social Services Violence Prevention and Monitoring Centers (ŞÖNİM)

---

[50] *Council of Europe – Istanbul Convention: Key Facts. https://www.coe.int/en/web/istanbul-convention/key-facts. Access date: December 2025*

[51] *Statement Regarding Turkey's Withdrawal from the Istanbul Convention. Presidency of Communications, Turkey https://www.iletisim.gov.tr/turkce/haberler/detay/statement-regarding-turkeys-withdrawal-from-the-istanbul-convention. Access date: December 2025*

[52] *National Action Plans for Combating Violence Against Women, Ministry of Family and Social Services https://www.aile.gov.tr/ksgm/ulusal-eylem-planlari/kadina-yonelik-siddetle-mucadele-ulusal-eylem-planlari/.. Access date: December 2025*

[53] *The Status of International Law in the Turkish Constitution, Office of the President of Turkey. https://www.anayasa.gov.tr/en/president/former-presidents-speeches/zuhtu-arslan/speeches/the-status-of-the-international-law-in-the-turkish-constitution. Access date: December 2025*

[54] *Turkish Human Rights and Equality Institution – Protection and Promotion of Human Rights. https://www.tihek.gov.tr/kategori/pages/insan-haklarinin-korunmasi-ve-gelistirilmesi. Access date: December 2025*

[55] *Office of the Ombudsman of Turkey – About the Institution. https://english.ombudsman.gov.tr/about-the-institution. Access date: December 2025*

- Republic of Türkiye Ministry of Family and Social Services Family, Women, Children and Disabled Social Service Hotline (ALO 183)
- Republic of Türkiye Ministry of Interior Gendarmerie General Command Child and Women Section Chiefs
- Federation of Women's Associations of Türkiye (TKDF) Domestic Violence Emergency Hotline (02126569696 -05496569696)
- Women Entrepreneurs Association of Türkiye (KAGİDER)

4.3.3.2.2 Benefits for gender

The INRAIL Project is expected to provide employment opportunities during both the construction and operational phases, which may benefit women and men differently due to existing gender norms. Men are likely to take on more roles in heavy construction, tunneling, and technical operations, while women may have greater access to administrative, service, or support roles.

Improved mobility provided by the new railway line may also benefit women and men differently. Women could gain better access to employment and public services if public transport integration and safety measures are ensured. However, insufficient attention to safety, accessibility, or affordability could limit women's ability to fully benefit from the enhanced mobility.

The Project also has the potential to improve local services and infrastructure, particularly community health, safety, and public transport facilities. It is important to actively include women's perspectives in stakeholder engagement activities and to design specific measures that reduce barriers to participation. These measures could include childcare support near construction sites and women-only, gender-sensitive spaces. Targeted actions will be necessary to ensure women have equal access to employment, skills development, and mobility opportunities. These measures can be implemented in alignment with the Project's SEP and LMP.

4.3.3.2.3 Findings

The current population data (TurkStat) for the relevant locations are presented in Table 4-19 Across Türkiye, the distribution of male and female population within the total population is nearly equal. In all units except for İstanbul, the male population exceeds the female population (56) (see Table 4-23, and Figure 4-29). It should be noted that there is no official data on population distribution by gender at sub settlement level (neigborhooods).

Table 4-23 Gender Distribution, TurkStat, 2024

Unit	Male	%	Female	%	Total
Türkiye	42,853,110	**50.02**	42,811,834	**49.98**	85,664,944
İstanbul	7,820,462	**49.81**	7,881,140	**50.19**	15,701,602
Kocaeli sub region	2,152,218	**50.20**	2,135,158	**49.80**	4,287,376
Kocaeli	1,072,955	**50.37**	1,057,051	**49.63**	2,130,006
Arnavutköy	177,241	**51.39**	167,627	**48.61**	344,868
Beykoz	121,372	**49.45**	124,068	**50.55**	245,440
Çatalca	41,082	**51.10**	39,317	**48.90**	80,399
Çekmeköy	152,305	**49.65**	154,434	**50.35**	306,739
Eyüpsultan	209,239	**49.74**	211,467	**50.26**	420,706
Pendik	376,425	**50.23**	372,931	**49.77**	749,356
Sancaktepe	253,615	**50.51**	248,462	**49.49**	502,077
Sarıyer	168,018	**49.04**	174,564	**50.96**	342,582
Sultanbeyli	187,923	**50.90**	181,270	**49.10**	369,193
Tuzla	151,271	**50.19**	150,129	**49.81**	301,400
Çayırova	79,988	**50.79**	77,515	**49.21**	157,503
Gebze	208,417	**50.61**	203,383	**49.39**	411,800

[56] *TurkStat, ABPRS Results, 2024, https://biruni.tuik.gov.tr/medas/?kn=95&locale=en, Access date: July 2025.*

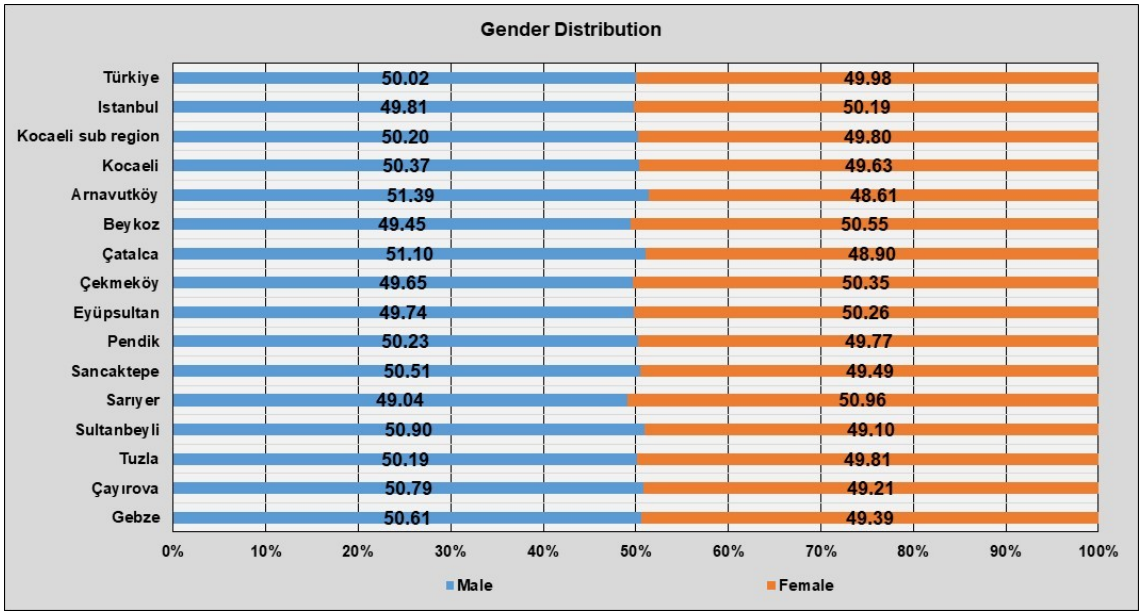


Figure 4-29 Gender Distribution, TurkStat, 2024

As a result of the 802 household interviews conducted, data was collected on 2,901 individuals. Approximately 49% of this population were identified as male and 51% as female (see Table 4-24, and Figure 4-30. While these figures are consistent with the data of the districts and provinces to which the settlements are affiliated, as well as national-level statistics for Türkiye, the proportion of women is slightly higher than the general distribution (see Table 4-23, and Figure 4-29).

Table 4-24 Gender Distribution, Household Survey, July 2025 (N:2,901)

Settlements	% of Male	% of Female	Total Population
Arnavutköy Baklalı	42.86	57.14	14
Arnavutköy Bolluca	42.11	57.89	19
Arnavutköy Boyalık	57.14	42.86	7
Arnavutköy Dursunköy	41.67	58.33	12
Arnavutköy İmrahor	35.29	64.71	51
Arnavutköy Tayakadın	42.86	57.14	28
Arnavutköy Yassıören	62.50	37.50	8
Beykoz Ali Bahadır	50.00	50.00	10
Beykoz Anadolu Feneri	60.00	40.00	10
Beykoz Bozhane	50.00	50.00	14
Beykoz Cumhuriyet	33.33	66.67	12
Beykoz Öğümce	58.33	41.67	12
Beykoz Paşamandıra	40.00	60.00	15
Beykoz Poyrazköy	75.00	25.00	12
Çatalca Ferhatpaşa	45.24	54.76	42
Çatalca İzzettin	62.50	37.50	8
Çatalca Kaleiçi	56.25	43.75	16
Çatalca Nakkaş	46.67	53.33	15
Çekmeköy Hüseyinli	46.67	53.33	15
Çekmeköy Nişantepe	47.30	52.70	74
Çekmeköy Ömerli	71.43	28.57	14
Çekmeköy Reşadiye	50.00	50.00	24
Eyüpsultan Ağaçlı	30.77	69.23	13
Eyüpsultan Çiftalan	50.00	50.00	8
Eyüpsultan Işıklar	41.67	58.33	12
Eyüpsultan İhsaniye	57.14	42.86	7
Eyüpsultan Odayeri	33.33	66.67	3

Settlements	% of Male	% of Female	Total Population
Pendik Emirli	58.33	41.67	12
Pendik Güllübağlar	46.79	53.21	109
Pendik Harmandere	52.24	47.76	67
Pendik Kavakpınar	46.03	53.97	378
Pendik Kurna	50.00	50.00	18
Pendik Kurtdoğmuş	55.56	44.44	18
Pendik Kurtköy	49.75	50.25	199
Pendik Ramazanoğlu	43.48	56.52	23
Pendik Sanayi	53.33	46.67	15
Pendik Şeyhli	46.67	53.33	105
Pendik Yenişehir	49.26	50.74	270
Sancaktepe Paşaköy	50.00	50.00	10
Sarıyer Demirciköy	50.00	50.00	10
Sarıyer Garipçe	37.50	62.50	8
Sarıyer Gümüşdere	55.00	45.00	20
Sarıyer Kısırkaya	44.44	55.56	9
Sarıyer Rumeli Feneri	38.46	61.54	13
Sarıyer Uskumruköy	45.45	54.55	55
Sultanbeyli Akşemsettin	50.40	49.60	125
Sultanbeyli Mecidiye	48.84	51.16	129
Tuzla Aydınlı	45.69	54.31	383
Tuzla Aydıntepe	58.17	41.83	153
Tuzla İstasyon	52.63	47.37	114
Çayırova Şekerpınar	40.00	60.00	15
Çayırova Yeni Mahalle	47.93	52.07	121
Gebze Cumhuriyet	57.45	42.55	47
Total	**1,408**	**1,493**	**2,901**
%	**48.53**	**51.47**	

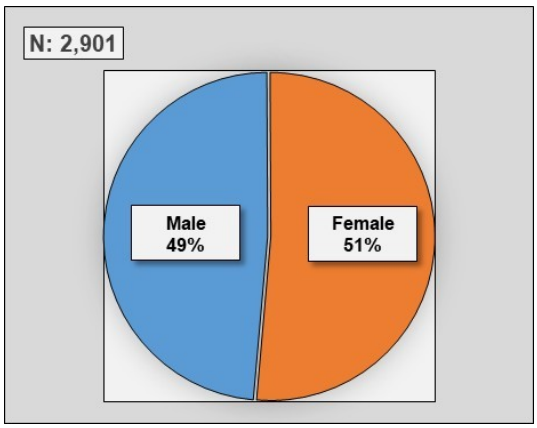


Figure 4-30 Gender distribution of the field, Household Survey, July 2025 (N:2,901)

4.3.3.2.4 Vulnerable Groups –Female household heads

Women who are the sole heads of household are considered part of the vulnerable groups. An analysis of employment rates by marital status shows that widowed women have the lowest rate. This results in a disadvantage for women who are sole household heads in terms of labor force participation (2022). According to Presidency of the Republic of Türkiye Strategy and Budget Office data[57], the women's labor force participation rate in January 2025 remained below the values of the previous year. Similar results gathered by Household Labour Force Survey. The

[57] *Presidency of the Republic of Türkiye Strategy and Budget Office. Total and Female Labor Force Participation Rate, January 2017 – January 2025.https://www.sbb.gov.tr/istihdam/. Access Date: July 2025*

labor force participation rate for those aged 15 years and over was 53.3% in 2023. This rate was 35.8% for females and 71.2% for males [58]. In Türkiye, women's labor force participation rates have consistently fallen behind the averages of the Organisation for Economic Co-operation and Development (OECD) [59].

Besides, women who are separated from their spouses (divorced) have been found to have the highest rates of being subject to physical, sexual, and emotional violence. Therefore, women who are sole household heads will be in a vulnerable situation due to their higher likelihood of experiencing violence (2014) [60].

Of the 802 household representatives who participated in the survey, 326 were women (41%); 41 of these women identified themselves as the sole head of their household (12.57%).

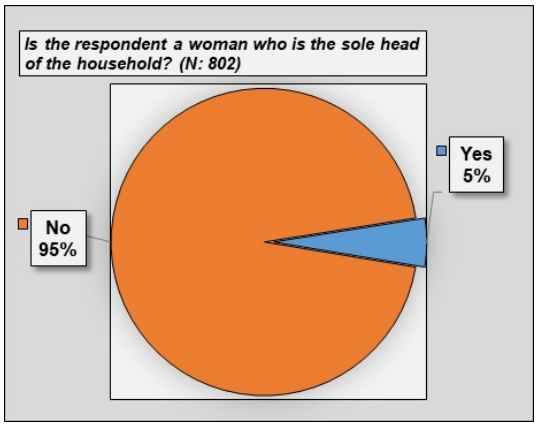


Figure 4-31 Female household heads, Household Survey July 2025 (N:802)

A total of 77 people live in the 41 households represented by women who are the sole heads of their households. The average household size in these households is 1.87. The most common household type is single-person Households (see Table 4-25). Among the 41 households represented by women who are the sole heads of their households, blue-collar workers and retirees stand out as the main sources of livelihood (see Table 4-25).

Table 4-25 Household size of female-headed households, Household Survey, July 2025 (N:41)

Settlements	1	2	3	4	6	Total
Pendik Yenişehir	9	6	3	0	0	18
Pendik Kavakpınar	3	2	6	0	6	17
Tuzla Aydınlı	0	2	6	4	0	12
Tuzla Aydıntepe	1	2	0	4	0	7
Gebze Cumhuriyet	0	2	0	4	0	6
Çatalca Ferhatpaşa	1	0	3	0	0	4
Pendik Kurtköy	2	2	0	0	0	4
Pendik Şeyhli	1	2	0	0	0	3
Beykoz Ali Bahadır	0	2	0	0	0	2
Arnavutköy Tayakadın	1	0	0	0	0	1
Eyüpsultan Işıklar	1	0	0	0	0	1
Eyüpsultan Odayeri	1	0	0	0	0	1
Sarıyer Uskumruköy	1	0	0	0	0	1

58 *TurkStat Press Release dated 06.03.2025. Women in Statistics, 2024. https://data.tuik.gov.tr/Bulten/Index?p=Women-in-Statistics-2024-54076. Access Date: July 2025*

59 *One Year After: Living and Working Conditions in Adıyaman, Hatay, Kahramanmaraş and Malatya after the February 2023 Earthquakes in Türkiye, 9789220413081 (web PDF). https://www.ilo.org/sites/default/files/2024-10/Household%20Survey%20Report.pdf. Access Date: July 2025*

60 *TurkStat, Gender Statistics, 2022, Vital and Gender Statistics Group, Publication Number 4681, Release Date March 2023., https://www.tuik.gov.tr/media/announcements/toplumsal_cinsiyet_istatistikleri.pdf, Access Date: July 2025.*

Settlements	1	2	3	4	6	Total
Total	21	20	18	12	6	77

Table 4-26 Livelihood sources of female-headed households, Household Survey, July 2025 (N:41)

	Pendik Yenişehir	Pendik Kavakpınar	Tuzla Aydınlı	Pendik Kurtköy	Tuzla Aydıntepe	Çatalca Ferhatpaşa	Pendik Şeyhli	Gebze Cumhuriyet	Arnavutköy Tayakadın	Beykoz Ali Bahadır	Eyüpsultan Işıklar	Eyüpsultan Odayeri	Sarıyer Uskumruköy	Total
Working as a blue-collar worker in permanent jobs	6	3	1	1	1	1	0	0	0	1	0	0	0	14
Retirement (domestic or abroad)	3	2	0	1	0	0	0	0	1	0	1	1	1	10
Commercial activities (shop, kiosk, workshop, other businesses, etc.)	1	1	1	0	2	0	1	1	0	0	0	0	0	7
Regular jobs in commercial enterprises (cashier, waiter, courier)	1	1	1	1	0	1	0	0	0	0	0	0	0	5
Income from daily jobs (cleaning, child/elder care, etc.)	0	0	0	0	0	0	0	1	0	0	0	0	0	1
Unemployed	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Rental income	0	0	0	0	0	0	1	0	0	0	0	0	0	1
Working as a white-collar employee in permanent jobs	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Working as a civil servant in permanent jobs	1	0	0	0	0	0	0	0	0	0	0	0	0	1
Total	13	7	4	3	3	2	2	2	1	1	1	1	1	41

Although efforts were made to ensure a high proportion of female participants in the household surveys, the share of women remained limited to 41%. This may be related to the fact that public spaces are more frequently used by men (see Figure 4-32).

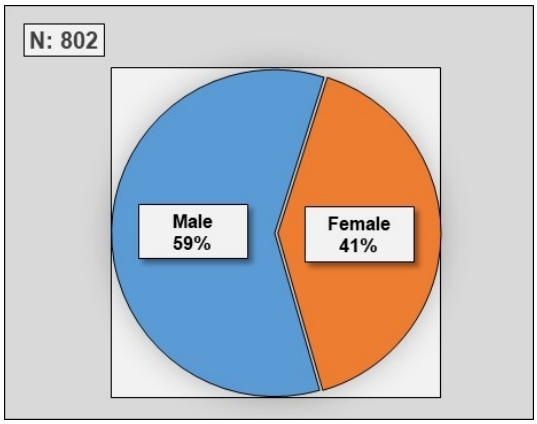


Figure 4-32 Gender distribution of the respondents, Household Survey, July 2025 (N:802)

The proportion of women in the settlements intersecting with the AoI is higher than the general distribution observed in the affiliated districts, provinces, and at the national level (see Table 4-23, and Figure 4-29). When compared with the gender distribution of respondents, these figures once again highlight the low level of female representation in public spaces (see Figure 4-32). This situation is related to the overall representation of women in local governance in Türkiye. In rural

areas, the proportion of women serving as mukhtar is 0.6%, while that of men is 99.4%[61].

When looking at the gender distribution of local representatives in the 53 settlements intersecting with the AoI, there is a disproportionate representation in favor of men. Out of the 53 settlements, 7 are represented by female mukhtars (Arnavutköy Tayakadın, Pendik Harmandere, Pendik Şeyhli, Sarıyer Demirciköy, Sarıyer Garipçe, Sarıyer Uskumruköy, and Tuzla Aydınlı) accounting for 13.21%. Excluding Gebze and Sancaktepe districts, each represented by only one neighborhood, the highest proportion of female representatives is observed in Sarıyer, where women make up 33.33% of local leadership. In contrast, all local representatives in the districts of Beykoz, Çatalca, Çayırova, Çekmeköy, Eyüpsultan, Sultanbeyli, and Tuzla are male (see Table 4-27).

Table 4-27 Gender Distribution of Mukhtars, Mukhtar Survey, July 2025 (N:53)

District	Female	%	Male	%
Arnavutköy	1	14.29	6	85.71
Beykoz	0	0.00	7	100.00
Çatalca	0	0.00	4	100.00
Çayırova	0	0.00	2	100.00
Çekmeköy	0	0.00	4	100.00
Eyüpsultan	0	0.00	5	100.00
Gebze	1	100.00	0	0.00
Pendik	3	27.27	8	72.73
Sancaktepe	0	0.00	1	100.00
Sarıyer	2	33.33	4	66.67
Sultanbeyli	0	0.00	2	100.00
Tuzla	0	0.00	3	100.00
Total	**7**	**13.21**	**46**	**86.79**

During the interviews with mukhtars, the following question was asked: "In your opinion, are there any risks for women/girls living in the area (e.g., harassment, assault)? In your previous project experiences (if any), have you encountered sensitive situations in this regard?"

None of the local representatives identified any direct risks related to harassment for women. Among the open-ended responses, 33 responded "no", 6 said "no comment", 4 answered "there haven't been any and won't be any," and 1 stated "it would have no effect." Responses that may indicate potential risks, in contrast to the previous, are listed below:

- İstanbul Sarıyer Demirciköy; There are risks for women as well — they even stole our animals during Kuzey Marmara Otoyolu (KMO) (Northern Marmara Motorway)[62] construction period (Female, 15-year tenure)
- İstanbul Arnavutköy Dursunköy; There were no incidents involving women, but the workers caused harm to the local community (Male, 1.5 -year tenure)
- İstanbul Pendik Güllübağ; Nothing happened and nothing will; however, migrants affect us a little (Male, 1.5 -year tenure)
- İstanbul Eyüpsultan Çiftalan; No, there won't be any — there have been other projects before (Male, 15-year tenure)

No specific risks related to women were highlighted in response to the question that could provide parallel insights to the previous one: "In your opinion, who is most likely to be affected or harmed by the Project activities?"

Although issues such as harassment and abuse were not explicitly raised, some responses to the

[61] *TurkStat, Gender Statistics, 2022, Vital and Gender Statistics Group, Publication Number 4681, Release Date March 2023., https://www.tuik.gov.tr/media/announcements/toplumsal_cinsiyet_istatistikleri.pdf, Access Date: July 2025.*

[62] *Final ESIA Report of the North Marmara Motorway Project, ENCON Environmental Consultancy Co., March 2018, https://www.kuzeymarmaraotoyolu.com/en/environmental-management*

open-ended question "Could you please state the three most important problems in your settlement?" included references focused on women and girls. These are presented below as direct translations of the original statements.

- İstanbul Beykoz Cumhuriyet; We would like recreational spaces and social gathering spaces to be built for women (Male, 1.5 -year tenure)
- İstanbul Sarıyer Gümüşdere; There are no spaces where women can socialize or engage in productive activities (Male, 7 -year tenure)
- İstanbul Arnavutköy Tayakadın; There are no areas where women and young girls can socialize or be productive (Female, 7 -year tenure)
- İstanbul Çatalca Nakkaş; There are limited spaces where women and youth can socialize (Male, 1.5 -year tenure)

In the focus group meeting held with the local residents of Eyüpsultan Ağaçlı neighborhood, it was emphasized that women in the area sustain their livelihoods by selling milk, and that such small-scale income activities should be taken into consideration. The Mor Çatı Women's Shelter Foundation highlighted the need to ensure gender balance among those to be employed during the construction and operation phases of the project. Thus, planning the project with attention to gender balance is important for supporting women's social and economic participation.

Accordingly, the importance of ensuring women's representation becomes even more pronounced during Project activities. In this context, stakeholder engagement efforts should place greater emphasis on promoting women's participation.

In this regard, additional measures should be implemented to ensure that women, particularly those who are the sole heads of household, women who are landowners of private lands, and all other women, have equal opportunities in stakeholder participation processes. For detailed information, please refer to Project specific SEP.

Overall, the assessment did not identify project impacts that are expected to disproportionately and adversely affect women or female-headed households compared to the wider project-affected population. The focus of this subsection on female-headed households reflects the availability of data and consultation findings indicating that this group represents a relevant vulnerability profile within the Project Area of Influence. Other vulnerable or disadvantaged groups, as defined under the World Bank ESF, were screened during the assessment; however, no project-specific risks uniquely or disproportionately affecting such groups were identified at this stage. Nevertheless, women—particularly female-headed households—may be more sensitive to temporary livelihood disruptions, access-related impacts, or changes in local employment dynamics during construction due to existing structural vulnerabilities related to labor force participation and income generation. These considerations were informed by consultation findings and have been taken into account in the impact assessment. Relevant mitigation and monitoring measures are reflected in the ESIA/ESMP, incorporated into the Project's risk assessment and management tables, and addressed through stakeholder engagement measures outlined in the SEP.

4.3.3.3 Age distribution

In the age group distribution of the population, the highest proportion in all units is in the 40–44 age range, whereas the highest proportion across Türkiye as a whole is in the 25–29 age range (63) (see Figure 4-33). The median age (64) in Türkiye is 34.4. This value is 34.5 for İstanbul and 34.0 for Kocaeli. The median age for males is younger compared to the median age for females

63 *TurkStat, ABPRS Results, 2024, https://biruni.tuik.gov.tr/medas/?kn=95&locale=en, Access date: July 2025.*

64 *Median age: The age of the person in the middle when all the persons in the population are sorted in ascending order. TurkStat Metadata of ABPRS. https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1#data0. Access date: July 2025.*

(65).

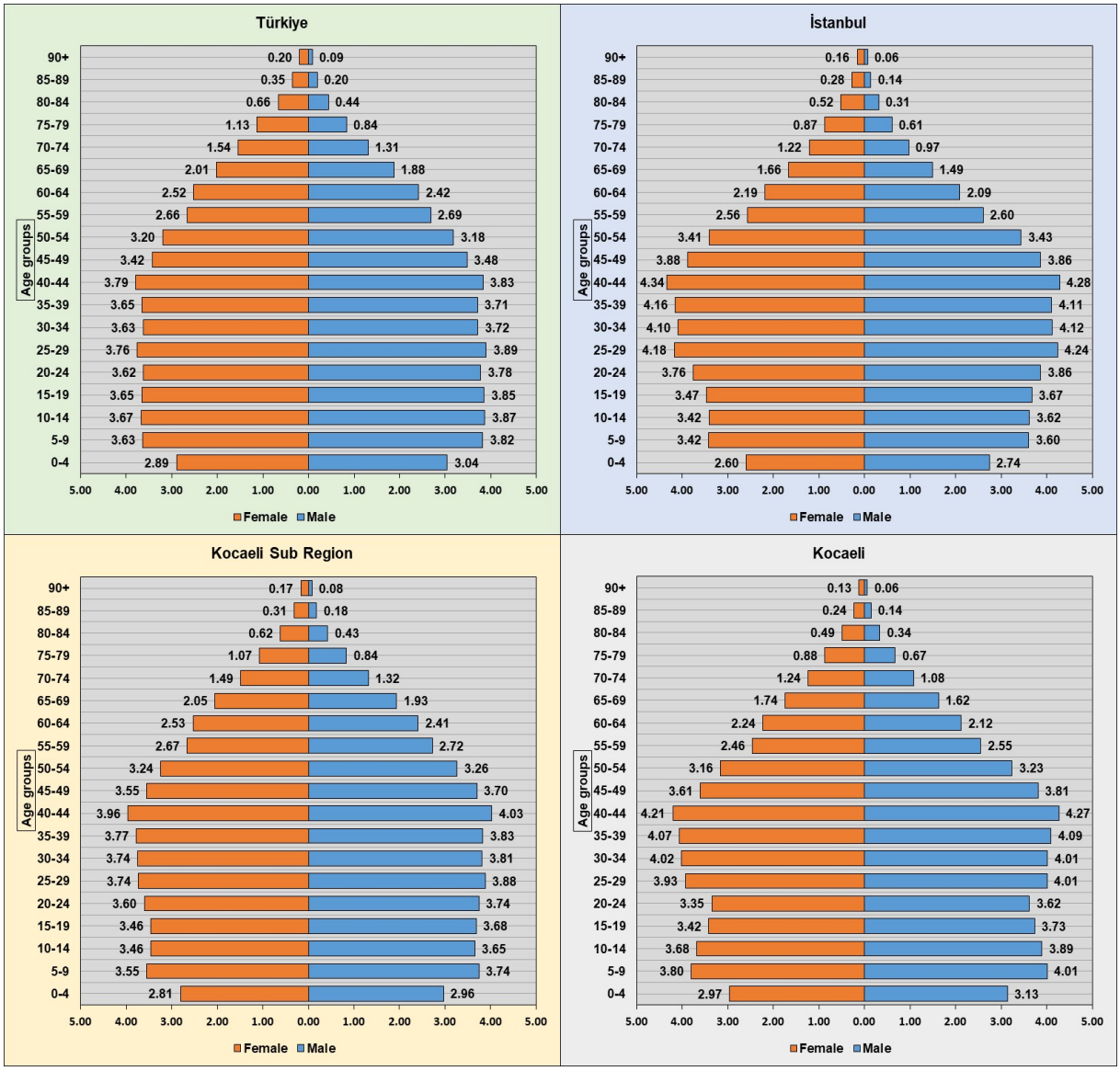


Figure 4-33 Population pyramids, TurkStat, 2024

In addition to the five-year age group distribution of the population, there is also a breakdown into the working-age population (15–64 age group) and the economically dependent population, which includes children (0–14 age group) and the elderly (65 years and over). The measure typically defines the age group 15–64 as “productive” and adds together persons aged 0–14 and 65 or older as “non-productive” ages (66) (67) (see Table 4-28, and Figure 4-34).

Table 4-28 Up to date Age Distribution Information, TurkStat, 2024

65 *TurkStat, The Results of Address Based Population Registration System, 2024. Median age by province and sex, 2023, 2024. https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2024-53783. Access date: July 2025.*

66 *ILO, Global Employment Trends for Youth 2017: Paths to a better working future International Labour Office – Geneva: ILO, 2017. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40dgreports/%40dcomm/%40publ/documents/publication/wcms_598669.pdf. Access date: July 2025.*

67 *ILO Employment and social protection in the new demographic context International Labour Office, Geneva, 2010. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_emp/%40emp_policy/documents/publication/wcms_125308.pdf. Access date: July 2025.*

	0-14 Age (Children)	%	15-64 ages (Youth)	%	65 and over ages (Elderly)	%	Total
Türkiye	17,926,565	**20.93**	58,626,081	**68.44**	9,112,298	**10.64**	85,664,944
İstanbul	3,046,388	**19.40**	11,352,421	**72.30**	1,302,793	**8.30**	15,701,602
Kocaeli sub region	865,036	**20.18**	2,972,730	**69.34**	449,610	**10.49**	4,287,376
Kocaeli	457,507	**21.48**	1,488,921	**69.90**	183,578	**8.62**	2,130,006
Arnavutköy	92,865	**26.93**	235,786	**68.37**	16,217	**4.70**	344,868
Beykoz	39,969	**16.28**	177,692	**72.40**	27,779	**11.32**	245,440
Çatalca	6,935	**16.88**	28,577	**69.56**	5,570	**13.56**	41,082
Çekmeköy	66,167	**21.57**	222,371	**72.50**	18,201	**5.93**	306,739
Eyüpsultan	78,755	**18.72**	308,573	**73.35**	33,378	**7.93**	420,706
Pendik	155,080	**20.70**	542,743	**72.43**	51,533	**6.88**	749,356
Sancaktepe	121,169	**24.13**	358,763	**71.46**	22,145	**4.41**	502,077
Sarıyer	50,804	**14.83**	254,335	**74.24**	37,443	**10.93**	342,582
Sultanbeyli	96,438	**26.12**	256,752	**69.54**	16,003	**4.33**	369,193
Tuzla	62,971	**20.89**	220,220	**73.07**	18,209	**6.04**	301,400
Çayırova	38,783	**24.62**	111,204	**70.60**	7,516	**4.77**	157,503
Gebze	93,532	**22.71**	291,424	**70.77**	26,844	**6.52**	411,800

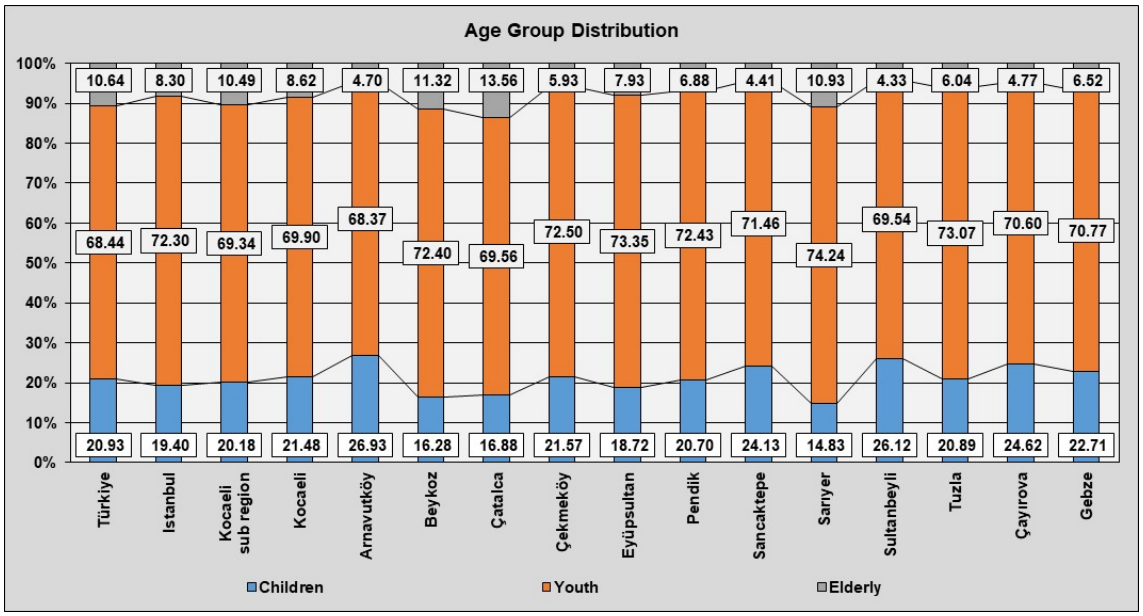


Figure 4-34 Age Group Distribution, TurkStat, 2024

The age-based dependency ratio can be defined as the total population in those outside the labor force (typically under 15 and over 65) divided by the total working-age population. The actual dependency ratio depends also on the labor force participation rate of the working age population and can be calculated as (total population – the labor force) / the labor force [68].

Within the framework of this definition, the proportion of children in the total population across Türkiye is higher than the proportion of the elderly. According to 2024 data, for Türkiye, the child

68 Decent Work Country Diagnostics. Technical Guidelines to Draft the Diagnostic Report. Prepared by: Country Diagnosis Tool Team July, 2015. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_mas/%40program/documents/genericdocument/wcms_561044.pdf. Access date: April 2025.

dependency ratio is 30.6% [69], while the elderly dependency ratio is 15.5% [70] [71].

Based on the information provided by 802 household heads who participated in the household survey, the total population of the settlements intersecting with AoI is 2,901. Approximately 74% of this population consists of young individuals of working age. The proportion of children is around 18%, while the elderly population accounts for approximately 8.5%. The age group distribution in these AoI-intersecting settlements is largely consistent with the national averages for Türkiye (see Table 4-29, Figure 4-34, and Figure 4-35).

Table 4-29 Age Group Distribution, Household Survey, July 2025 (N:2,901)

	Children	%	Youth	%	Elderly	%	Total
Arnavutköy Baklalı	1	**7.14**	9	**64.29**	4	**28.57**	14
Arnavutköy Bolluca	3	**15.79**	14	**73.68**	2	**10.53**	19
Arnavutköy Boyalık	0	**0.00**	5	**71.43**	2	**28.57**	7
Arnavutköy Dursunköy	2	**16.67**	10	**83.33**	0	**0.00**	12
Arnavutköy İmrahor	15	**29.41**	30	**58.82**	6	**11.76**	51
Arnavutköy Tayakadın	6	**21.43**	20	**71.43**	2	**7.14**	28
Arnavutköy Yassıören	3	**37.50**	5	**62.50**	0	**0.00**	8
Beykoz Ali Bahadır	1	**10.00**	7	**70.00**	2	**20.00**	10
Beykoz Anadolu Feneri	0	**0.00**	5	**50.00**	5	**50.00**	10
Beykoz Bozhane	1	**7.14**	11	**78.57**	2	**14.29**	14
Beykoz Cumhuriyet	0	**0.00**	7	**58.33**	5	**41.67**	12
Beykoz Öğümce	4	**33.33**	7	**58.33**	1	**8.33**	12
Beykoz Paşamandıra	1	**6.67**	11	**73.33**	3	**20.00**	15
Beykoz Poyrazköy	0	**0.00**	10	**83.33**	2	**16.67**	12
Çatalca Ferhatpaşa	2	**4.76**	33	**78.57**	7	**16.67**	42
Çatalca İzzettin	0	**0.00**	7	**87.50**	1	**12.50**	8
Çatalca Kaleiçi	2	**12.50**	14	**87.50**	0	**0.00**	16
Çatalca Nakkaş	2	**13.33**	11	**73.33**	2	**13.33**	15
Çekmeköy Hüseyinli	2	**13.33**	13	**86.67**	0	**0.00**	15
Çekmeköy Nişantepe	11	**14.86**	60	**81.08**	3	**4.05**	74
Çekmeköy Ömerli	1	**7.14**	13	**92.86**	0	**0.00**	14
Çekmeköy Reşadiye	10	**41.67**	14	**58.33**	0	**0.00**	24
Eyüpsultan Ağaçlı	0	**0.00**	6	**46.15**	7	**53.85**	13
Eyüpsultan Çiftalan	0	**0.00**	4	**50.00**	4	**50.00**	8
Eyüpsultan Işıklar	0	**0.00**	10	**83.33**	2	**16.67**	12
Eyüpsultan İhsaniye	3	**42.86**	4	**57.14**	0	**0.00**	7
Eyüpsultan Odayeri	0	**0.00**	2	**66.67**	1	**33.33**	3
Pendik Emirli	2	**16.67**	10	**83.33**	0	**0.00**	12
Pendik Güllübağ	20	**18.35**	82	**75.23**	7	**6.42**	109
Pendik Harmandere	13	**19.40**	49	**73.13**	5	**7.46**	67
Pendik Kavakpınar	77	**20.37**	274	**72.49**	27	**7.14**	378
Pendik Kurna	1	**5.56**	16	**88.89**	1	**5.56**	18
Pendik Kurtdoğmuş	2	**11.11**	13	**72.22**	3	**16.67**	18
Pendik Kurtköy	35	**17.59**	157	**78.89**	7	**3.52**	199
Pendik Ramazanoğlu	8	**34.78**	14	**60.87**	1	**4.35**	23
Pendik Sanayi	2	**13.33**	11	**73.33**	2	**13.33**	15
Pendik Şeyhli	13	**12.38**	79	**75.24**	13	**12.38**	105
Pendik Yenişehir	44	**16.30**	202	**74.81**	24	**8.89**	270

69 Child dependency ratio: The number of persons at "0-14" age group per 100 persons at "15-64" age group. TurkStat Metadata of ABPRS. https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1#data0. Access date: July 2025.
70 Elderly dependency ratio: The number of persons at "65 and over" age group per 100 persons at "15-64" age group. TurkStat Metadata of ABPRS. https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1#data0. Access date: July 2025.
71 TurkStat, The Results of Address Based Population Registration System, 2024, Population and age dependency ratio by age group, 2007-2024. https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2024-53783. Access date: July 2025.

	Children	%	Youth	%	Elderly	%	Total
Sancaktepe Paşaköy	0	**0.00**	7	**70.00**	3	**30.00**	10
Sarıyer Demirciköy	2	**20.00**	5	**50.00**	3	**30.00**	10
Sarıyer Garipçe	1	**12.50**	6	**75.00**	1	**12.50**	8
Sarıyer Gümüşdere	2	**10.00**	16	**80.00**	2	**10.00**	20
Sarıyer Kısırkaya	1	**11.11**	4	**44.44**	4	**44.44**	9
Sarıyer Rumeli Feneri	4	**30.77**	8	**61.54**	1	**7.69**	13
Sarıyer Uskumruköy	11	**20.00**	43	**78.18**	1	**1.82**	55
Sultanbeyli Akşemsettin	26	**20.80**	91	**72.80**	8	**6.40**	125
Sultanbeyli Mecidiye	30	**23.26**	89	**68.99**	10	**7.75**	129
Tuzla Aydınlı	65	**16.97**	295	**77.02**	23	**6.01**	383
Tuzla Aydıntepe	31	**20.26**	114	**74.51**	8	**5.23**	153
Tuzla İstasyon	17	**14.91**	87	**76.32**	10	**8.77**	114
Çayırova Şekerpınar	0	**0.00**	14	**93.33**	1	**6.67**	15
Çayırova Yeni Mahalle	21	**17.36**	88	**72.73**	12	**9.92**	121
Gebze Cumhuriyet	10	**21.28**	33	**70.21**	4	**8.51**	47
Total	**508**	**17.51**	**2,149**	**74.08**	**244**	**8.41**	**2,901**

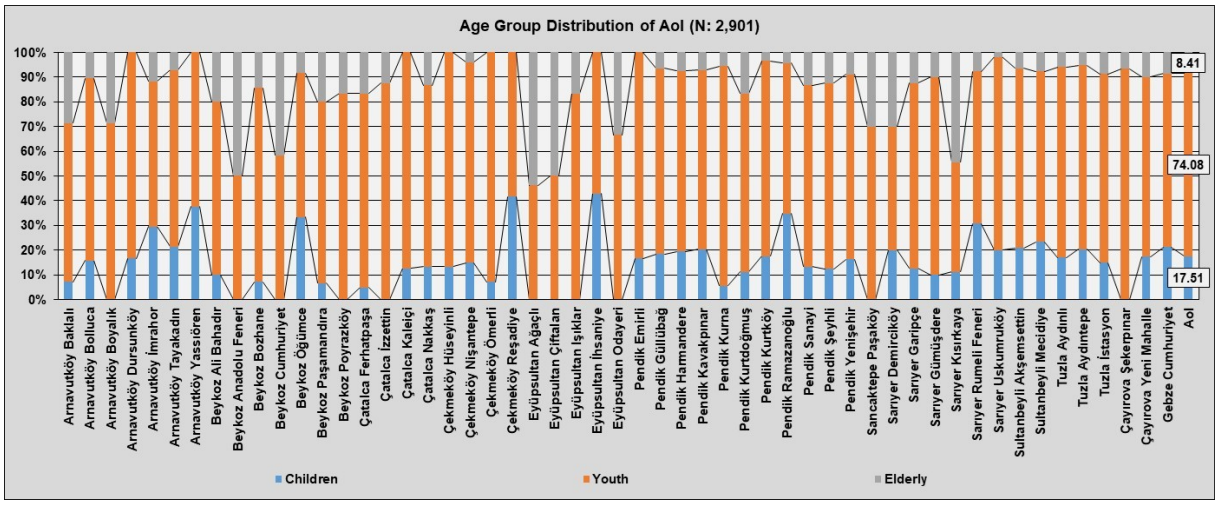


Figure 4-35 Age Group Distribution, Household Survey, July 2025 (N:2,901)

In some participating households, there were no individuals within certain age groups. For instance, in 11 settlements, there were no individuals in the child age group, while in 8 settlements, no elderly individuals were recorded. Excluding these two cases, the lowest proportion of children was observed in Çatalca Ferhatpaşa, whereas the highest was in Eyüpsultan İhsaniye. For the elderly age group, the lowest proportion was recorded in Sarıyer Uskumruköy, while highest proportion was again in Eyüpsultan Ağaçlı. In summary, elderly dependency ratios are highest in Eyüpsultan Ağaçlı, while child dependency ratios are highest in Çatalca Ferhatpaşa (see Table 4-29 and Figure 4-35).

4.3.3.3.1 Vulnerable Groups / Elderlies (including living-alone individuals)

The elderly dependency ratio has been increasing globally since 1990 with the aging of the population. While on average there were 16 elderly people for every 100 people of working age in the world in 2019, it is estimated that this number will reach 28 in 2050. Although the world population continues to increase, the population growth rate is slowing down due to decreasing fertility, life expectancy at birth is increasing globally, and the share of the elderly population is increasing [72].

72 Presidency of the Republic of Türkiye. Presidency of Strategy and Budget. Twelfth Development Plan (2024-2028). https://www.sbb.gov.tr/wp-content/uploads/2025/03/Twelfth-Development-Plan_2024-2028.pdf. Access date: July 2025

In accordance with WBG, World Development Indicators (WDI) database[73], age dependency ratio is the ratio of dependents-people younger than 15 or older than 64-to the working-age population-those ages 15-64. Data are shown as the proportion of dependents per 100 working-age population. According to this definition, the 2024 data for Türkiye are as follows (see Table 4-30).

Table 4-30 Age dependency ratio (% of working-age population), WDI, 2024

	%
Age dependency ratio	46.48
Age dependency ratio, old	15.06
Age dependency ratio, young	31.42

The elderly population accounts for approximately 8.5% of 2,901 total population covered by 802 households. The age group distribution in these AoI-intersecting settlements is largely consistent with the national averages for Türkiye. There are 174 households that reported having elderly individuals in their households. Their distribution by settlement is provided in Table 4-31. According to the data provided, approximately 22% of households include elderly individuals, whereas these individuals represent around 8.4% of the total population. Three of the top five settlements with the highest number of households that include elderly individuals are located in Pendik, while the remaining two are in Tuzla and Çayırova. With regard to potential barriers to participation for elderly individuals, special attention should be paid to these settlements, especially Pendik Kavakpınar, Pendik Yenişehir and Tuzla Aydınlı.

Table 4-31 Elderlies, Household Survey, July 2025 (N:174/244)

Settlements	Yes	%	% in total household (802)	Number of elderly individuals	%	% in total population (2,901)
Pendik Kavakpınar	19	10.92	2.37	27	11.07	0.93
Pendik Yenişehir	16	9.20	2.00	24	9.84	0.83
Tuzla Aydınlı	16	9.20	2.00	23	9.43	0.79
Pendik Şeyhli	9	5.17	1.12	13	5.33	0.45
Çayırova Yeni Mahalle	8	4.60	1.00	12	4.92	0.41
Tuzla İstasyon	8	4.60	1.00	10	4.10	0.34
Pendik Kurtköy	6	3.45	0.75	7	2.87	0.24
Sultanbeyli Akşemsettin	6	3.45	0.75	8	3.28	0.28
Sultanbeyli Mecidiye	6	3.45	0.75	10	4.10	0.34
Tuzla Aydıntepe	6	3.45	0.75	8	3.28	0.28
Çatalca Ferhatpaşa	5	2.87	0.62	7	2.87	0.24
Pendik Güllübağ	5	2.87	0.62	7	2.87	0.24
Arnavutköy İmrahor	4	2.30	0.50	6	2.46	0.21
Beykoz Anadolu Feneri	4	2.30	0.50	5	2.05	0.17
Eyüpsultan Ağaçlı	4	2.30	0.50	7	2.87	0.24
Arnavutköy Baklalı	3	1.72	0.37	4	1.64	0.14
Beykoz Cumhuriyet	3	1.72	0.37	5	2.05	0.17
Çekmeköy Nişantepe	3	1.72	0.37	3	1.23	0.10
Gebze Cumhuriyet	3	1.72	0.37	4	1.64	0.14
Pendik Harmandere	3	1.72	0.37	5	2.05	0.17
Arnavutköy Tayakadın	2	1.15	0.25	2	0.82	0.07
Beykoz Bozhane	2	1.15	0.25	2	0.82	0.07
Beykoz Paşamandıra	2	1.15	0.25	3	1.23	0.10
Beykoz Poyrazköy	2	1.15	0.25	2	0.82	0.07
Çatalca Nakkaş	2	1.15	0.25	2	0.82	0.07
Eyüpsultan Çiftalan	2	1.15	0.25	4	1.64	0.14
Eyüpsultan Işıklar	2	1.15	0.25	2	0.82	0.07
Pendik Kurtdoğmuş	2	1.15	0.25	3	1.23	0.10

73 WBG: World Development Indicators. Last Updated: 07/01/2025. https://databank.worldbank.org/source/world-development-indicators/Type/TABLE/preview/on#. Access date: July 2025.

Settlements	Yes	%	% in total household (802)	Number of elderly individuals	%	% in total population (2,901)
Pendik Sanayi	2	1.15	0.25	2	0.82	0.07
Sancaktepe Paşaköy	2	1.15	0.25	3	1.23	0.10
Sarıyer Demirciköy	2	1.15	0.25	3	1.23	0.10
Sarıyer Kısırkaya	2	1.15	0.25	4	1.64	0.14
Arnavutköy Bolluca	1	0.57	0.12	2	0.82	0.07
Arnavutköy Boyalık	1	0.57	0.12	2	0.82	0.07
Beykoz Ali Bahadır	1	0.57	0.12	2	0.82	0.07
Beykoz Öğümce	1	0.57	0.12	1	0.41	0.03
Çatalca İzzettin	1	0.57	0.12	1	0.41	0.03
Çayırova Şekerpınar	1	0.57	0.12	1	0.41	0.03
Eyüpsultan Odayeri	1	0.57	0.12	1	0.41	0.03
Pendik Kurna	1	0.57	0.12	1	0.41	0.03
Pendik Ramazanoğlu	1	0.57	0.12	1	0.41	0.03
Sarıyer Garipçe	1	0.57	0.12	1	0.41	0.03
Sarıyer Gümüşdere	1	0.57	0.12	2	0.82	0.07
Sarıyer Rumeli Feneri	1	0.57	0.12	1	0.41	0.03
Sarıyer Uskumruköy	1	0.57	0.12	1	0.41	0.03
Total	**174**	**100.00**	**21.70**	**244**	**100.00**	**8.41**

It was identified that 15 out of the 802 household heads were elderly individuals living alone. Seven of these individuals are elderly women who also serve as the heads of their households. Apart from being elderly individuals living alone, some of these persons also face other disadvantages, such as chronic illnesses (see Table 4-32).

Table 4-32 Elderly individuals living alone, Household Survey, July 2025 (N:15)

Settlement	Gender	Age	Livelihood source	Disability	Chronic illness	Illiteracy	Female household-head
Eyüpsultan Işıklar	Female	82	Retirement	No	Yes	No	Yes
Pendik Kurtköy	Female	73	Retirement	No	Yes	No	Yes
Çatalca Ferhatpaşa	Female	72	Retirement	No	No	No	Yes
Sarıyer Uskumruköy	Female	72	Retirement	No	Yes	No	Yes
Pendik Kavakpınar	Female	71	Retirement	No	Yes	No	Yes
Pendik Kavakpınar	Female	67	Retirement	No	Yes	No	Yes
Pendik Yenişehir	Female	66	Retirement	No	Yes	No	Yes
Tuzla Aydınlı	Male	80	Retirement	No	No	No	No
Tuzla Aydıntepe	Male	76	Retirement	No	Yes	No	No
Pendik Yenişehir	Male	75	Retirement	No	Yes	No	No
Pendik Güllübağ	Male	74	Rental income	No	Yes	No	No
Pendik Kavakpınar	Male	72	Retirement	No	Yes	No	No
Beykoz Poyrazköy	Male	70	Retirement	No	No	No	No
Tuzla Aydınlı	Male	70	Retirement	No	Yes	No	No
Sultanbeyli Akşemsettin	Male	67	Retirement	No	Yes	No	No

During the mukhtar interviews, representatives of 48 settlements who agreed to participate were asked, “How many elderly individuals living alone / female heads of households are there in the settlement?” Five of them responded negatively to this question. Two mukhtars were unable to provide an estimate, while six mukhtars expressed the numbers in ranges (e.g 3-5, 4-5 etc) rather than providing an exact figure. According to these data, the total number in the region exceeds 10,000 (see Table 4-33).

Table 4-33 Elderly individuals living alone, Mukhtar Survey, July 2025 (N:48)

Settlement	Number
Pendik Yenişehir	10,000
Sultanbeyli Mecidiye	200
Beykoz Bozhane	75

Settlement	Number
Çekmeköy Ömerli	60
Pendik Kurtköy	60
Eyüpsultan Işıklar	30
Sancaktepe Paşaköy	30
Tuzla Aydıntepe	25
Arnavutköy Tayakadın	20
Beykoz Cumhuriyet	20
Çatalca Nakkaş	20
Pendik Sanayi	20
Arnavutköy Boyalık	15
Beykoz Ali Bahadır	15
Eyüpsultan Ağaçlı	15
Pendik Kavakpınar	14
Çatalca Kaleiçi	12
Beykoz Anadolu Feneri	10
Beykoz Öğümce	10
Beykoz Poyrazköy	10
Çekmeköy Hüseyinli	10
Sarıyer Kısırkaya	10
Tuzla İstasyon	10
Çayırova Yeni Mahalle	10
Beykoz Paşamandıra	8
Pendik Kurna	7
Pendik Kurtdoğmuş	7
Sarıyer Garipçe	7
Arnavutköy Dursunköy	6
Gebze Cumhuriyet	6
Çatalca İzzettin	5
Çekmeköy Nişantepe	5
Sultanbeyli Akşemsettin	3
Arnavutköy Yassıören	2
Çekmeköy Reşadiye	1
Pendik Şeyhli	7-8 (7.5)
Eyüpsultan Odayeri	6-7 (6.5)
Pendik Güllübağlar	4-5 (4.5)
Sarıyer Demirciköy	4-5 (4.5)
Arnavutköy İmrahor	3-5 (4.0)
Eyüpsultan Çiftalan	3-4 (3.5)
Pendik Emirli	Not available
Pendik Harmandere	Not available
Sarıyer Gümüşdere	Not available
Çayırova Şekerpınar	Not available
Eyüpsultan İhsaniye	Not available
Çatalca Ferhatpaşa	No idea
Tuzla Aydınlı	No idea
Approximately total	**≈10,758**

4.3.3.4 Population movements

4.3.3.4.1 Population changes

The global population, which reached 8 billion by the end of 2022, is expected to increase to approximately 8.5 billion in 2030, 9.7 billion in 2050 and 10.4 billion in 2100, according to the

latest estimates made by the United Nations (UN) [74].

As part of the study (İstanbul Housing Demand Study Report) ([75]), conducted to identify the 10-year needs and expectations of the İstanbul housing market, it is projected that the total population of İstanbul will exceed 16.2 million and the number of households will reach 5.95 million by 2034. According to the study of the İstanbul Planning Agency Population Projections study, İstanbul is expected to receive a net migration of 109,270 people between 2025 and 2034. Between 2015 and 2024, the city's population density increased by an average of 0.44% annually. However, the coronavirus disease 2019 (COVID-19) pandemic that began in 2020, along with declining birth rates and shifts in migration patterns, has caused population growth in the city to follow a more stagnant trend. According to the TurkStat Population Projections study for the period 2023–2100, İstanbul is expected to have a population of 16,129 million in 2030, followed by Ankara with 6.062 million, Izmir with 4,618 million, Bursa with 3,429 million, and Antalya with 2,966 million ([76]).

In the 2023-2024 period, the annual population growth rate ([77]) in Türkiye is 3.4%, in İstanbul it is 2.9%, and in Kocaeli it is 12.8%. In the previous period, that is, in 2022-2023, these rates were 1.1% for Türkiye, -16.0% for İstanbul, and 11.4‰ for Kocaeli ([78]). Detailed information on population changes over the past 25 years (2000–2024) is available in Table 4-34, and Figure 4-36.

[74] *Presidency of the Republic of Türkiye. Presidency of Strategy and Budget. Twelfth Development Plan (2024-2028). https://www.sbb.gov.tr/wp-content/uploads/2025/03/Twelfth-Development-Plan_2024-2028.pdf. Access date: July 2025.*

[75] *Association of Housing Developers and Investors (Konutder) Istanbul Housing Demand Study Report, with the support of PwC Türkiye, 17012024. https://konutder.org.tr/files/PwC_Konutder_İ%CC%87stanbul%20Konut%20İ%CC%87htiyac%C4%B1%20C%CC%A7al%C4%B1s%CC%A7mas%C4%B1%20Rapor_17012024.pdf. / https://konutder.org.tr/files/konutderpwcistanbul-konut-ihtiyaci-calismasi2202504vf3-1744989716961.pdf. Access date: July 2025.*

[76] *Istanbul Planning Agency Population Projections. https://ipa.istanbul/yayinlarimiz/50/nufus-projeksiyonlari. Access date: July 2025.*

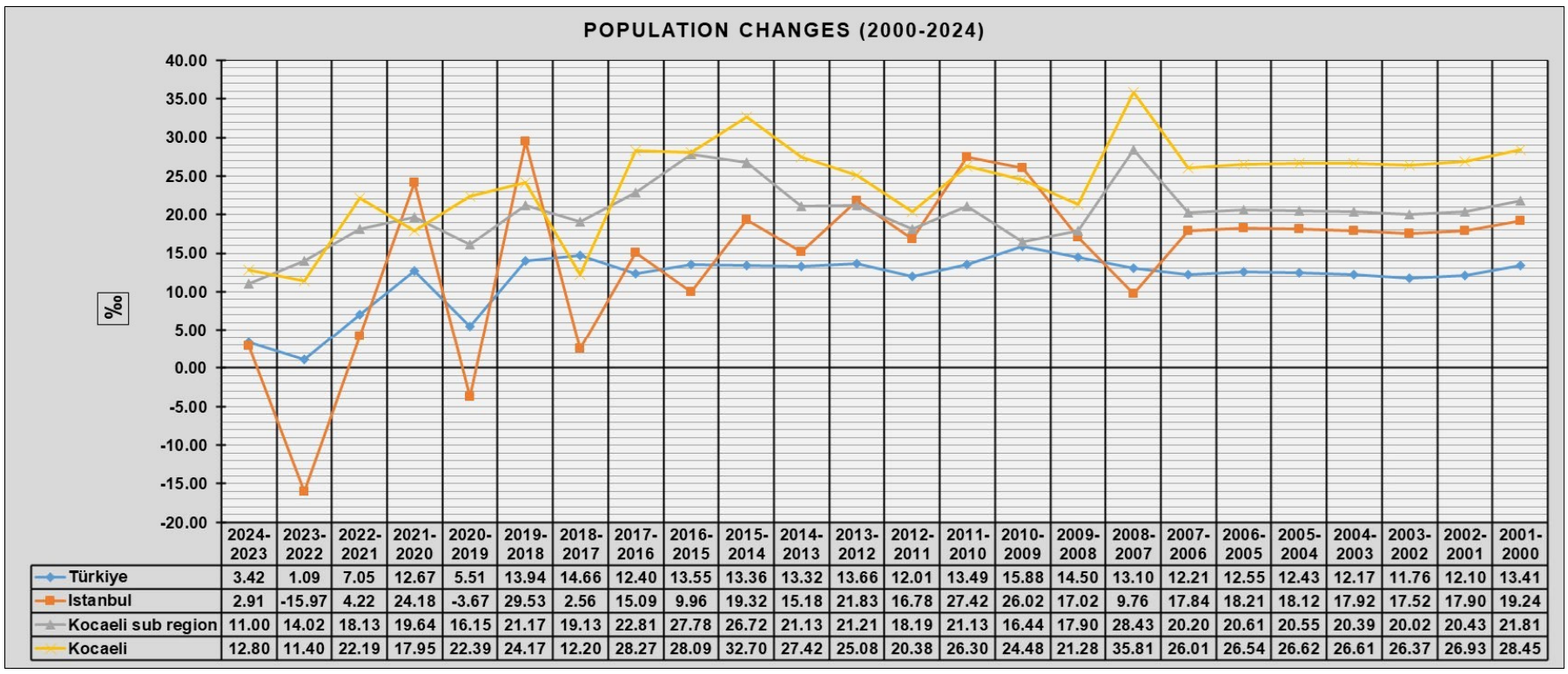
[77] *Annual growth rate of population: In the period between two census dates, population increase per 1000 population per year. It was calculated by natural growth correlation. TurkStat Metadata of ABPRS. https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1#data0. Access date: July 2025.*

[78] *TurkStat, The Results of Address Based Population Registration System, 2024. Annual growth rate of population and population density of provinces by years, 2007-2024. https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2024-53783. Access date: July 2025.*

Table 4-34 Population changes figures for the last 25 years

Years	Türkiye	‰	İstanbul	‰	Kocaeli sub region	‰	Kocaeli	‰
	Total population	Annual population growth rate[79]	Total population	Annual population growth rate	Total population	Annual population growth rate	Total population	Annual population growth rate
2024-2023	85,664,944	3.42	15,701,602	2.91	4,287,376	11.00	2,130,006	12.80
2023-2022	85,372,377	1.09	15,655,924	-15.97	4,240,456	14.02	2,102,907	11.40
2022-2021	85,279,553	7.05	15,907,951	4.22	4,181,440	18.13	2,079,072	22.19
2021-2020	84,680,273	12.67	15,840,900	24.18	4,106,308	19.64	2,033,441	17.95
2020-2019	83,614,362	5.51	15,462,452	-3.67	4,026,438	16.15	1,997,258	22.39
2019-2018	83,154,997	13.94	15,519,267	29.53	3,961,953	21.17	1,953,035	24.17
2018-2017	82,003,882	14.66	15,067,724	2.56	3,878,979	19.13	1,906,391	12.20
2017-2016	80,810,525	12.40	15,029,231	15.09	3,805,481	22.81	1,883,270	28.27
2016-2015	79,814,871	13.55	14,804,116	9.96	3,719,652	27.78	1,830,772	28.09
2015-2014	78,741,053	13.36	14,657,434	19.32	3,617,728	26.72	1,780,055	32.70
2014-2013	77,695,904	13.32	14,377,018	15.18	3,522,353	21.13	1,722,795	27.42
2013-2012	76,667,864	13.66	14,160,467	21.83	3,448,702	21.21	1,676,202	25.08
2012-2011	75,627,384	12.01	13,854,740	16.78	3,376,330	18.19	1,634,691	20.38
2011-2010	74,724,269	13.49	13,624,240	27.42	3,315,463	21.13	1,601,720	26.30
2010-2009	73,722,988	15.88	13,255,685	26.02	3,246,147	16.44	1,560,138	24.48
2009-2008	72,561,312	14.50	12,915,158	17.02	3,193,210	17.90	1,522,408	21.28
2008-2007	71,517,100	13.10	12,697,164	9.76	3,136,555	28.43	1,490,358	35.81
2007-2006	70,586,256	12.21	12,573,836	17.84	3,048,651	20.20	1,437,926	26.01
2006-2005	69,729,967	12.55	12,351,506	18.21	2,987,678	20.61	1,401,013	26.54
2005-2004	68,860,539	12.43	12,128,577	18.12	2,926,735	20.55	1,364,317	26.62
2004-2003	68,010,215	12.17	11,910,733	17.92	2,867,197	20.39	1,328,481	26.61
2003-2002	67,187,251	11.76	11,699,172	17.52	2,809,324	20.02	1,293,594	26.37
2002-2001	66,401,851	12.10	11,495,948	17.90	2,753,639	20.43	1,259,932	26.93
2001-2000	65,603,160	13.41	11,292,009	19.24	2,697,947	21.81	1,226,460	28.45
2000	**64,729,501**	**-**	**11,076,840**	**-**	**2,639,749**	**-**	**1,192,053**	**-**

79 *Annual population growth rate calculated by using the following Formula in Microsoft Excel.=(LN(The next census/previous census)/(The time period between the censuses))*1000. TurkStat Metadata of ABPRS. https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1#data0. Access date: Access date: July 2025.*



	2024-2023	2023-2022	2022-2021	2021-2020	2020-2019	2019-2018	2018-2017	2017-2016	2016-2015	2015-2014	2014-2013	2013-2012	2012-2011	2011-2010	2010-2009	2009-2008	2008-2007	2007-2006	2006-2005	2005-2004	2004-2003	2003-2002	2002-2001	2001-2000
Türkiye	3.42	1.09	7.05	12.67	5.51	13.94	14.66	12.40	13.55	13.36	13.32	13.66	12.01	13.49	15.88	14.50	13.10	12.21	12.55	12.43	12.17	11.76	12.10	13.41
Istanbul	2.91	-15.97	4.22	24.18	-3.67	29.53	2.56	15.09	9.96	19.32	15.18	21.83	16.78	27.42	26.02	17.02	9.76	17.84	18.21	18.12	17.92	17.52	17.90	19.24
Kocaeli sub region	11.00	14.02	18.13	19.64	16.15	21.17	19.13	22.81	27.78	26.72	21.13	21.21	18.19	21.13	16.44	17.90	28.43	20.20	20.61	20.55	20.39	20.02	20.43	21.81
Kocaeli	12.80	11.40	22.19	17.95	22.39	24.17	12.20	28.27	28.09	32.70	27.42	25.08	20.38	26.30	24.48	21.28	35.81	26.01	26.54	26.62	26.61	26.37	26.93	28.45

Figure 4-36 Population changes figures for the last 25 years

In the mukhtar survey, which 48 out of 53 settlement representatives agreed to participate in, participants were asked the question: “How has the population in your settlement changed over the past five years?” 26 mukhtars (54%) stated that the population had increased in response to this question, while the remaining responses are presented in Figure 4-37. There is no significant difference in population change at the district level. However, in all settlements within Çekmeköy and Sultanbeyli, only population growth has been observed. In the settlements within Eyüpsultan, the population has largely remained stable, with no increase recorded. The population of Arnavutköy is mostly on an upward trend, with no data indicating a decline.

Increased	Decreased	No Change
Arnavutköy Boyalık	Arnavutköy Dursunköy	Beykoz Ali Bahadır
Arnavutköy Tayakadın	Arnavutköy İmrahor	Beykoz Anadolu Feneri
Arnavutköy Yassıören	Beykoz Paşamandıra	Beykoz Bozhane
Beykoz Cumhuriyet	Eyüpsultan Ağaçlı	Beykoz Poyrazköy
Beykoz Öğümce	Eyüpsultan Işıklar	Çatalca Nakkaş
Çatalca Ferhatpaşa	Eyüpsultan İhsaniye	Çayırova Şekerpınar
Çatalca İzzettin	Eyüpsultan Odayeri	Eyüpsultan Çiftalan
Çatalca Kaleiçi	Pendik Emirli	Pendik Kurtdoğmuş
Çayırova Yeni Mahalle	Pendik Kurna	Pendik Sanayi
Çekmeköy Hüseyinli	Sarıyer Demirciköy	Sancaktepe Paşaköy
Çekmeköy Nişantepe	Sarıyer Kısırkaya	Sarıyer Garipçe
Çekmeköy Ömerli		
Çekmeköy Reşadiye		
Gebze Cumhuriyet		
Pendik Güllübağ		
Pendik Harmandere		
Pendik Kavakpınar		
Pendik Kurtköy		
Pendik Şeyhli		
Pendik Yenişehir		
Sarıyer Gümüşdere		
Sultanbeyli Akşemsettin		
Sultanbeyli Mecidiye		
Tuzla Aydınlı		
Tuzla Aydıntepe		
Tuzla İstasyon		

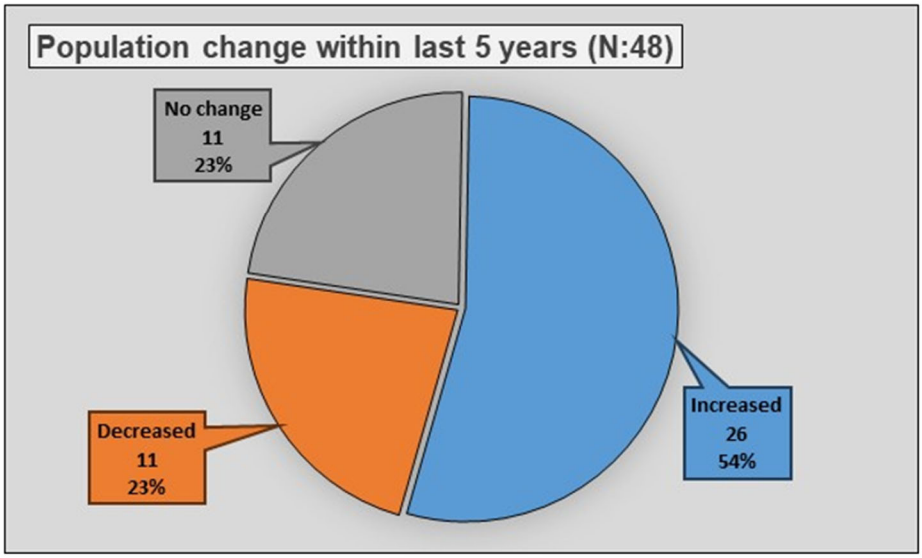


Figure 4-37 Population change, Mukhtar Survey, July 2025 (N:48)

As for the reasons behind these changes, the following responses were given in Table 4-35. When examining the responses grouped under the relevant change, the reasons causing population decrease and those leading to population stability (no change) appear to be partially parallel. In this context, it has been observed that zoning and construction bans applied in settlements significantly affect population decline. Similarly, the opening of areas for zoning has led to the construction of new housing and the movement of population into these areas.

Based on this, it can be said that zoning planning in the settlements within the AoI over the past five years has been one of the important factors affecting population mobility. While different reasons for population increase are observed at the neighborhood level, large-scale transportation projects (such as the Northern Marmara and Şile Motorways), earthquake

concerns, the impact of the pandemic, and foreign population movements are other significant factors influencing population dynamics.

Table 4-35 Reasons related to population changes within last 5 years, Mukhtar Survey, July 2025 (N:48)

INCREASED	**Reasons provided by mukhtars**
Arnavutköy Boyalık	Gaining neighbourhood status
Arnavutköy Tayakadın	Construction of hotels and new settlements following the opening of the airport
Arnavutköy Yassıören	Establishment of Darülaceze[80] (public care home), with patients registered here
Beykoz Cumhuriyet	Due to workers
Beykoz Öğümce	Migration to rural areas after marriage and the pandemic
Çatalca Ferhatpaşa	Population increase after the opening of the airport
Çatalca İzzettin	Increase due to earthquake concerns
Çatalca Kaleiçi	Migration caused by earthquakes; increase in the number of people building single-storey houses
Çekmeköy Hüseyinli	Increase due to marriage
Çekmeköy Nişantepe	Increase caused by the Şile Motorway
Çekmeköy Ömerli	Construction of housing estates and villas in rural areas due to the pandemic
Çekmeköy Reşadiye	Population increase due to villas
Pendik Güllübağ	Earthquake-related reasons
Pendik Harmandere	Shift in population towards the area as it developed
Pendik Kavakpınar	Settlement starting in newly zoned areas
Pendik Kurtköy	Increase due to urban transformation
Pendik Şeyhli	Being a rocky area considered safe; increase due to earthquake concerns
Pendik Yenişehir	Construction of new housing estates
Sarıyer Gümüşdere	Rural area with natural beauty and easy access to the city
Sultanbeyli Akşemsettin	Influx of foreign migration
Sultanbeyli Mecidiye	Affordable rents and strong kinship ties
Tuzla Aydınlı	Urban transformation
Tuzla Aydıntepe	Increase due to land speculation
Tuzla İstasyon	Urban transformation
Çayırova Yeni Mahalle	Migration from other areas due to being more economically affordable
Gebze Cumhuriyet	Migration due to employment opportunities
DECREASED	**Reasons provided by mukhtars**
Beykoz Ali Bahadır	Lack of zoning
Beykoz Anadolu Feneri	Absence of construction and zoning permits
Beykoz Bozhane	No zoning permits
Beykoz Poyrazköy	Closed to zoning / Young population leaving
Çatalca Nakkaş	Zoning issues
Eyüpsultan Çiftalan	Seasonal movements / Summer–winter use
Pendik Kurtdoğmuş	No zoning / Younger generation leaving
Pendik Sanayi	Lack of zoning
Sancaktepe Paşaköy	Population decrease after the Northern Marmara Motorway due to expropriation
Sarıyer Garipçe	No zoning permits due to being a 1st-degree protected area
Çayırova Şekerpınar	Zoning problems / No construction
NO CHANGE	**Reasons provided by mukhtars**
Arnavutköy Dursunköy	Either 10 people have been added or not
Arnavutköy İmrahor	No migration
Beykoz Paşamandıra	No zoning
Eyüpsultan Ağaçlı	No reason
Eyüpsultan Işıklar	No zoning / no construction / no population change
Eyüpsultan İhsaniye	Stable
Eyüpsultan Odayeri	No migration
Pendik Emirli	Number of households did not increase
Pendik Kurna	Zoning ban

[80] *Darülaceze Directorate. https://www.darulaceze.gov.tr/kurumsal. Access date: August 2025*

INCREASED	Reasons provided by mukhtars
Sarıyer Demirciköy	No change
Sarıyer Kısırkaya	Zoning ban

Çayırova Municipality stated that due to the high population density in the region, new construction should not be permitted. In the focus group discussion with the local community in Ağaçlı Neighborhood of Eyüpsultan, it was mentioned that the young population migrates to Istanbul for work, while the village has generally become a retirement community with an aging population.

4.3.3.4.2 Migration characteristics

In 2022, the top three regions from which İstanbul received the highest number of migrants were East Marmara (13.6%), Western Black Sea (12%), and Southeastern Anatolia (11.9%). While the proportion of female migrants to İstanbul was higher than that of males from Central Anatolia, Northeastern Anatolia, Western Anatolia, Eastern Black Sea, and Western Marmara, the proportion of male migrants was higher from East Marmara, Southeastern Anatolia, Western Black Sea, the Mediterranean, Central Eastern Anatolia, and the Aegean regions ([81]).

In the study focusing on population change in İstanbul between 2013 and 2040 ([82]), it was shown that urban expansion would have a significant impact on forested areas. The data indicated a rapid settlement pressure and risk of ecosystem loss in the northern forest regions. This situation has further intensified, particularly after the construction of the Third Bosphorus Bridge and the TEM highway connection projects. Another study identifying a 2.5-fold population increase in İstanbul between 1990 and 2018 states that the city's urban centers have shifted. In this context, it is noted that urban sprawl accelerated as the population migrating from rural areas turned to informal housing to meet their shelter needs, and these buildings were later granted zoning permits. According to the study, "Population growth and urban sprawl, which developed in parallel with the increase in industrial facilities, led to the construction of new roads and bridges. Thus, the settlement area spread along the coasts of Tekirdag in the west, Izmit in the east, the Black Sea in the north, and the Sea of Marmara in the south. This has been identified as the main cause of habitat degradation in natural areas, especially in agricultural and forested areas".

A separate article ([83]) focusing on population changes in İstanbul districts during the 2012–2017 period, Sancaktepe and Arnavutköy, both located within the AoI, were among the districts where the population increased by more than 25%. It was stated that this growth was influenced by transportation and housing projects. When evaluating populations based on their place of registration (place of origin), it was observed that in Sultanbeyli, which is also within the AoI, there is almost no population registered directly in İstanbul. Similarly, Arnavutköy and Sancaktepe are among the districts with the lowest share of İstanbul-registered residents. Regarding the origins of the populations residing in these districts, Tuzla and Beykoz stand out with a high proportion of residents from the Black Sea region, while Kartal and its surroundings are predominantly inhabited by people of Sivas and Eastern–Southeastern Anatolia origin. Although Kartal is located outside the AoI, it shares similar demographic characteristics with the AoI-intersecting districts Pendik and Tuzla. On the other hand, Çatalca is one of the few districts where more than 50% of the population is registered in İstanbul.

While the population is decreasing in central districts and those adjacent to the center of İstanbul,

---

81 *TR10 Düzey-2 Bölgesi Bölge Planı 2024-2028. İstanbul Development Agency https://www.istka.org.tr/media/pdf/h4fuFPWyKYFCZ0RkYV9CJVbbtcZwcSKjfWZ4nBUyJuKM7M4EiDTR.pdf. Access date: July 2025.*

82 *Akin, Anil & Sunar, Filiz & Berberoglu, Suha. (2015). Urban change analysis and future growth of Istanbul. Environmental monitoring and assessment. 187.4721.10.1007/s10661-015-4721-1.https://link.springer.com/article/10.1007/s10661-015-4721-1*

83 *Sunata, U., & Ergül, D. (2019). İstanbul İlçelerinin Nüfus Değişimi ve Kütük Bilgilerinin Analizi. Göç Dergisi, 6(1), 37-72. https://doi.org/10.33182/gd.v6i1.635. https://dergi.tplondon.com/goc/article/view/635.https://dergi.tplondon.com/goc/article/view/635/606.*

the population of peripheral districts is increasing. Over the past decade, the population has grown by more than 50% in Beylikdüzü, Sancaktepe, Esenyurt, Arnavutköy, Başakşehir, and Şile. Fatih has experienced the highest population decline at 16.4%, while central districts such as Beşiktaş, Beyoğlu, and Kadıköy have also seen a decrease of around 10%. Urbanization and population levels in many districts of İstanbul have reached a saturation point. In 2013, population growth was recorded in only 8 districts. As long as the current trend continues, population growth in İstanbul is expected to occur predominantly in districts such as Şile, Silivri, Çatalca, and Arnavutköy ([84]).

Taking these findings into account, please analyze İstanbul's population change over the last ten years in light of Table 4-36.

[84] *Istanbul 39: Socioeconomic Profile of the Districts. ILKE PUBLICATIONS: 249.RESEARCH REPORTS: 20.* https://ilke.org.tr/files/netstk/50/web/115/4873/dosyalar/istanbul39.pdf

Table 4-36 Population changes figures of last 10 years (‰)

#	Province	District	Settlement	2024	2024-2023	2023	2023-2022	2022	2022-2021	2021	2021-2020	2020	2020-2019	2019	2019-2018	2018	2018-2017	2017	2017-2016	2016	2016-2015	2015	2024-2015
1	İstanbul	Arnavutköy	Baklalı	866	-31	893	43	855	37	824	-38	856	-29	881	33	852	32	825	12	815	-7	821	5
2	İstanbul	Arnavutköy	Bolluca	8,446	16	8,308	4	8,274	33	8,005	53	7,588	36	7,322	47	6,986	0	6,984	23	6,827	16	6,719	23
3	İstanbul	Arnavutköy	Boyalık	758	-8	764	55	723	-12	732	28	712	21	697	-17	709	51	674	-48	707	58	667	13
4	İstanbul	Arnavutköy	Dursunköy	433	-9	437	-20	446	51	424	5	422	-21	431	-32	445	-42	464	17	456	-32	471	-8
5	İstanbul	Arnavutköy	İmrahor	12,088	9	11,976	23	11,706	38	11,275	31	10,930	43	10,465	23	10,231	18	10,052	38	9,678	22	9,463	24
6	İstanbul	Arnavutköy	Tayakadın	3,716	51	3,533	180	2,951	29	2,867	-8	2,889	-158	3,385	-495	5,555	58	5,242	432	3,402	80	3,140	17
7	İstanbul	Arnavutköy	Yassıören	675	-7	680	13	671	58	633	50	602	89	551	-14	559	-4	561	34	542	136	473	36
8	İstanbul	Beykoz	Ali Bahadır	781	-1	782	5	778	23	760	25	741	-20	756	0	756	-11	764	17	751	-17	764	2
9	İstanbul	Beykoz	Anadolu Feneri	687	-1	688	-10	695	-4	698	-58	740	26	721	-53	760	13	750	55	710	-80	769	-11
10	İstanbul	Beykoz	Bozhane	464	-6	467	-9	471	21	461	-17	469	35	453	-43	473	-4	475	6	472	4	470	-1
11	İstanbul	Beykoz	Cumhuriyet	1,966	-15	1,996	-12	2,021	12	1,996	-4	2,004	-11	2,026	-5	2,037	35	1,966	9	1,949	12	1,925	2
12	İstanbul	Beykoz	Öğümce	493	25	481	6	478	17	470	4	468	30	454	0	454	-49	477	-4	479	15	472	4
13	İstanbul	Beykoz	Paşamandıra	1,374	15	1,353	63	1,271	28	1,236	12	1,221	5	1,215	46	1,160	95	1,055	22	1,032	-13	1,045	27
14	İstanbul	Beykoz	Poyrazköy	881	-10	890	1	889	16	875	-11	885	-22	905	-10	914	-10	923	15	909	-16	924	-5
15	İstanbul	Çatalca	Ferhatpaşa	28,400	10	28,128	15	27,713	19	27,199	39	26,147	41	25,096	37	24,183	114	21,572	37	20,796	51	19,764	36
16	İstanbul	Çatalca	İzzettin	1,304	-22	1,333	105	1,200	30	1,165	38	1,121	31	1,087	59	1,025	8	1,017	9	1,008	-111	1,126	15
17	İstanbul	Çatalca	Kaleiçi	7,617	16	7,495	-16	7,616	2	7,603	-7	7,660	-16	7,780	-4	7,814	41	7,503	-59	7,956	158	6,793	11
18	İstanbul	Çatalca	Nakkaş	803	-34	831	68	776	-29	799	-9	806	-47	845	-15	858	48	818	-18	833	16	820	-2
19	İstanbul	Çatalca	Hüseyinli	849	-49	892	9	884	36	853	-20	870	26	848	75	787	21	771	-22	788	-3	790	7
20	İstanbul	Çekmeköy	Nişantepe	12,546	6	12,476	42	11,958	33	11,573	313	8,459	-222	10,561	20	10,351	11	10,236	49	9,749	49	9,283	30
21	İstanbul	Çekmeköy	Ömerli	5,702	16	5,614	55	5,313	83	4,892	91	4,468	39	4,298	15	4,235	39	4,073	17	4,003	-5	4,024	35
22	İstanbul	Çekmeköy	Reşadiye	2,887	37	2,783	104	2,508	33	2,426	69	2,265	35	2,187	-21	2,233	46	2,132	-11	2,155	13	2,127	31
23	İstanbul	Eyüpsultan	Ağaçlı	731	52	694	-104	770	116	686	-96	755	-20	770	129	677	9	671	69	626	-240	796	-9
24	İstanbul	Eyüpsultan	Çiftalan	187	11	185	-5	186	61	175	-66	187	-26	192	65	180	189	149	-13	151	-7	152	21
25	İstanbul	Eyüpsultan	Işıklar	549	-45	574	48	547	41	525	4	523	-10	528	-35	547	-39	569	-7	573	41	550	0
26	İstanbul	Eyüpsultan	İhsaniye	185	-5	186	157	159	-73	171	12	169	-52	178	-60	189	167	160	13	158	0	158	16
27	İstanbul	Eyüpsultan	Odayeri	229	58	216	28	210	-65	224	-65	239	-12	242	196	199	20	195	-130	222	-31	229	0
28	İstanbul	Pendik	Emirli	252	28	245	25	239	83	220	14	217	-88	237	-33	245	-44	256	-75	276	11	273	-8
29	İstanbul	Pendik	Güllübağlar	19,001	20	18,633	18	18,308	39	17,607	75	16,335	63	15,339	60	14,450	42	13,852	23	13,535	34	13,087	37
30	İstanbul	Pendik	Harmandere	9,947	38	9,579	35	9,249	37	8,913	47	8,507	37	8,202	40	7,882	-5	7,925	10	7,844	39	7,546	28
31	İstanbul	Pendik	Kavakpınar	65,879	7	65,394	-9	66,008	16	64,932	26	63,274	31	61,365	34	59,336	-15	60,252	12	59,548	9	59,033	11
32	İstanbul	Pendik	Kurna	1,154	3	1,151	-14	1,167	18	1,146	-40	1,193	29	1,159	-3	1,163	-67	1,244	24	1,215	-15	1,233	-7
33	İstanbul	Pendik	Kurtdoğmuş	614	-98	677	454	430	-50	452	-52	476	-79	515	-10	520	165	441	2	440	-25	451	31
34	İstanbul	Pendik	Kurtköy	38,756	23	37,886	2	37,801	17	37,149	38	35,779	51	34,001	71	31,665	29	30,775	23	30,073	56	28,427	31
35	İstanbul	Pendik	Ramazanoğlu	2,427	-18	2,470	-47	2,589	-40	2,696	23	2,634	-32	2,720	-15	2,760	-60	2,930	-50	3,081	-31	3,178	-27
36	İstanbul	Pendik	Sanayi	2,999	-1	3,003	-37	3,117	7	3,095	-15	3,143	-36	3,257	-17	3,314	-30	3,414	-22	3,491	6	3,471	-15
37	İstanbul	Pendik	Şeyhli	19,684	20	19,298	1	19,283	14	19,023	25	18,552	33	17,944	41	17,219	29	16,720	39	16,088	35	15,537	24
38	İstanbul	Pendik	Yenişehir	65,637	1	65,548	-6	65,929	15	64,941	39	62,447	31	60,539	32	58,657	14	57,841	33	55,948	32	54,172	19
39	İstanbul	Sancaktepe	Paşaköy	1,758	-2	1,761	39	1,693	-23	1,733	15	1,708	-5	1,717	-10	1,734	6	1,723	14	1,699	-27	1,746	1
40	İstanbul	Sarıyer	Demirciköy	1,698	9	1,683	10	1,666	5	1,657	74	1,539	70	1,435	93	1,308	2	1,306	2	1,304	13	1,287	28
41	İstanbul	Sarıyer	Garipçe	370	-27	380	-29	391	-10	395	-5	397	18	390	8	387	-15	393	-194	477	-297	642	-55
42	İstanbul	Sarıyer	Gümüşdere	2,519	-59	2,673	-320	3,680	-22	3,762	165	3,190	-345	4,506	141	3,914	-69	4,193	13	4,137	33	4,003	-46
43	İstanbul	Sarıyer	Kısırkaya	378	30	367	39	353	23	345	-23	353	-3	354	11	350	50	333	-27	342	-49	359	5
44	İstanbul	Sarıyer	Rumeli Feneri	4,074	-103	4,516	40	4,337	38	4,175	580	2,338	-742	4,908	-59	5,208	135	4,550	-5	4,574	19	4,490	-10
45	İstanbul	Sarıyer	Uskumruköy	10,197	28	9,920	6	9,864	12	9,745	39	9,369	50	8,910	49	8,482	36	8,178	61	7,694	109	6,897	39
46	İstanbul	Sultanbeyli	Akşemsettin	13,886	24	13,561	3	13,523	28	13,154	24	12,845	21	12,572	6	12,501	-6	12,581	3	12,549	-16	12,750	9
47	İstanbul	Sultanbeyli	Mecidiye	21,859	3	21,799	-12	22,055	12	21,784	-5	21,891	-12	22,148	-1	22,176	-35	22,972	1	22,949	0	22,958	-5
48	İstanbul	Tuzla	Aydınlı	72,942	44	69,836	15	68,777	42	65,954	46	62,965	53	59,736	49	56,882	25	55,493	49	52,847	61	49,712	38
49	İstanbul	Tuzla	Aydıntepe	27,173	9	26,917	-6	27,075	24	26,445	10	26,181	20	25,657	52	24,353	15	23,998	57	22,667	107	20,357	29
50	İstanbul	Tuzla	İstasyon	26,338	66	24,653	71	22,966	-12	23,252	23	22,725	24	22,189	93	20,223	14	19,935	31	19,333	7	19,200	32
51	Kocaeli	Çayırova	Şekerpınar	2,847	5	2,834	32	2,744	34	2,653	-4	2,664	41	2,558	-8	2,578	-15	2,618	96	2,378	-62	2,531	12
52	Kocaeli	Çayırova	Yeni Mahalle	21,192	4	21,101	-5	21,213	24	20,714	15	20,404	15	20,095	4	20,005	-8	20,166	30	19,571	13	19,317	9
53	Kocaeli	Gebze	Cumhuriyet	10,038	24	9,803	28	9,533	61	8,967	90	8,194	37	7,897	94	7,190	87	6,589	102	5,951	67	5,565	59
			Total	**539,236**	**17**	**530,343**	**8**	**526,059**	**22**	**514,456**	**42**	**493,516**	**17**	**485,224**	**33**	**469,671**	**17**	**461,756**	**31**	**447,758**	**34**	**432,957**	**22**

In the household survey conducted with 802 participants, the time spent in the settlements throughout the year was assessed. As a result, the settlements intersecting the AoI are not temporary residential areas, but rather "permanent" settlements used for at least six months. So that, out of 802 participants, 791 (95%) stated that they reside in their settlement throughout the entire year.

The top five settlements with the highest number of households residing year-round are located in Pendik and Tuzla. Compared to other areas with a high concentration of permanent residents, the districts of Eyüpsultan, Tuzla, Sultanbeyli, and Pendik have a relatively higher share of temporary residents. In light of these findings, the settlements with the highest concentration of permanent residents—those who stay for all or nearly all of the year—are located in the districts of Pendik, Tuzla, and Gebze. The settlements in these districts will be exposed to the project's long-term impacts throughout the year.

Table 4-37 Time Spent in the Settlement, Household Survey, July 2025 (N: 802 / 2,901)

Duration	Settlement	Number of Households	Total Population in the Households
Entire Year	Tuzla Aydınlı	105	381
	Pendik Kavakpınar	92	368
	Pendik Yenişehir	92	267
	Pendik Kurtköy	56	199
	Tuzla Aydıntepe	42	151
	Tuzla İstasyon	37	114
	Sultanbeyli Akşemsettin	29	125
	Sultanbeyli Mecidiye	31	129
	Pendik Şeyhli	28	105
	Çayırova Yeni Mahalle	31	121
	Pendik Güllübağ	27	109
	Çekmeköy Nişantepe	19	74
	Çatalca Ferhatpaşa	16	41
	Pendik Harmandere	16	67
	Sarıyer Uskumruköy	13	55
	Gebze Cumhuriyet	13	45
	Arnavutköy İmrahor	9	51
	Arnavutköy Tayakadın	7	28
	Çatalca Kaleiçi	6	16
	Arnavutköy Bolluca	5	19
	Pendik Ramazanoğlu	5	23
	Arnavutköy Baklalı	4	14
	Beykoz Ali Bahadır	4	10
	Beykoz Anadolu Feneri	4	10
	Beykoz Bozhane	4	14
	Beykoz Cumhuriyet	4	12
	Beykoz Öğümce	4	12
	Beykoz Paşamandıra	4	15
	Beykoz Poyrazköy	4	12
	Çatalca Nakkaş	4	15
	Çekmeköy Hüseyinli	4	15
	Çekmeköy Ömerli	4	14
	Çekmeköy Reşadiye	4	24
	Eyüpsultan Işıklar	4	12
	Pendik Kurna	4	18
	Pendik Kurtdoğmuş	5	18
	Pendik Sanayi	4	15
	Sancaktepe Paşaköy	4	10
	Sarıyer Gümüşdere	4	20

Duration	Settlement	Number of Households	Total Population in the Households
	Çayırova Şekerpınar	5	15
	Arnavutköy Dursunköy	3	12
	Çatalca İzzettin	3	8
	Eyüpsultan Çiftalan	3	8
	Eyüpsultan İhsaniye	3	7
	Pendik Emirli	3	12
	Sarıyer Garipçe	3	8
	Sarıyer Kısırkaya	3	9
	Sarıyer Rumeli Feneri	3	13
	Arnavutköy Boyalık	2	7
	Arnavutköy Yassıören	2	8
	Eyüpsultan Ağaçlı	2	4
	Eyüpsultan Odayeri	2	3
	Sarıyer Demirciköy	2	10
	Sub Total	791	2872
Approximately 6 Months	Eyüpsultan Ağaçlı	2	9
	Pendik Kavakpınar	2	7
	Pendik Yenişehir	2	3
	Çatalca Ferhatpaşa	1	1
	Tuzla Aydınlı	1	2
	Tuzla Aydıntepe	1	2
	Gebze Cumhuriyet	1	2
	Sub Total	**10**	**26**
Unknown/ No Response	Pendik Kavakpınar	**1**	**3**
	Total	**802**	**2,901**

460 out of 802 households (57%) have lived in the settlement for more than 20 years. Overall, the data show that 668 out of 802 households in the AoI have lived in the area for at least 5 years. Households that have been living in the area for more than 20 years are predominantly located in the districts of Pendik, Tuzla, and Sultanbeyli. On the other hand, among the households that settled in the region relatively recently—within the last 10 years—there is also a settlement located in Gebze district of Kocaeli.

When considered together with the results provided by the previous paragraphs, it can be said that the majority of the permanent population in the area has been settled there for at least 5 years. Therefore, this population is likely to have interacted with other projects that have been active in the region over the last 5 years. This situation may increase the potential impacts of the planned new project. Considering that the population permanently residing in the area over the past five years may have experienced greater impacts from other projects, this may increase the risk of cumulative impacts of the new Project.

Table 4-38 Duration of household's settlement in the current location802 / 2,901)2,901)

Duration of settlement in this location	Settlements	Number of Households	Total Population in the Households
Over 20 years	Pendik Kavakpınar	47	173
	Tuzla Aydınlı	45	160
	Pendik Kurtköy	37	130
	Pendik Yenişehir	38	119
	Sultanbeyli Mecidiye	22	91
	Çayırova Yeni Mahalle	23	88
	Tuzla Aydıntepe	24	83
	Pendik Şeyhli	18	65
	Tuzla İstasyon	22	61
	Sultanbeyli Akşemsettin	12	48
	Sarıyer Uskumruköy	11	47

Duration of settlement in this location	Settlements	Number of Households	Total Population in the Households
	Pendik Güllübağ	13	46
	Çekmeköy Nişantepe	10	36
	Arnavutköy İmrahor	6	33
	Pendik Harmandere	6	32
	Çatalca Ferhatpaşa	12	31
	Arnavutköy Tayakadın	6	23
	Sarıyer Gümüşdere	4	20
	Gebze Cumhuriyet	4	16
	Beykoz Paşamandıra	4	15
	Çatalca Nakkaş	4	15
	Pendik Sanayi	4	15
	Arnavutköy Baklalı	4	14
	Çekmeköy Ömerli	4	14
	Eyüpsultan Ağaçlı	4	13
	Pendik Kurtdoğmuş	4	13
	Pendik Ramazanoğlu	3	13
	Sarıyer Rumeli Feneri	3	13
	Arnavutköy Dursunköy	3	12
	Beykoz Cumhuriyet	4	12
	Beykoz Öğümce	4	12
	Beykoz Poyrazköy	4	12
	Çekmeköy Hüseyinli	3	12
	Eyüpsultan Işıklar	4	12
	Beykoz Bozhane	3	11
	Arnavutköy Bolluca	2	10
	Beykoz Ali Bahadır	4	10
	Sancaktepe Paşaköy	4	10
	Sarıyer Demirciköy	2	10
	Çayırova Şekerpınar	2	10
	Çatalca Kaleiçi	3	9
	Sarıyer Kısırkaya	3	9
	Arnavutköy Yassıören	2	8
	Beykoz Anadolu Feneri	3	8
	Çatalca İzzettin	3	8
	Eyüpsultan Çiftalan	3	8
	Pendik Emirli	2	8
	Eyüpsultan İhsaniye	3	7
	Arnavutköy Boyalık	1	4
	Çekmeköy Reşadiye	1	4
	Pendik Kurna	1	3
	Sarıyer Garipçe	1	2
	Eyüpsultan Odayeri	1	1
	Sub total	**460**	**1,639**
11–20 years	Pendik Kavakpınar	24	118
	Pendik Yenişehir	26	78
	Tuzla Aydınlı	15	60
	Tuzla Aydıntepe	10	37
	Sultanbeyli Akşemsettin	7	28
	Pendik Kurtköy	7	27
	Sultanbeyli Mecidiye	6	23
	Çayırova Yeni Mahalle	4	19
	Çekmeköy Nişantepe	3	16
	Tuzla İstasyon	5	15
	Arnavutköy İmrahor	2	14

Duration of settlement in this location	Settlements	Number of Households	Total Population in the Households
	Pendik Güllübağ	3	13
	Pendik Şeyhli	4	13
	Pendik Kurna	2	11
	Çatalca Ferhatpaşa	3	9
	Çekmeköy Reşadiye	2	9
	Çatalca Kaleiçi	2	6
	Arnavutköy Tayakadın	1	5
	Pendik Harmandere	1	5
	Pendik Ramazanoğlu	1	5
	Sarıyer Garipçe	1	5
	Arnavutköy Bolluca	1	4
	Pendik Emirli	1	4
	Arnavutköy Boyalık	1	3
	Sarıyer Uskumruköy	1	2
	Çayırova Şekerpınar	1	2
	Gebze Cumhuriyet	1	2
	Sub total	**135**	**533**
6–10 years	Tuzla Aydınlı	20	71
	Pendik Kavakpınar	8	24
	Gebze Cumhuriyet	5	22
	Pendik Kurtköy	6	21
	Pendik Yenişehir	6	20
	Tuzla Aydıntepe	5	18
	Sultanbeyli Akşemsettin	3	15
	Çekmeköy Reşadiye	1	11
	Tuzla İstasyon	3	11
	Pendik Şeyhli	2	8
	Pendik Harmandere	1	7
	Çekmeköy Nişantepe	2	6
	Pendik Güllübağ	1	6
	Sarıyer Uskumruköy	1	6
	Çayırova Yeni Mahalle	2	6
	Pendik Kurna	1	4
	Arnavutköy Bolluca	1	3
	Beykoz Anadolu Feneri	1	2
	Eyüpsultan Odayeri	1	2
	Çatalca Ferhatpaşa	1	1
	Çatalca Kaleiçi	1	1
	Sarıyer Garipçe	1	1
	Sub total	**73**	**266**
1–5 years	Tuzla Aydınlı	24	86
	Pendik Kavakpınar	12	49
	Pendik Yenişehir	21	47
	Pendik Güllübağ	8	31
	Sultanbeyli Akşemsettin	6	28
	Pendik Harmandere	8	23
	Tuzla İstasyon	5	17
	Çekmeköy Nişantepe	4	16
	Tuzla Aydıntepe	4	15
	Pendik Kurtköy	3	14
	Pendik Şeyhli	2	9
	Gebze Cumhuriyet	4	7
	Pendik Kurtdoğmuş	1	5
	Pendik Ramazanoğlu	1	5

Duration of settlement in this location	Settlements	Number of Households	Total Population in the Households
	Arnavutköy İmrahor	1	4
	Beykoz Bozhane	1	3
	Çekmeköy Hüseyinli	1	3
	Sultanbeyli Mecidiye	1	3
	Arnavutköy Bolluca	1	2
	Çayırova Şekerpınar	1	2
	Çayırova Yeni Mahalle	1	2
	Çatalca Ferhatpaşa	1	1
	Sub total	**111**	**372**
Less than 1 year	Pendik Güllübağ	2	13
	Sultanbeyli Mecidiye	2	12
	Tuzla İstasyon	2	10
	Pendik Kavakpınar	3	9
	Pendik Şeyhli	1	6
	Pendik Yenişehir	3	6
	Sultanbeyli Akşemsettin	1	6
	Tuzla Aydınlı	2	6
	Çayırova Yeni Mahalle	1	6
	Pendik Kurtköy	1	2
	Çayırova Şekerpınar	1	1
	Sub total	**19**	**77**
Just arrived	Pendik Kavakpınar	1	5
	Pendik Kurtköy	2	5
	Pendik Şeyhli	1	4
	Sub total	**4**	**14**
Total		**802**	**2,901**

260 out of 802 households (32.42%) stated that they had not migrated from anywhere (see Table 4-39). This information aligns with the data from households that reported having lived in the area for more than 20 years. The number of household members who reported migrating for work is higher than those who stated they have lived in the same place since birth. Considering the internal migration dynamics in Türkiye, employment-seeking is a leading reason for migration to major cities. This trend is also valid for the AoI. Similarly, relatives or fellow townspeople who have previously migrated play an influential role in attracting those left behind to urban areas. Within the settlements in the AoI, this reason ranked fourth among the most frequently stated drivers of migration. One of the key findings of the household survey is that more affordable house and land prices rank among the top five reasons for migration. This becomes even more striking when considering the high cost of living in areas such as İstanbul and Kocaeli.

To assess whether there is a relationship between reasons for migration and places of residence, an additional dataset was created.

Table 4-39 Migration reasons, Household Survey, July 2025 (N: 2,901)

Migration reason	%
I was born and raised here / I did not migrate from another place	34.09
Work / Employment	33.09
Family-related reasons (marriage, divorce, etc.)	11.17
Previously migrated relatives and fellow townspeople	6.51
Affordable housing / rent / land prices	5.58

Migration reason	%
Socioeconomic reasons such as inadequate education, health, or infrastructure services in the previous location	2.79
Owning a summer or winter house	2.17
Reasons related to urban transformation	1.90
Desire to escape the problems of the metropolis	0.83
Education	0.79
Natural disasters	0.45
War / civil war or similar conditions in the country of origin	0.31
Other	0.31
Total	**2,901**

In cases of migration for employment, Tuzla and Pendik again stand out among the residential areas. In this context, it is noteworthy that neighborhoods in Sultanbeyli rank higher than locations like Gebze and Çayırova, which are known for their dense labor markets. At this point, it can be stated that industrial areas such as Gebze and Çayırova fall outside the current migration patterns driven by employment. In summary, while Gebze and Çayırova are characterized by long-established populations who migrated over 20 years ago in search of employment, Sultanbeyli appears to continue to attract population today due to its employment opportunities. In summary, while Gebze and Çayırova are characterized by long-established populations who migrated over 20 years ago in search of employment, Sultanbeyli appears to be a that continues to attract population today due to its employment opportunities.

The number of households who stated that they migrated to their current location due to more affordable rental, housing, and land prices is highest in these of Pendik, Çayırova, Çekmeköy, and Tuzla.

The low housing prices may be related to the impact of mass housing investments in the regions. For instance, the 1,130 social housing units initiated by the Ministry of Environment, Urbanization and Climate Change and the Housing Development Administration (TOKİ) in Aydınlı Neighborhood, Tuzla, İstanbul, have been completed. The completed units will be handed over to the rightful owners between June 16 and July 25, 2025 [85].

This finding, which stands out for 50 of the 802 surveyed households, should be taken into account due to the project's potential impacts on land, housing, and rental prices. This situation will be particularly significant for the settlements to which the land acquisition areas are connected, as well as for the surrounding communities. In this context, land and property owners, along with users and tenants, will be in direct interaction with the Project. The relevant impacts should be subject to more detailed assessments once the Project route is finalized.

Households that have migrated due to challenging socio-economic conditions in their original regions may be considered more sensitive to the potential social impacts of the project. Their migration, initially undertaken to address existing deficiencies, may turn into a negative experience if project-induced social tensions increase in their current area of residence. In this context, such as Pendik, Tuzla, Çekmeköy, Sarıyer, and Sultanbeyli should be given particular consideration.

Earthquakes and other natural disasters, which are regularly on the public agenda in Türkiye, have also emerged as reasons for migration. In a different context, ongoing internal conflicts in neighboring countries—such as the civil war in Syria—have contributed to the region's role as a destination for migrants.

The city hosting the largest number of Syrians is İstanbul, with 481,011 individuals. In terms of

85 *TOKİ https://www.toki.gov.tr/haber/istanbul-tuzlada-1130-sosyal-konut-teslim-ediliyor. Access date: July 2025.*

the number of Syrians by city, Kocaeli ranks 14th with 47,849 individuals [86].

According to the *Provincial Breakdown of Syrian Refugees in Türkiye - September 2024 data*, the number of Syrian refugees located in İstanbul ranges over 300,000 similar to Gaziantep. These figures illustrated for Hatay between 50,001 and 100,00 people (see Figure 4-38). However, there is no data available regarding their distribution at the district and neighborhood levels[87].

Nevertheless, the refugee and migrant population in the region may show sensitivity to the impacts of the project. Conditions such as inadequate housing, unemployment, and language barriers may be among these circumstances.

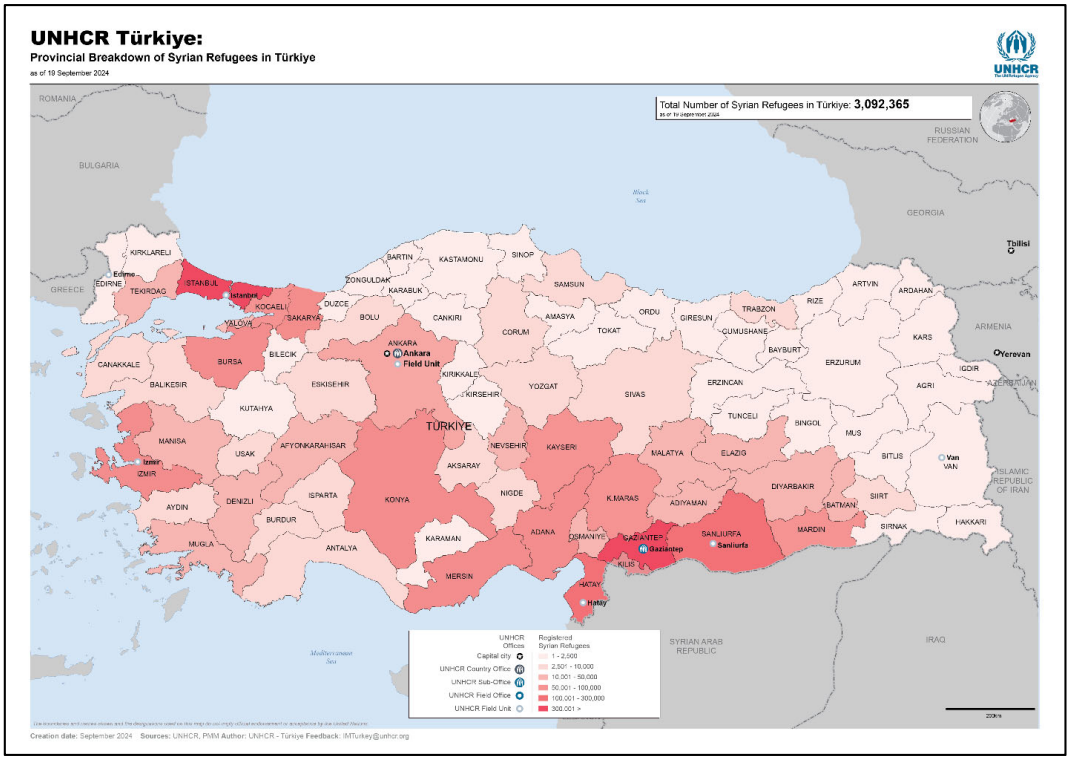


Figure 4-38 Provincial Breakdown of Syrian Refugees, UNHCR, September 2024

Research shows that around 9% of İstanbul's land and nearly 20% of its road network are in zones of high earthquake vulnerability, with southeastern European and eastern Asian sides being the most critical ([88]). Despite the long-standing debates surrounding this risk, following the February 6 earthquakes([89]), it has been observed that earthquake survivors — particularly refugees from the Hatay region — migrated to İstanbul to join their relatives residing in the city.

According to the study conducted by the Association for Migration Research, İstanbul has become a significant destination city for migrants coming from the disaster-affected region ([90]).

---

[86] *Mülteciler Derneği, 2025. Türkiye'deki Suriyeli Sayısı Mayıs 2025. https://multeciler.org.tr/turkiyedeki-suriyeli-sayisi/. Access date: July 2025.*

[87] *UNHCR Türkiye: Provincial Breakdown Syrian Refugees in Turkiye - September 2024. https://data.unhcr.org/en/documents/download/111466. Access date: July 2025.*

[88] *Alemdar, K.D. Seismic risk assessment of transportation networks for the impending Istanbul earthquake with GIS-based MCDM approach. Nat Hazards 121, 10085–10123 (2025). https://doi.org/10.1007/s11069-025-07199-y. https://link.springer.com/article/10.1007/s11069-025-07199-y. Access date: July 2025*

[89] *https://www.tmmob.org.tr/icerik/tmmob-6-subat-depremleri-8-ay-degerlendirme-raporu-yayimlandi*

[90] *Danış, D., Biehl Öztuzcu, K., & Kablan, E. (2023). Göç ve deprem III – İstanbul'a gelen depremzede mültecilere yönelik kabul ve dışlama mekanizmaları. Göç Araştırmaları Derneği. Retrieved from https://gocarastirmalaridernegi.org/tr/calismalar/arastirmalar/goc-ve-deprem-durum-tespit-raporu/322-goc-ve-deprem-durum-tespit-raporu-iii. Access date: July 2025*

The earthquakes have profoundly affected the labor market and created various impacts on employment across different demographic groups. Women have experienced a disproportionate impact, suffering greater job losses compared to men [91]. In relation to this issue, it would be beneficial to highlight the employment of women in earthquake-affected households in local employment processes.

These trends are reflected in field data. Although the numbers are relatively low, Pendik and Çatalca stand out as sensitive areas for households that migrated due to natural disasters, while Tuzla appears to be particularly relevant for households displaced by war.

An additional analysis was conducted to explore whether there is a relationship between the reasons for migration and the specific settlements. It was examined whether there is a meaningful relationship between the reasons for migration to the settlement and the length of residence of household representatives. Among the 802 households, 272 reported “work” as their reason for migration. Of those who migrated due to work, 102 individuals stated that they have been living in their current settlement for more than 20 years. Although reported at a low level, conditions such as natural disasters and war were also mentioned among the reasons for migration. Most of the individuals who migrated due to natural disasters have been living in the area for more than 20 years, while those who relocated due to war migrated to the area at least 10 years ago.

[91] *One Year After: Living and Working Conditions in Adıyaman, Hatay, Kahramanmaraş and Malatya after the February 2023 Earthquakes in Türkiye, 9789220413081 (web PDF). https://www.ilo.org/sites/default/files/2024-10/Household%20Survey%20Report.pdf. Access Date: July 2025*

Table 4-40 Relation between migration reason and migration time, Household Survey, July 2025 (N: 802)

Migration reason	Over 20 years	% in Migration reason	% in Duration	11–20 years	% in Migration reason	% in Duration	6–10 years	% in Migration reason	% in Duration	1–5 years	% in Migration reason	% in Duration	Less than 1 year	% in Migration reason	% in Duration	Just arrived	% in Migration reason	% in Duration	Over 20 years	% in Migration reason
Work / Employment	102	**37.50**	**22.17**	40	**14.71**	**29.63**	36	**13.24**	**49.32**	78	**28.68**	**70.27**	14	**5.15**	**73.68**	2	**0.74**	**50.00**	272	**33.92**
I was born and raised here / I did not migrate from another place	222	**85.38**	**48.26**	37	**13.60**	**27.41**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	1	**0.38**	**25.00**	260	**32.42**
Family-related reasons (marriage, divorce, etc.)	44	**51.76**	**9.57**	20	**7.35**	**14.81**	13	**15.29**	**17.81**	7	**8.24**	**6.31**	1	**1.18**	**5.26**	0	**0.00**	**0.00**	85	**10.60**
Affordable housing / rent / land prices	25	**48.08**	**5.43**	7	**2.57**	**5.19**	9	**17.31**	**12.33**	10	**19.23**	**9.01**	1	**1.92**	**5.26**	0	**0.00**	**0.00**	52	**6.48**
Previously migrated relatives and fellow townspeople	40	**81.63**	**8.70**	5	**1.84**	**3.70**	0	**0.00**	**0.00**	2	**4.08**	**1.80**	1	**2.04**	**5.26**	1	**2.04**	**25.00**	49	**6.11**
Socioeconomic reasons such as inadequate education, health, or infrastructure services in the previous location	11	**50.00**	**2.39**	5	**1.84**	**3.70**	0	**0.00**	**0.00**	6	**27.27**	**5.41**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	22	**2.74**
Owning a summer or winter house	8	**47.06**	**1.74**	7	**2.57**	**5.19**	2	**11.76**	**2.74**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	17	**2.12**
Reasons related to urban transformation	3	**17.65**	**0.65**	7	**2.57**	**5.19**	3	**17.65**	**4.11**	4	**23.53**	**3.60**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	17	**2.12**
Education	0	**0.00**	**0.00**	1	**0.37**	**0.74**	4	**44.44**	**5.48**	2	**22.22**	**1.80**	2	**22.22**	**10.53**	0	**0.00**	**0.00**	9	**1.12**
Desire to escape the problems of the metropolis	1	**11.11**	**0.22**	3	**1.10**	**2.22**	5	**55.56**	**6.85**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	9	**1.12**
Other	0	**0.00**	**0.00**	1	**0.37**	**0.74**	1	**25.00**	**1.37**	2	**50.00**	**1.80**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	4	**0.50**
Natural disasters	4	**100.00**	**0.87**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	4	**0.50**
War / civil war or similar conditions in the country of origin	0	**0.00**	**0.00**	2	**0.74**	**1.48**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	0	**0.00**	**0.00**	2	**0.25**
Total	460	**57.36**	**100.00**	135	**49.63**	**100.00**	73	**9.10**	**100.00**	111	**13.84**	**100.00**	19	**2.37**	**100.00**	4	**0.50**	**100.00**	802	**100.00**

Illustration	Explanation
0	No data
100.00	Most highest value among “% in migration reasons”
48.26	Most highest value among “% in duration”
102	Value
17.65	Percentage

4.3.3.4.3 Rural and urban areas

The urban and rural data for the year 2024[92], provided under the World Development Indicators by the WB, are as follows. According to these data, the already low rural population (22.11%) is exhibiting annual negative growth trends (-1,70%). Approximately 38% of the total population lives in urban areas with more than 1 million inhabitants. The population of the largest cities is around 16 million, with İstanbul alone accounting for about 15 million of this total (see Table 4-41).

Table 4-41 Rural and urban population indicators, WDI, 2024

Indicator	Values	Indicator	Values
Population in largest city [93]	16,047,350.00	Population in the largest city (% of urban population)	24.09
Population in urban agglomerations of more than 1 million [94]	33,252,269.00	Population in urban agglomerations of more than 1 million (% of total population)	38.88
Urban population	66,613,051.00	Urban population (% of total population)	77.89
Rural population	18,905,610.00	Rural population (% of total population)	22.11
		Rural population growth (annual %)	-1.70

As of 31 December 2022, 57, 934,583 people resided in the localities classified as densely populated, which constituted only 1.6% of the total surface area of Türkiye. In other words, 67.9% of Türkiye's population resided in densely populated areas. In the localities classified as thinly populated and constituted 93.5% of Türkiye's surface area, 17.3% of the total population resided. On the other hand, 14.8% of the population resided in the intermediate-density areas that constituted 4.9% of the country's total surface area. It was seen that 96.4% of the residents of İstanbul, the province with the largest population, resided in the localities classified as densely populated, 2.7% of them resided in the intermediate-density and 0.9% of them resided in the thinly populated (see Table 4-42 and Figure 4-39)[95].

Table 4-42 Rural and urban population indicators, TurkStat, 2022

2022[96]	Densely populated areas / Urban	%	Intermediate-density areas / Urban	%	Thinly populated areas / Rural	%	Total population
Türkiye	57,934,583	**67.93**	12,629,180	**14.81**	14,715,790	**17.26**	85,279,553
İstanbul	15,332,888	**96.39**	429,869	**2.70**	145,194	**0.91**	15,907,951
Kocaeli	1,705,098	**82.01**	275,810	**13.27**	98,164	**4.72**	2,079,072

92 *WBG World Development Indicators. Last Updated: 07/01/2025. https://databank.worldbank.org/source/world-development-indicators/Type/TABLE/preview/on#. Access date: July 2025.*

93 *Population in largest city is the urban population living in the country's largest metropolitan area. World Urbanization Prospects 2018, UN, uri: https://population.un.org/wup/, publisher: UN Population Division, date published: 2018. Access date: July 2025.*

94 *Population in urban agglomerations of more than one million is the country's population living in metropolitan areas that in 2018 had a population of more than one million people. World Urbanization Prospects 2018, UN, uri: https://population.un.org/wup/, publisher: UN Population Division, date published: 2018. Access date: July 2025.*

95 *Urban-Rural Population Statistics, 2022, Press Release No. 49755, dated May 11, 2023. https://data.tuik.gov.tr/Bulten/Index?p=Urban-Rural-Population-Statistics-2022-49755. Access date: July 2025.*

96 *TurkStat, Urban-Rural Population Statistics, 2022. Table-2 Population by urban-rural classification, sex and provinces, 2022. https://data.tuik.gov.tr/Bulten/Index?p=Urban-Rural-Population-Statistics-2022-49755. Access date: July 2025.*

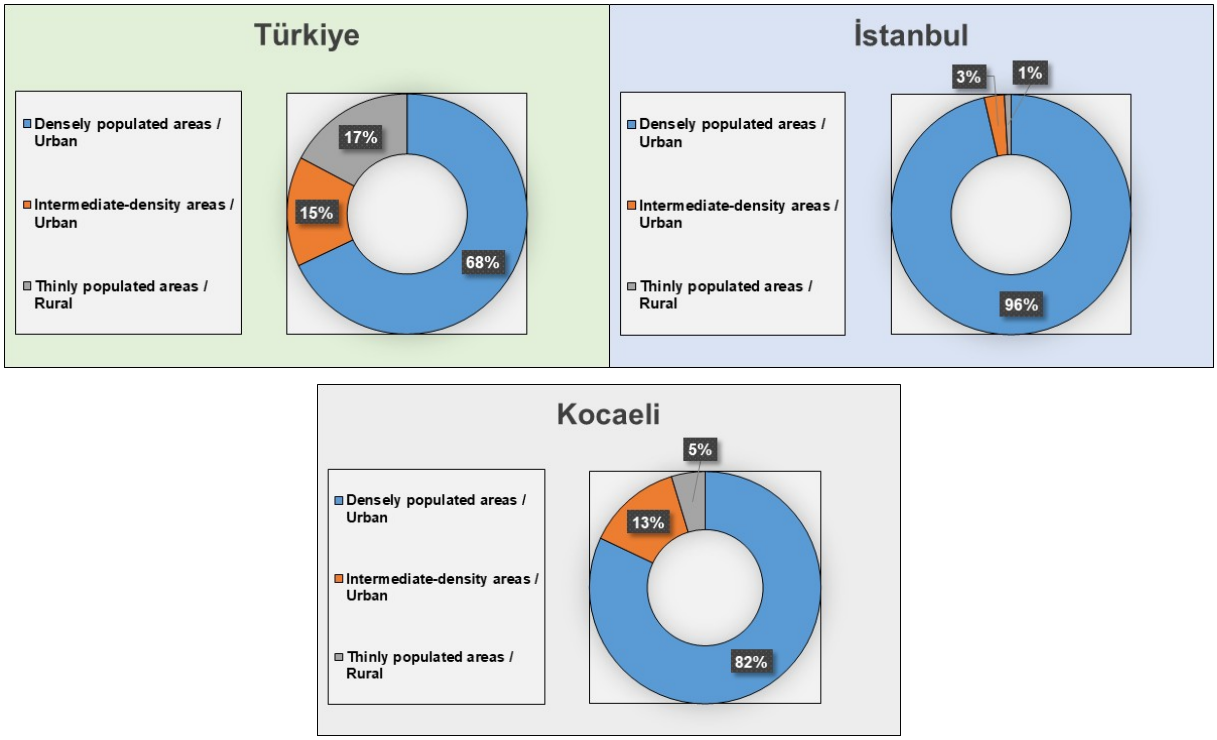


Figure 4-39 Rural and urban population indicators, TurkStat, 2022

With the enactment of the relevant Law 97 dated 2012, settlements classified as villages within metropolitan municipalities were reclassified as neighborhoods. It was aimed to identify the rural or urban characteristics of the settlements surrounding the AoI. For this reason, settlements that held village status prior to the implementation of the Law (Law on the Establishment of Metropolitan Municipalities in Thirteen Provinces and Twenty-Six Districts and the Amendment of Certain Laws and Decree Laws) were examined. As a result, it was determined that 28 out of the 53 settlements intersecting with the AoI had village status. The list of identified settlements is provided in Table 4-43. A review of Table 4-43 shows that the same settlement was affiliated with different administrative units in different years. This situation is related to changes in administrative structures necessitated by factors such as rapid urbanization and population growth in İstanbul.

The official procedures implemented during these administrative changes may include the following:

- A settlement may be transferred from the administrative boundary of the district to which it is registered to the boundary of another district (refer to Baklalı, Boyalık, Tayakadın, Yassıören, Hüseyinli, Reşadiye, Paşaköy),
- A settlement may be reassigned from the administrative boundary of one subdistrict (bucak) to another (refer to Bozhane, Cumhuriyet, Öğümce, Paşamandıra, Ağaçlı, Çiftalan, Işıklar, İhsaniye, Odayeri), and
- The name of the settlement may be changed (refer to the district Eyüp and/or Eyüpsultan).

[97] *Kazan, A. (2017). The Effects of the Law No 6360 on the Financial Structures of Metropolitan Municipalities. Sayıştay Dergisi(104), 87-106. https://www.sayistay.gov.tr/files/4465_der104m5.pdf. Access date: July 2025.*

Table 4-43 Population Figures of Former Village Neighbourhoods (2008-2012), TurkStat

Province	District	Sub-District	#	Settlement	2012	2011	2010	2009	2008
İstanbul	Arnavutköy	Central	1	Baklalı	834	800	821	826	761
İstanbul	Çatalca	Hadımköy			NA	NA	NA	NA	NA
İstanbul	Arnavutköy	Central	2	Boyalık	695	652	645	627	585
İstanbul	Çatalca	Hadımköy			NA	NA	NA	NA	NA
İstanbul	Arnavutköy	Central	3	Tayakadın	2,457	2,377	2,274	2,212	2,028
İstanbul	Gaziosmanpaşa	Central			NA	NA	NA	NA	NA
İstanbul	Arnavutköy	Central	4	Yassıören	500	498	516	534	540
İstanbul	Çatalca	Hadımköy			NA	NA	NA	NA	NA
İstanbul	Beykoz	Central	5	Ali Bahadır	783	809	808	796	787
İstanbul	Beykoz	Central	6	Anadolu Feneri	1,157	635	637	640	633
İstanbul	Beykoz	Mahmutşevketpaşa	7	Bozhane	NA	NA	NA	NA	424
İstanbul	Beykoz	Central			452	454	440	442	NA
İstanbul	Beykoz	Mahmutşevketpaşa	8	Cumhuriyet	NA	NA	NA	NA	1,681
İstanbul	Beykoz	Central			1,841	1,820	1,764	1,700	NA
İstanbul	Beykoz	Mahmutşevketpaşa	9	Öğümce	NA	NA	NA	NA	417
İstanbul	Beykoz	Mahmutşevketpaşa			NA	NA	NA	NA	NA
İstanbul	Beykoz	Central			448	449	458	442	NA
İstanbul	Beykoz	Mahmutşevketpaşa	10	Paşamandıra	NA	NA	NA	NA	826
İstanbul	Beykoz	Central			925	910	891	876	NA
İstanbul	Beykoz	Central	11	Poyrazköy	888	915	904	875	861
İstanbul	Çekmeköy	Central	12	Hüseyinli	747	746	748	772	830
İstanbul	Ümraniye	Central			NA	NA	NA	NA	NA
İstanbul	Çekmeköy	Central	13	Reşadiye	2,004	2,011	1,969	1,947	1,759
İstanbul	Ümraniye	Central			NA	NA	NA	NA	NA
İstanbul	Eyüp	Kemerburgaz	14	Ağaçlı	NA	NA	NA	NA	NA
İstanbul	Eyüp	Central			979	599	632	472	491
İstanbul	Eyüp	Kemerburgaz	15	Çiftalan	NA	NA	NA	NA	NA
İstanbul	Eyüp	Central			126	120	128	138	160
İstanbul	Eyüp	Kemerburgaz	16	Işıklar	NA	NA	NA	NA	NA
İstanbul	Eyüp	Central			550	553	567	606	609
İstanbul	Eyüp	Kemerburgaz	17	İhsaniye	NA	NA	NA	NA	NA
İstanbul	Eyüp	Central			174	183	188	209	202
İstanbul	Eyüp	Kemerburgaz	18	Odayeri	NA	NA	NA	NA	NA
İstanbul	Eyüp	Central			228	252	259	278	278
İstanbul	Pendik	Central	19	Emirli	296	297	306	261	271
İstanbul	Pendik	Central	20	Kurna	1,297	1,332	1,303	1,389	1,387
İstanbul	Pendik	Central	21	Kurtdoğmuş	470	489	501	524	519
İstanbul	Kartal	Samandıra	22	Paşaköy	NA	NA	NA	NA	NA
İstanbul	Sancaktepe	Central			1,686	1,660	1,658	1,627	1,491
İstanbul	Sarıyer	Central	23	Demirciköy	1,162	1,104	1,083	1,054	948
İstanbul	Sarıyer	Central	24	Garipçe	448	456	340	337	445
İstanbul	Sarıyer	Central	25	Gümüşdere	2,751	2,020	2,140	2,656	3,242
İstanbul	Sarıyer	Central	26	Kısırkaya	417	413	424	423	434
İstanbul	Sarıyer	Central	27	Rumeli Feneri	3,571	4,729	2,337	2,486	2,508
İstanbul	Sarıyer	Central	28	Uskumruköy	5,077	4,778	4,524	4,064	3,443

4.3.4 General Economic Conditions

Türkiye's national income per capita in terms of purchasing power parity (PPP), which is generally on the rise, reached 69 percent of the EU average in 2022. National income per capita in Organisation for Economic Co-operation and Development (OECD)-defined PPP terms also increased from 28,299 United States Dollar (USD) in 2018 to 37,445 USD in 2022. While the share of the industrial sector in Gross Domestic Product (GDP) increased over the years in the 2019- 2022 period, the share of the services sector decreased. As of 2022, the shares of

agriculture, industry and services sectors in nominal GDP were 6.5 percent, 26.4 percent and 56.6 percent, respectively [98].

As a result of the transformation of the economic structure, those leaving the agricultural sector across the country have started working in the industry and services sectors. While İstanbul hosts a high concentration of employment in the industry and services sectors, it ranks last among all regions in terms of the proportion of agricultural employment [99].

When the number of employees in the main sectors is examined across Türkiye, it is observed that the highest employment occurs in the services sector, followed by the industry and agriculture sectors, respectively. Compared to the national average, the services and industry sectors stand out particularly in İstanbul [100].

As of 2022, the labor force participation rate in Türkiye was 53.1 percent, with 35.1 percent for women and 71.4 percent for men [101]. İstanbul, with a population of 15.9 million, accounts for 18.6% of the country's total population. With an employment figure reaching 6.3 million, the city represents 20% of Türkiye's total employment of 30.7 million. Between 2013 and 2022, while İstanbul's population increased by 1.7 million, the number of employed persons rose by 1.6 million, demonstrating the city's strong capacity for job creation. The employment rate in İstanbul stood at 50.4%, which is above the national average of 45.7%. Similarly, the female employment rate in İstanbul was 33.2%, higher than the national average of 30.4% [102].

In the TR42 NUTS-2 Region, industrial enterprises owned by İstanbul-based companies or operating as subcontractors for these companies are concentrated along the Gebze–Düzce corridor. Similarly, in the TR21 NUTS-2 Region (Tekirdağ sub region), such enterprises are located along the Çerkezköy–Çorlu–Lüleburgaz corridor [103].

İstanbul, together with its hinterland extending into Tekirdağ and Kocaeli, forms a city-region centered around İstanbul. This region is characterized by dense flows of goods, services, labor, and logistics. The Tekirdağ–İstanbul–Kocaeli corridor constitutes Türkiye's largest city-region and serves as a driving force of the national economy, with its high number of enterprises, scale of production, and the quality of its workforce [104].

According to the results of the 2023 Household Labour Force Survey, the employment rate of the population was 48.3%, with 31.3% for women and 65.7% for men. The highest employment rate was recorded in the Tekirdağ, Edirne, Kırklareli region at 54.5%, while the lowest employment rate was observed in the Mardin, Batman, Şırnak, Siirt region at 37.5%. The highest female employment rate was 38.9% in the Antalya, Isparta, Burdur region, whereas the lowest female employment rate was 19.8% in the Mardin, Batman, Şırnak, Siirt region. However, it was observed

98 *Presidency of the Republic of Türkiye. Presidency of Strategy and Budget. Twelfth Development Plan (2024-2028). https://www.sbb.gov.tr/wp-content/uploads/2025/03/Twelfth-Development-Plan_2024-2028.pdf. Access date: July 2025*

99 *TR10 Düzey-2 Bölgesi Bölge Planı 2024-2028. İstanbul Development Agency. https://www.istka.org.tr/media/pdf/h4fuFPWyKYFCZ0RkYV9CJVbbtcZwcSKjfWZ4nBUyJuKM7M4EiDTR.pdf. Access date: July 2025*

100 *TR10 Düzey-2 Bölgesi Bölge Planı 2024-2028. İstanbul Development Agency. https://www.istka.org.tr/media/pdf/h4fuFPWyKYFCZ0RkYV9CJVbbtcZwcSKjfWZ4nBUyJuKM7M4EiDTR.pdf. Access date: July 2025*

101 *Presidency of the Republic of Türkiye. Presidency of Strategy and Budget. Twelfth Development Plan (2024-2028). https://www.sbb.gov.tr/wp-content/uploads/2025/03/Twelfth-Development-Plan_2024-2028.pdf. Access date: July 2025.*

102 *TR10 Düzey-2 Bölgesi Bölge Planı 2024-2028. İstanbul Development Agency. https://www.istka.org.tr/media/pdf/h4fuFPWyKYFCZ0RkYV9CJVbbtcZwcSKjfWZ4nBUyJuKM7M4EiDTR.pdf. Access date: April 2025.*

103 *TR10 Düzey-2 Bölgesi Bölge Planı 2024-2028. İstanbul Development Agency. https://www.istka.org.tr/media/pdf/h4fuFPWyKYFCZ0RkYV9CJVbbtcZwcSKjfWZ4nBUyJuKM7M4EiDTR.pdf. Access date: April 2025.*

104 *TR10 Düzey-2 Bölgesi Bölge Planı 2024-2028. İstanbul Development Agency. https://www.istka.org.tr/media/pdf/h4fuFPWyKYFCZ0RkYV9CJVbbtcZwcSKjfWZ4nBUyJuKM7M4EiDTR.pdf. Access date: April 2025.*

that women's employment rate is less than half of that of men. The share of part-time workers in total employment was 10.2%; this share was 16.1% for women and 7.3% for men.
The employment rate of women with at least one child under the age of three living in the household was 27.1%, compared to an employment rate of 90.1% for men in the same category.

The gender pay (or earnings) gap is defined as the percentage difference between men's and women's wages or earnings relative to men's wages or earnings. According to the Structure of Earnings Statistics, for the indicator calculated using annual average gross wages and salaries, the highest gap was observed among higher education graduates at 17.4%, while the lowest gap (13.2%) was recorded among those with primary education or below. For the indicator calculated using annual average gross earnings, the highest gap was 20.0% among upper secondary (high school) graduates, and the lowest gap was 14.9% among those with primary education or below [105][106]. Regional results of these figures are illustrated in Table 4-46.

Table 4-44 Main labour force indicators by sex and sub region Level 2, 2023, 15+age[107]

	Labour force participation rate			Employment rate			Unemployment rate		
Level 2	Total	Male	Female	Total	Male	Female	Total	Male	Female
TR Türkiye	53.3	71.2	35.8	48.3	65.7	31.3	9.4	7.7	12.6
TR10 (İstanbul)	57.0	74.9	39.5	51.9	69.3	34.9	8.9	7.4	11.7
TR42 (Kocaeli, Sakarya, Düzce, Bolu, Yalova)	58.2	75.6	40.6	53.0	70.7	35.1	9.0	6.5	13.6

Bahçe and Memiş (2025) calculated the relationship between poverty and gender using the 2023 dataset of the TurkStat Income and Living Conditions Survey; the resulting findings are presented below in **Table 4-45**. When the female and male populations are separated, it is seen that the poverty rate of women is higher than that of men. One of the main reasons for this is that women have a higher rate of low income or no income at all.

Table 4-45 Gender-disaggregated relative poverty rate (2023)[108]

	Relative Poverty Rate - Income Based - below 60% median equivalent household income		
Level 2	Total	Femele	Male
TR10 (İstanbul)	7.4	7.8	7.1

[105] *Turkish Statistical Institute (TurkStat). (2025, March 6). Statistics on women, 2024 (Press Release No. 54076).* https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Kadin-2024-54076. *Access date: Decenber 2025.*

[106] *Turkish Statistical Institute & UN Women Turkey. (2025). Women in Türkiye: A statistical overview, 2024 (TurkStat report). https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Kadin-2024-54076. Access date: December 2025.*

[107] *TurkStat, Women in Statistics, 2024, Access date: December 2025.*

[107] *TurkStat, Household Labour Force Survey, 2023, Access date: December 2025.*

[108] *TurkStat, Women in Statistics, 2024, Access date: December 2025.*

[108] *Cinsiyet Eşitliği İzleme Derneği (CEİD). (2025). Gender Equality Monitoring Report of Türkiye 2023–2024 (Annual report). CEİD. https://ceidizler.ceid.org.tr/dosya/yillik-rapor-2023-24mart6pdf.pdf. Access date: December 2025.*

	Relative Poverty Rate - Income Based - below 60% median equivalent household income		
Level 2	**Total**	**Femele**	**Male**
TR42 (Kocaeli, Sakarya, Düzce, Bolu, Yalova)	9.1	9.5	8.7

A recent and growing body of empirical studies document that gender gaps in the labour market are to a great extent attributable to cultural norms regarding gender roles in society (Giuliano 2020)[109].

Gatti and Dollar (1999) investigate in their paper the relationships among gender inequality, income and growth, using data for over 100 countries over the past three decades. Their primary focus is on gender inequality in educational attainment. They find that gender inequality in secondary schooling is bad for growth, but only for countries at lower middle income status and above, and increases in per capita income lead to reductions in gender inequality[110].

According to prepared article to investigate the gender wage gap for full-time formal sector employees[111], disaggregated by education level, the gender gap is higher in the private sector. However, women with tertiary education in the public sector are significantly better qualified compared to men, and consequently the adjusted gender wage gap is higher for women with tertiary education in the public sector.

Childcare, elderly care, and care for the sick are globally regarded as responsibilities primarily borne by women. In Türkiye, the leading reason why women remain outside the labor force is their engagement in household and care work (42.9%). By contrast, there are no men who are outside the labor force for this reason. On the other hand, while only 6.2% of women are outside the labor force due to retirement, the corresponding proportion for men is 40.7%. The limited availability of income-generating formal employment opportunities prevents women from acquiring pension entitlements.

When other reasons for remaining outside the labor force are examined, it is noteworthy that the number of women who are discouraged workers—those who have sought employment but stopped looking because they could not find a job—as well as women who are not seeking work for various reasons but are available to work, is higher than that of men. Although the number of women in this situation exceeds that of men by 720,000, the relatively low proportion is attributable to the fact that nearly half of women are engaged in household work[112].

The OECD report emphasized [113] that female labour force participation improved, but still remains significantly lower than in other OECD countries, with women also facing higher unemployment rates than men. The underutilisation of women's talents limits Türkiye's economic potential. Closing the gap between men and women could increase long-term GDP per capita growth. Doing

---

[109] *Gevrek, Z. E., & Gevrek, D. (2023). Social norms and the gender gap in labor force participation: Evidence from Turkey. Applied Economics Letters, 30(15), 2102–2107. https://doi.org/10.1080/13504851.2022.2094315. Access date: December 2025.*

[110] *Canbak, Başak (2012) Female labor force participation in Turkey: the role of skill premium and gender wage gap. [Thesis]. http://192.168.1.20/record=b1505253 (Table of Contents). Access date: December 2025.*

[111] *Tekgüç, H., Eryar, D. & Cindoğlu, D. Women's Tertiary Education Masks the Gender Wage Gap in Turkey.* J Labor Res *38, 360–386 (2017). https://doi.org/10.1007/s12122-017-9243-x. Access date: December 2025.*

[112] *Toksöz, G. (2025). İşgücü piyasasının cinsiyetçi yapısı, geleceğin işleri ve kadınların önündeki engeller [Report]. TESEV – Türkiye Ekonomi Politikaları Araştırma Vakfı. https://www.tesev.org.tr/wp-content/uploads/rapor_isgucu_piyasasinin_cinsiyetci_yapisi_gelecegin_isleri_ve_kadinlarin_onundeki_engeller.pdf. Access date: 2025.*

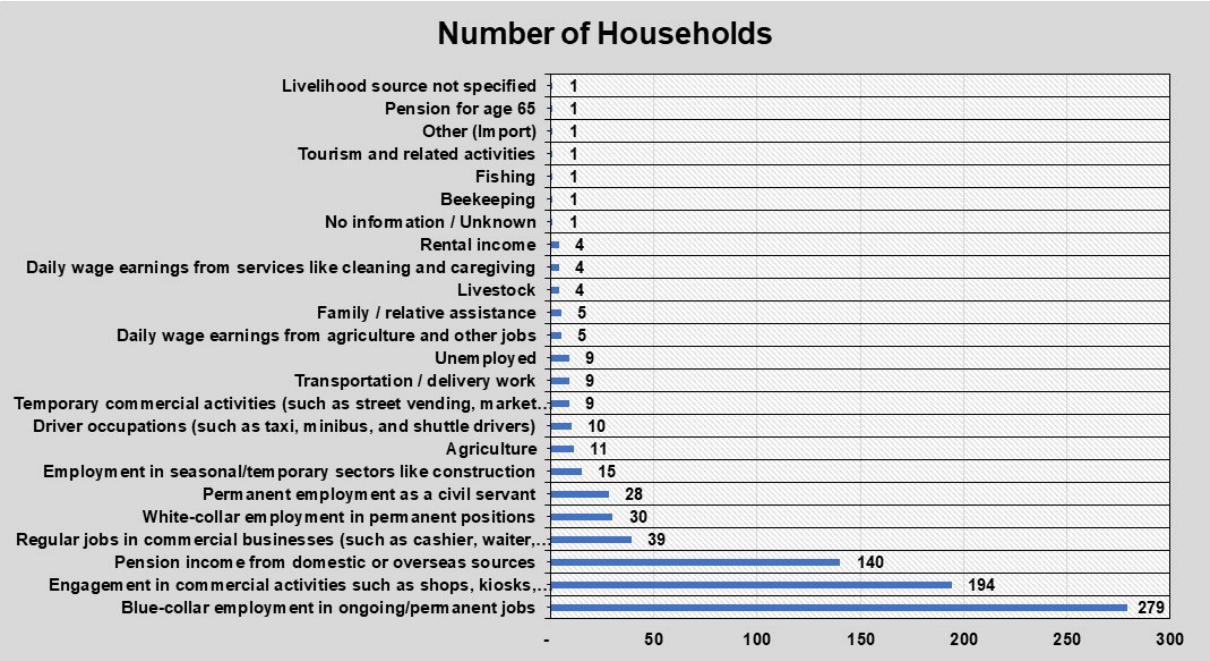
[113] *OECD (2025), OECD Economic Surveys: Türkiye 2025, OECD Publishing, Paris, https://doi.org/10.1787/d01c660f-en. Access date: 2025.*

so requires a combination of tax policies, expanding pre-school education facilities and promoting more equitable family policies.

Women are likely to reduce engagement in the workforce after childbirth. Motherhood significantly affects women's workforce participation in Türkiye. The child penalty – defined as the Average reduction in women's employment over the 10 years following the birth of their first child – is around 29% in Türkiye. While slightly lower than the OECD average, it tends to persist over time. In urban areas like İstanbul, the child penalty is even higher, reaching 61%, reflecting regional differences in job flexibility.

4.3.5 Livelihood sources

The following Figure 4-40, compiled from the responses given by household representatives participating in the household interviews, shows the distribution of livelihood sources among the households and the total population. Out of 802 households, 279 have regular employment as blue-collar workers as their main source of livelihood. The total population dependent on this income source amounts to 1,108 individuals. Commercial activities rank second among livelihood sources with 194 households, followed by pension income in third place. These top three livelihood sources correspond to 613 out of 802 households (76%) and account for 2,203 out of the total population of 2,901 individuals (75%).



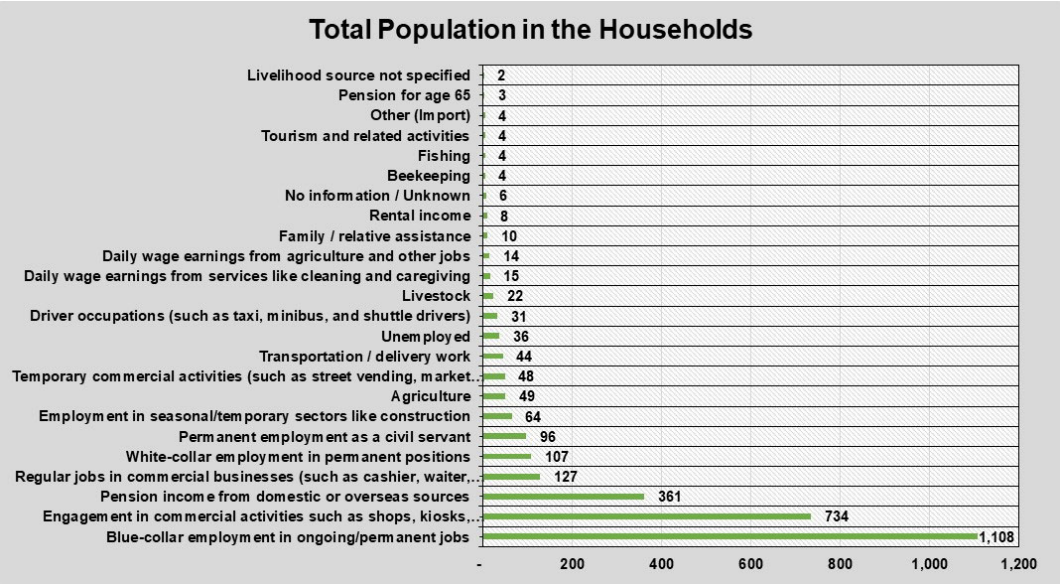


Figure 4-40 Main livelihood sources, Household Survey, July 2025

The distribution of the relevant income sources by settlements is presented in Table 4-46. Tuzla and Pendik rank first among the settlements for each of the top three income sources. For blue-collar workers, Sultanbeyli follows Tuzla and Pendik; for commercial activities, Çayırova is next; and for pension income, the Sultanbeyli area comes after Tuzla and Pendik.

Agriculture and livestock are included among the income sources but are limited to 15 households (2%). Similarly, beekeeping and fishing have also emerged as sources of livelihood in related areas, yet remain limited to 2 households (i.e. below 1%). The number of individuals dependent on agriculture and livestock income is 71 (2.4%), while those associated with beekeeping and fishing amount to 8 people, representing less than 1% of the population.

Households engaged in agricultural activities are primarily located in Sarıyer, Çatalca, and Arnavutköy. The settlements of Gümüşdere in Sarıyer, and Baklalı and Yassıören in Arnavutköy, and Emirli in Pendik were classified as villages prior to the relevant legal changes (see Table 4-43).

The settlements of Arnavutköy Baklalı, Eyüpsultan Çiftalan, and Beykoz Öğümce, where livestock activities are carried out, were also classified as villages in the past due to their rural characteristics. Accordingly, the settlements formerly designated as “villages” represent areas within the AoI where agricultural and livestock activities, which are now rarely observed, still take place.

Table 4-46 Main livelihood sources, Household Survey, July 2025 (N: 802 / 2,901)

Main livelihood source	Settlement	Number of Households	Total Population in the Households
Blue-collar employment in ongoing/permanent jobs	Pendik Kavakpınar	40	161
	Tuzla Aydınlı	32	134
	Pendik Yenişehir	39	133
	Sultanbeyli Akşemsettin	18	95
	Pendik Kurtköy	25	84
	Pendik Güllübağ	15	70
	Pendik Şeyhli	13	55
	Sultanbeyli Mecidiye	10	46
	Tuzla Aydıntepe	8	34
	Çayırova Yeni Mahalle	8	33
	Çekmeköy Nişantepe	8	30
	Pendik Harmandere	7	25

Main livelihood source	Settlement	Number of Households	Total Population in the Households
	Sarıyer Uskumruköy	4	25
	Tuzla İstasyon	5	19
	Arnavutköy Tayakadın	4	18
	Gebze Cumhuriyet	3	18
	Çatalca Ferhatpaşa	7	16
	Çekmeköy Reşadiye	1	11
	Çatalca Kaleiçi	4	10
	Pendik Kurna	2	9
	Sarıyer Rumeli Feneri	2	9
	Beykoz Ali Bahadır	3	8
	Çekmeköy Hüseyinli	2	8
	Pendik Ramazanoğlu	2	8
	Arnavutköy Boyalık	2	7
	Sarıyer Garipçe	2	6
	Arnavutköy Yassıören	1	5
	Çekmeköy Ömerli	1	5
	Sarıyer Kısırkaya	1	5
	Arnavutköy Bolluca	1	3
	Arnavutköy Dursunköy	1	3
	Beykoz Öğümce	1	3
	Eyüpsultan Işıklar	1	3
	Sarıyer Gümüşdere	1	3
	Çayırova Şekerpınar	1	2
	Arnavutköy İmrahor	1	1
	Çatalca İzzettin	1	1
	Eyüpsultan İhsaniye	1	1
	Pendik Kurtdoğmuş	1	1
	Sub Total	**279**	**1,108**
Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Pendik Kavakpınar	27	115
	Tuzla Aydınlı	31	111
	Pendik Kurtköy	12	56
	Tuzla Aydıntepe	14	54
	Çayırova Yeni Mahalle	12	46
	Pendik Yenişehir	14	42
	Pendik Harmandere	8	35
	Tuzla İstasyon	9	27
	Sarıyer Uskumruköy	7	25
	Arnavutköy İmrahor	5	22
	Pendik Şeyhli	6	21
	Sultanbeyli Mecidiye	6	21
	Pendik Güllübağ	6	20
	Pendik Kurtdoğmuş	3	15
	Gebze Cumhuriyet	6	14
	Çekmeköy Nişantepe	3	12
	Sultanbeyli Akşemsettin	3	11
	Beykoz Paşamandıra	2	9
	Pendik Kurna	2	9
	Pendik Emirli	2	8
	Beykoz Öğümce	2	7
	Arnavutköy Tayakadın	1	6
	Çayırova Şekerpınar	1	6
	Çekmeköy Reşadiye	1	5
	Pendik Sanayi	1	5
	Beykoz Anadolu Feneri	1	4
	Beykoz Poyrazköy	1	4

Main livelihood source	Settlement	Number of Households	Total Population in the Households
	Çatalca Ferhatpaşa	1	4
	Çekmeköy Ömerli	1	4
	Pendik Ramazanoğlu	1	4
	Beykoz Bozhane	1	3
	Çekmeköy Hüseyinli	1	3
	Beykoz Cumhuriyet	1	2
	Eyüpsultan Odayeri	1	2
	Sarıyer Garipçe	1	2
	Sub Total	**194**	**734**
Pension income from domestic or overseas sources	Tuzla Aydınlı	16	36
	Pendik Yenişehir	15	30
	Tuzla İstasyon	12	30
	Pendik Kavakpınar	11	29
	Pendik Şeyhli	8	27
	Pendik Kurtköy	8	26
	Sultanbeyli Mecidiye	7	24
	Tuzla Aydıntepe	9	20
	Çekmeköy Nişantepe	4	17
	Çatalca Ferhatpaşa	5	11
	Çayırova Yeni Mahalle	5	11
	Beykoz Poyrazköy	3	8
	Arnavutköy Bolluca	2	7
	Eyüpsultan Ağaçlı	3	7
	Pendik Güllübağ	2	7
	Beykoz Cumhuriyet	2	6
	Beykoz Paşamandıra	2	6
	Çayırova Şekerpınar	2	6
	Arnavutköy Baklalı	2	5
	Eyüpsultan Işıklar	2	5
	Sultanbeyli Akşemsettin	3	5
	Arnavutköy Tayakadın	2	4
	Beykoz Anadolu Feneri	2	4
	Çatalca İzzettin	1	4
	Çekmeköy Hüseyinli	1	4
	Pendik Sanayi	1	4
	Sarıyer Kısırkaya	2	4
	Çatalca Kaleiçi	1	3
	Eyüpsultan Çiftalan	2	3
	Beykoz Ali Bahadır	1	2
	Sancaktepe Paşaköy	1	2
	Gebze Cumhuriyet	1	2
	Eyüpsultan Odayeri	1	1
	Sarıyer Uskumruköy	1	1
	Sub Total	**140**	**361**
Regular jobs in commercial businesses (such as cashier, waiter, courier)	Tuzla Aydınlı	7	30
	Pendik Yenişehir	10	22
	Pendik Kavakpınar	4	16
	Çekmeköy Nişantepe	3	13
	Pendik Kurtköy	5	13
	Çatalca Ferhatpaşa	2	7
	Eyüpsultan Ağaçlı	1	6
	Sultanbeyli Akşemsettin	2	5
	Çekmeköy Reşadiye	1	4
	Çatalca İzzettin	1	3
	Çatalca Kaleiçi	1	3

Main livelihood source	Settlement	Number of Households	Total Population in the Households
	Tuzla İstasyon	1	3
	Tuzla Aydıntepe	1	2
	Sub Total	**39**	**127**
White-collar employment in permanent positions	Pendik Yenişehir	9	27
	Tuzla İstasyon	6	20
	Tuzla Aydınlı	5	17
	Pendik Kavakpınar	2	11
	Pendik Kurtköy	3	11
	Tuzla Aydıntepe	2	8
	Pendik Ramazanoğlu	1	5
	Arnavutköy Bolluca	1	4
	Pendik Güllübağ	1	4
	Sub Total	**30**	**107**
Permanent employment as a civil servant	Tuzla Aydınlı	4	14
	Pendik Kavakpınar	3	12
	Çayırova Yeni Mahalle	2	10
	Beykoz Bozhane	2	8
	Sultanbeyli Mecidiye	2	8
	Tuzla İstasyon	2	8
	Eyüpsultan İhsaniye	2	6
	Çekmeköy Ömerli	1	4
	Çekmeköy Reşadiye	1	4
	Eyüpsultan Işıklar	1	4
	Pendik Güllübağ	1	4
	Pendik Yenişehir	2	4
	Beykoz Anadolu Feneri	1	2
	Çatalca Ferhatpaşa	1	2
	Sultanbeyli Akşemsettin	1	2
	Tuzla Aydıntepe	1	2
	Gebze Cumhuriyet	1	2
	Sub Total	**28**	**96**
Employment in seasonal/temporary sectors like construction	Tuzla Aydıntepe	4	21
	Pendik Kavakpınar	3	18
	Tuzla Aydınlı	3	11
	Gebze Cumhuriyet	2	7
	Sultanbeyli Mecidiye	1	4
	Çatalca Ferhatpaşa	1	2
	Çayırova Şekerpınar	1	1
	Sub Total	**15**	**64**
Agriculture	Sarıyer Gümüşdere	2	16
	Çatalca Nakkaş	3	11
	Arnavutköy Dursunköy	2	9
	Arnavutköy Baklalı	1	4
	Pendik Emirli	1	4
	Arnavutköy Yassıören	1	3
	Sancaktepe Paşaköy	1	2
	Sub Total	**11**	**49**
Temporary commercial activities (such as street vending, market trading, etc.)	Arnavutköy İmrahor	1	10
	Sultanbeyli Mecidiye	2	10
	Sarıyer Demirciköy	1	7
	Tuzla Aydınlı	1	7
	Çayırova Yeni Mahalle	1	6
	Sarıyer Uskumruköy	1	4
	Pendik Sanayi	1	3
	Çekmeköy Ömerli	1	1

Main livelihood source	Settlement	Number of Households	Total Population in the Households
	Sub Total	**9**	**48**
Transportation / delivery work	Tuzla Aydınlı	3	12
	Arnavutköy İmrahor	1	8
	Pendik Harmandere	1	7
	Pendik Kurtköy	1	5
	Pendik Kavakpınar	1	4
	Sultanbeyli Akşemsettin	1	4
	Sultanbeyli Mecidiye	1	4
	Sub Total	**9**	**44**
Unemployed	Sultanbeyli Mecidiye	2	12
	Tuzla Aydıntepe	2	7
	Pendik Kavakpınar	2	6
	Pendik Ramazanoğlu	1	6
	Beykoz Bozhane	1	3
	Tuzla Aydınlı	1	2
	Sub Total	**9**	**36**
Driver occupations (such as taxi, minibus, and shuttle drivers)	Tuzla Aydınlı	3	9
	Pendik Kavakpınar	2	6
	Pendik Yenişehir	2	5
	Çayırova Yeni Mahalle	1	5
	Pendik Kurtköy	1	3
	Sultanbeyli Akşemsettin	1	3
	Sub Total	**10**	**31**
Livestock	Arnavutköy İmrahor	1	10
	Arnavutköy Baklalı	1	5
	Eyüpsultan Çiftalan	1	5
	Beykoz Öğümce	1	2
	Sub Total	**4**	**22**
Daily wage earnings from agriculture and other jobs	Sancaktepe Paşaköy	2	6
	Sarıyer Gümüşdere	1	1
	Tuzla Aydıntepe	1	3
	Çayırova Yeni Mahalle	1	4
	Sub Total	**5**	**14**
Daily wage earnings from services like cleaning and caregiving	Arnavutköy Bolluca	1	5
	Gebze Cumhuriyet	1	4
	Sarıyer Demirciköy	1	3
	Tuzla İstasyon	1	3
	Sub Total	**4**	**15**
Family / relative assistance	Pendik Güllübağ	1	3
	Çekmeköy Nişantepe	1	2
	Pendik Kurtdoğmuş	1	2
	Pendik Yenişehir	1	2
	Pendik Kurtköy	1	1
	Sub Total	**5**	**10**
Rental income	Pendik Yenişehir	2	5
	Pendik Şeyhli	1	2
	Pendik Güllübağ	1	1
	Sub Total	**4**	**8**
Beekeeping	Beykoz Cumhuriyet	1	4
Fishing	Sarıyer Rumeli Feneri	1	4
Tourism and related activities	Tuzla İstasyon	1	4
Pension for age 65	Pendik Sanayi	1	3
Other (Import)	Çatalca Nakkaş	1	4
Livelihood source not	Tuzla Aydıntepe	1	2

Main livelihood source	Settlement	Number of Households	Total Population in the Households
specified			
No information / Unknown	Çayırova Yeni Mahalle	1	6
	Total	**802**	**2,901**

In the mukhtar survey conducted across 48 settlements, the three main sources of livelihood in each settlement were inquired about. Regardless of the order in which they were ranked (1st, 2nd, or 3rd), the five most frequently mentioned sources of livelihood (144 responses) are as follows:

- Blue-collar employment in ongoing/permanent jobs (31/144)
- Pension income from domestic or overseas sources (26/144)
- Agriculture (18/144)
- Livestock (18/144)
- Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises (17/144)

The total of these five responses (110) accounts for more than 75% of the overall 144 responses (48 settlements × 3 answers each) (see Figure 4-41).

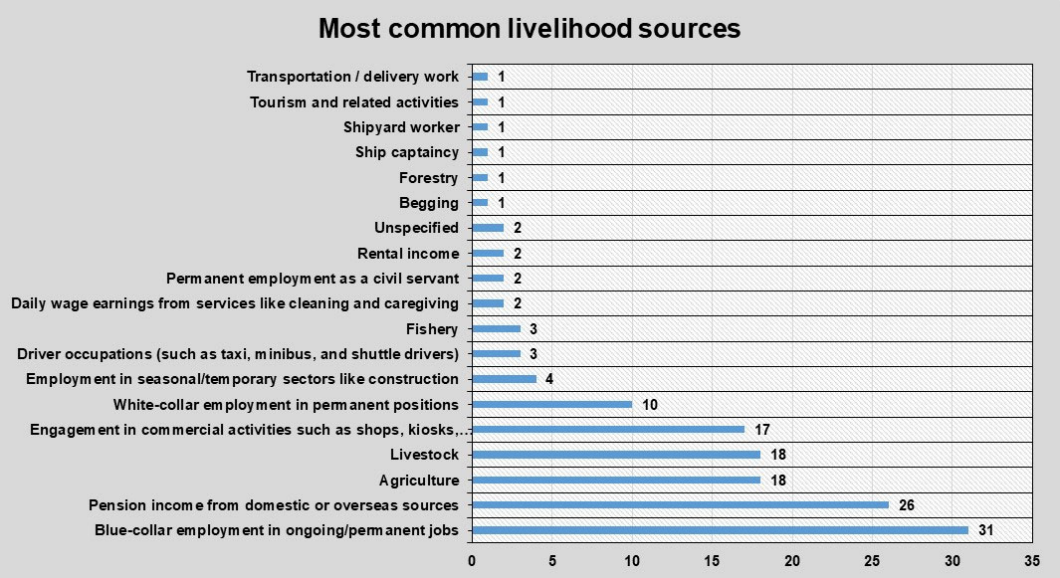


Figure 4-41 Most common livelihood sources, Mukhtar Survey, July 2025, (N:144)

Although "begging" was mentioned only once among the sources of livelihood, it was identified as one of the most common sources (as third in Çekmeköy Nişantepe) (see Table 4-47).

When “blue-collar employment in ongoing/permanent jobs” is in the first position, it is most frequently reported as “agriculture” in the second position and “livestock” in the third position. The livelihood source that most frequently accompanies the Agriculture-Livestock pair is “Pension income from domestic or overseas sources”. In reviewing all results are examined together, agriculture was mentioned only once as the primary source of livelihood, while livestock never appeared in the first position.

Considering the geographical location of the settlements, fishing and related occupations (such as captaincy) were reflected in very few responses, particularly in the coastal districts of Beykoz and Sarıyer, while there were no responses in this sector in Eyüp.

In the household findings, the presence of commercial activities among the top three sources of livelihood showed a similar pattern here, with this activity having the second-highest (following-

agriculture) proportion among the second most important sources of livelihood. This is particularly noteworthy for industrial areas such as Gebze and Çayırova.

Table 4-47 Most common livelihood sources, Mukhtar Survey, July 2025, (N:48)

Settlement	First	Second	Third
Arnavutköy Boyalık	Blue-collar employment in ongoing/permanent jobs	Agriculture	Livestock
Arnavutköy Dursunköy	Pension income from domestic or overseas sources	Agriculture	Livestock
Arnavutköy İmrahor	Blue-collar employment in ongoing/permanent jobs	Driver occupations (such as taxi, minibus, and shuttle drivers)	Agriculture
Arnavutköy Tayakadın	Blue-collar employment in ongoing/permanent jobs	Agriculture	Livestock
Arnavutköy Yassıören	Blue-collar employment in ongoing/permanent jobs	Agriculture	Livestock
Beykoz Ali Bahadır	Blue-collar employment in ongoing/permanent jobs	Permanent employment as a civil servant	Pension income from domestic or overseas sources
Beykoz Anadolu Feneri	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Pension income from domestic or overseas sources	Fishery
Beykoz Bozhane	Agriculture	Livestock	Forestry
Beykoz Cumhuriyet	Blue-collar employment in ongoing/permanent jobs	Tourism and related activities	Pension income from domestic or overseas sources
Beykoz Öğümce	Blue-collar employment in ongoing/permanent jobs	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Pension income from domestic or overseas sources
Beykoz Paşamandıra	Pension income from domestic or overseas sources	Agriculture	Livestock
Beykoz Poyrazköy	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Fishery	Ship captaincy
Çatalca Ferhatpaşa	Pension income from domestic or overseas sources	Agriculture	Livestock
Çatalca İzzettin	Blue-collar employment in ongoing/permanent jobs	Agriculture	Livestock
Çatalca Kaleiçi	Blue-collar employment in ongoing/permanent jobs	Pension income from domestic or overseas sources	Agriculture
Çatalca Nakkaş	Blue-collar employment in ongoing/permanent jobs	Agriculture	Livestock
Çekmeköy Hüseyinli	Blue-collar employment in ongoing/permanent jobs	Transportation / delivery work	Livestock
Çekmeköy Nişantepe	Employment in seasonal/temporary sectors like construction	Daily wage earnings from services like cleaning and caregiving	Begging
Çekmeköy Ömerli	Blue-collar employment in ongoing/permanent jobs	Daily wage earnings from services like cleaning and caregiving	Pension income from domestic or overseas sources
Çekmeköy Reşadiye	White-collar employment in permanent positions	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Rental income
Eyüpsultan Ağaçlı	Pension income from domestic or overseas sources	Agriculture	Livestock
Eyüpsultan Çiftalan	Blue-collar employment in ongoing/permanent jobs	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Unspecified
Eyüpsultan Işıklar	Pension income from domestic or overseas sources	Agriculture	Livestock
Eyüpsultan İhsaniye	Pension income from domestic or overseas sources	Livestock	Rental income
Eyüpsultan Odayeri	Blue-collar employment in ongoing/permanent jobs	White-collar employment in permanent positions	Pension income from domestic or overseas sources
Pendik Emirli	Pension income from domestic or overseas sources	Agriculture	Livestock
Pendik Güllübağ	Driver occupations (such as taxi, minibus, and shuttle drivers)	Engagement in commercial activities such as shops,	Pension income from domestic or overseas sources

Settlement	First	Second	Third
		kiosks, workshops, and other enterprises	
Pendik Harmandere	Blue-collar employment in ongoing/permanent jobs	White-collar employment in permanent positions	Pension income from domestic or overseas sources
Pendik Kavakpınar	Blue-collar employment in ongoing/permanent jobs	White-collar employment in permanent positions	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises
Pendik Kurna	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Agriculture	Livestock
Pendik Kurtdoğmuş	Pension income from domestic or overseas sources	Agriculture	Livestock
Pendik Kurtköy	Blue-collar employment in ongoing/permanent jobs	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Pension income from domestic or overseas sources
Pendik Sanayi	Blue-collar employment in ongoing/permanent jobs	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Pension income from domestic or overseas sources
Pendik Şeyhli	Blue-collar employment in ongoing/permanent jobs	White-collar employment in permanent positions	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises
Pendik Yenişehir	Blue-collar employment in ongoing/permanent jobs	White-collar employment in permanent positions	Pension income from domestic or overseas sources
Sancaktepe Paşaköy	Blue-collar employment in ongoing/permanent jobs	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Unspecified
Sarıyer Demirciköy	Blue-collar employment in ongoing/permanent jobs	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Livestock
Sarıyer Garipçe	Blue-collar employment in ongoing/permanent jobs	White-collar employment in permanent positions	Fishery
Sarıyer Gümüşdere	Driver occupations (such as taxi, minibus, and shuttle drivers)	Pension income from domestic or overseas sources	Agriculture
Sarıyer Kısırkaya	Blue-collar employment in ongoing/permanent jobs	White-collar employment in permanent positions	Permanent employment as a civil servant
Sultanbeyli Akşemsettin	Blue-collar employment in ongoing/permanent jobs	Employment in seasonal/temporary sectors like construction	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises
Sultanbeyli Mecidiye	Blue-collar employment in ongoing/permanent jobs	Employment in seasonal/temporary sectors like construction	Pension income from domestic or overseas sources
Tuzla Aydınlı	Blue-collar employment in ongoing/permanent jobs	White-collar employment in permanent positions	Pension income from domestic or overseas sources
Tuzla Aydıntepe	Blue-collar employment in ongoing/permanent jobs	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Shipyard worker
Tuzla İstasyon	White-collar employment in permanent positions	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Pension income from domestic or overseas sources
Çayırova Şekerpınar	Blue-collar employment in ongoing/permanent jobs	Agriculture	Livestock
Çayırova Yeni Mahalle	Blue-collar employment in ongoing/permanent jobs	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Pension income from domestic or overseas sources
Gebze Cumhuriyet	Blue-collar employment in ongoing/permanent jobs	Employment in seasonal/temporary sectors like construction	Pension income from domestic or overseas sources

4.3.5.1 Agriculture

In the meetings held with institutions in Çayırova [114], it was stated that the region is primarily an industrial area, and therefore, no significant impact on agriculture is expected. In the meeting with the AFAD, it was mentioned that greenhouse farming is carried out in some villages in the north of Istanbul, but overall, the region is industrially oriented. The Tuzla District Governorate also stated that agricultural activities are limited in the district. In the meeting with Gebze Newspaper, it was noted that there are many greenhouse areas in the region. Pendik Municipality emphasized that agriculture is carried out in the Göçbeyli region, which is near the route, and therefore, more sensitive care should be taken. Beykoz District Governorate stated that agricultural activities, such as vegetable growing and cereal production, are intensively carried out in rural areas within the Beykoz, Şile, and Çekmeköy triangle. A significant portion of the 45 neighborhoods in Beykoz are designated as forest villages, and it was reported that the majority of the population in these neighborhoods earns its livelihood through agriculture and livestock. Çekmeköy Municipality and Çekmeköy District Governorate emphasized that the project area is agricultural land, although these areas are not as actively used as before. Sancaktepe Municipality stressed that measures must be taken to continue agriculture and livestock, and supporting small-scale agricultural activities in the northern part of Sancaktepe and preserving the region's ecological balance is crucial. Arnavutköy Municipality stated that villagers use the land in the region, but most of it is informal and there is no private ownership. In the meeting with Eyüpsultan District Governorate, it was mentioned that agriculture and livestock are still carried out in a few villages, but due to the decrease in the number of people engaged in these activities, no significant impact is expected within the scope of the project. In the meeting with Istanbul Airport, it was reported that agriculture and livestock activities are still ongoing in Çatalca. Similarly, the Sarıyer District Governorate mentioned that these activities continue in the rural areas of the region. Specifically, livestock farming is conducted in Demirciköy and Kısırkaya, and greenhouse production is carried out in Gümüşdere and Uskumru neighborhoods.

In the focus group meeting with the local community of Paşaköy Neighborhood in Sancaktepe, the potential impact of project activities on agricultural lands and pastures was raised as a common concern. In the focus group meeting with the local community of Ali Bahadır Neighborhood in Beykoz, it was emphasized that special efforts should be made for farmers and those engaged in livestock in the region. In the focus group meeting with the local community of Gümüşdere in Sarıyer, it was stated that the project should be carried out in areas where agricultural activities are conducted, with detailed planning beforehand, to prevent any loss of income. In the focus group meeting with the local community of Odayeri Neighborhood in Eyüpsultan, it was highlighted that the population dependent on agriculture and livestock has lost their sources of livelihood. In Nakkaş Neighborhood in Çatalca, it was mentioned that agricultural activities have become more difficult due to the fragmentation of fields and the reduction of agricultural lands, which has also increased economic costs. To ensure the sustainability of agriculture, it was suggested that grievances should be addressed and, if necessary, land allocation from state-owned lands should be made. Additionally, it was emphasized that adequate planning for passageways is necessary for the continuity of agricultural activities.

The Istanbul Development Agency stated that the share of agriculture in Istanbul's economy is low, but it is important to preserve agricultural production, especially in the regions of Çatalca and Silivri. The Istanbul Metropolitan Municipality Women's Center emphasized that agriculture and livestock activities are continuing in Arnavutköy district, and these activities, particularly in rural areas, should be taken into account. The Çatalca Women's Cooperative also noted that there are intense agricultural activities in the region and that more care should be taken during the

114 Çayırova Municipality, Çayırova District Governate, Çayırova District Directorate of Agriculture and Forestry, TCDD İzmit Maintenance Directorate, Kocaeli Metropolitan Municipality - Department of Transportation, Kocaeli Governorship, East Marmara Development Agency

construction and operational phases in this area. In the meeting with the Arnavutköy Disabled Association, it was stated that, after the construction of Istanbul Airport, the drainage of wetland areas near the village has made agriculture and livestock increasingly difficult, and that the process should be handled more sensitively in such projects.

Although agricultural activities are limited in some areas along the project route, agriculture and livestock remain the primary source of livelihood for the rural population in districts such as Beykoz, Çekmeköy, Sancaktepe, Arnavutköy, Çatalca, and Sarıyer. The local community is concerned about the decrease in pasture and agricultural lands and the risk posed to their sources of livelihood. This issue must be carefully addressed to preserve the social and economic integrity of rural communities. To ensure the sustainability of agriculture, measures must be taken to protect the livelihoods of the local population.

4.3.5.2 Animal husbandry & grazing activities

In the institutional meetings held in Çayırova, it was mentioned that the region is an industrial area and that livestock farming is not practiced. In the meeting with Gebze Newspaper, it was stated that livestock farming is particularly carried out in the Darıca region. In the meeting with the AFAD, it was mentioned that livestock activities exist in the Silivri-Çatalca region, but the area is generally industrially oriented. Tuzla Municipality stated that there are no agricultural or livestock activities in the Tuzla region. Beykoz District Governorate reported that a significant portion of the population in approximately 25 forest villages in the district is engaged in livestock farming, and that livestock farming and beekeeping activities are intensively carried out in rural areas. Pendik Municipality stated that livestock farming is conducted in the northern villages, but since the proportion is low, these activities are not expected to be affected by the project.

In the meeting with the Çatalca Municipality, it was stated that there are pasture areas in the project area. In the focus group meeting with the local community in Işıklar Neighborhood of Eyüpsultan, it was emphasized that preserving these areas is important for the sustainability of livestock farming.

In the focus group meeting with the local community in Ağaçlı Neighborhood of Eyüpsultan, it was stated that livestock farming has almost completely ceased due to previous projects. Similarly, in the meeting held in Odayeri Neighborhood, concerns were raised that villages engaged in livestock farming would be negatively affected by the project, and that these activities might cease. In the meeting in Işıklar Neighborhood, it was emphasized that preserving the pond in the area is crucial to prevent negative impacts on agricultural and livestock activities.

The acceleration of industrialization has significant impacts, particularly on agriculture-based activities such as livestock farming in rural areas. As industrial areas expand, the decline of traditional livelihoods such as agriculture and livestock farming has become a major concern for the local people. To ensure the sustainability of these activities, projects must be planned with greater sensitivity, taking into account their environmental effects. Protecting water resources and natural areas is crucial for the continuation of these activities.

4.3.6 Unemployment and local employment

According to the ILO, persons in unemployment are defined as all those of working age who were not in employment, carried out activities to seek employment during a specified recent period and were currently available to take up employment given a job opportunity [115].

115 *Productivity Ecosystems for Decent Work. Glossary of frequently used terminology. March 2023. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_emp/%40emp_ent/documents/publication/wcms_873800.pdf. Access date: August 2025.*

In light of the analyses presented by the WB in Türkiye, as of April 2024 [116], wage income - supported by minimum wage increases (30 percent in 2025) and strong labor market performance- is expected to remain the main driving force in poverty reduction. However, due to the high broad unemployment rate and informality, individuals who are unable to access labor markets may not benefit from growth.

The youth unemployment data, based on information from WDI, are illustrated in Table 4-48.

Table 4-48 Employment figures of Türkiye, WDI, 2024

Indicators	Male	Female	Total
Employment to population ratio, 15+ (%)	66.43	32.17	49.17
Employment to population ratio, ages 15-24, (%)	50.76	26.54	38.90
Share of youth not in education, employment or training, (% of youth population)	15.51	29.74	22.48
Unemployment, (% of total labor force)	6.93	11.39	8.45
Unemployment, (% of total labor force ages 15-24)	12.44	21.18	15.57

The Covid-19 pandemic has had a lasting impact on youth unemployment in Türkiye, where rates remain higher than overall unemployment significant disruption in this area as well.

Within-country spatial inequalities limit workers' -especially women's- ability to transition into better-paying jobs. The number of unemployed persons aged 15 years old and over increased by 52 thousand to 3 million 47 thousand persons in June 2025 compared to the previous month. As the unemployment rate estimated 8.6% with increased by 0.2 percentage point compared to the previous month; it was estimated 7.1% for men and 11.4% for women [117].

During the meeting with the Sancaktepe District Governorship, the provision of employment opportunities was identified as one of the positive impacts of the project. Similarly, the local residents of Beykoz Cumhuriyet neighborhood expressed that local employment would have a beneficial effect. Discussions held in Beykoz Paşamandıra neighborhood also anticipate positive impacts of the project particularly in the field of employment, based on past experiences. However, in Eyüpsultan Işıklar neighborhood, it was noted that residents have not sufficiently benefited from promised employment opportunities in previous projects and that commitments were not fulfilled. In this context, the importance of establishing contractual quotas for local employment in projects was emphasized. Additionally, during the meeting with the Mor Çatı Women's Shelter Foundation, the need to ensure gender balance among those employed during the construction and operation phases of the project was highlighted.

While employment opportunities remain an important expectation for the local community, past failures to deliver on promises have increased distrust. This underscores the necessity of planning local employment in a concrete and binding manner within projects. Furthermore, considering gender balance and other social equity dimensions is critical for ensuring social justice and inclusivity.

4.3.6.1 Vulnerable Groups / Households Facing Economic Hardship

On the assumption that unemployment and dependence on state-provided social assistance indicate economic hardship, individuals in this group have been considered disadvantaged. This is a pre-existing DVIG situation, independent of the engagement activities, and these individuals are more likely to be adversely affected by the potential economic impacts of the project.

In household interviews, the question 'Are there any unemployed individuals in the household?' was asked in order to obtain an approximate picture of unemployment within AoI. 11.72% of the

116 *The WB in Türkiye. Country Overview. Economy. https://www.worldbank.org/en/country/turkey/overview. Last update: April 2024. Access date: August 2025.*

117 *TurkStat. Labour Force Statistics, June 2025. 30.07.2025. Number 54074. https://data.tuik.gov.tr/Bulten/Index?p=Labour-Force-Statistics-June-2025-54074. Access date: August 2025.*

802 household heads mentioned that there are unemployed individuals in their households. It has been observed that these figures are consistent with the results for Türkiye. Another finding is that 180 out of 802 households are facing economic difficulties. This indicates that, even when a household has a source of income, it is still insufficient. Of these 180 households, 146 reported that there are no unemployed individuals in the household, yet they are still facing significant economic difficulties.

Although no direct findings related to household income were identified during the interviews, 180 out of 802 household heads stated that their households were experiencing significant economic difficulties.

In interviews with mukhtars, it was reported that 33 out of 48 settlements have young people facing unemployment. According to the mukhtars[118], the number of individuals of working age who are actively seeking employment is 19,272. The settlement with the highest reported number of unemployed individuals (6,000), Tuzla Aydınlı, is also the settlement with the highest number of households dependent on social assistance (10,000).

Including the top three settlements standing out under the heading of these DVIG category are as follows (see Table 4-49):

Table 4-49 Economic hardship, Mukhtar survey, Mukhtar Survey, July 2025, (N:48)

Settlements	Number of unemployed individuals	Number of individuals dependent on social assistance
Tuzla Aydınlı	6,000	10,000
Sultanbeyli Mecidiye	5,000	3,000
Pendik Kavakpınar	3,000	1,000
Tuzla Aydıntepe	500	1,000
Çekmeköy Nişantepe	-	800
Pendik Kurtköy	400	450
Gebze Cumhuriyet	1,500	343
Pendik Yenişehir	1,000	200
Çayırova Yeni Mahalle	200	200
Çatalca Kaleiçi	155	200
Sancaktepe Paşaköy	20	100
Pendik Güllübağ	-	100
Beykoz Anadolu Feneri	40	78
Sultanbeyli Akşemsettin	30	60
Pendik Kurna	-	60
Arnavutköy Tayakadın	150	50
Çayırova Şekerpınar	50	50
Çekmeköy Ömerli	-	50
Pendik Sanayi	-	50
Tuzla İstasyon	100	30
Sarıyer Demirciköy	-	25
Beykoz Poyrazköy	50	20
Çekmeköy Hüseyinli	50	20
Eyüpsultan Işıklar	30	20
Arnavutköy Boyalık	23	20
Beykoz Cumhuriyet	-	20

[118] *In Türkiye, social assistance also includes unemployment assistances. These data are monitored by the Social Assistance and Solidarity Foundations, a subsidiary of the Ministry of Family and Social Services operating under the district governorates. Individuals in sensitive situations, such as the unemployed, apply to mukhtars to be registered with these units at the district governorate and to have their circumstances assessed. After the mukhtars forward these applications to the relevant unit at the district governorate, the institution evaluates whether the applicant is eligible to receive social assistance. Based on this evaluation, the applicant either receives the assistance or does not. In summary, like other social assistance requests (e.g., for food, heating, disability, or old-age support), unemployment assistance applications are also communicated to these units via data collected by mukhtars. Therefore, it is assumed that the unemployment data provided by the mukhtars are largely realistic.*

Settlements	Number of unemployed individuals	Number of individuals dependent on social assistance
Çatalca Nakkaş	50	15
Pendik Şeyhli	19	12
Pendik Harmandere	100	10
Eyüpsultan Ağaçlı	50	10
Arnavutköy Dursunköy	40	10
Eyüpsultan Odayeri	18	10
Beykoz Paşamandıra	15	10
Sarıyer Kısırkaya	5	10
Beykoz Öğümce	-	10
Çatalca İzzettin	-	10
Beykoz Bozhane	-	6
Pendik Kurtdoğmuş	40	5
Arnavutköy Yassıören	-	5
Sarıyer Gümüşdere	-	5
Eyüpsultan Çiftalan	8	3
Sarıyer Garipçe	15	2
Beykoz Ali Bahadır	150	1
Çekmeköy Reşadiye	-	-
Eyüpsultan İhsaniye	-	-
Pendik Emirli	-	-
Çatalca Ferhatpaşa	400	No information
Arnavutköy İmrahor	65	No information

4.3.7 Health

As of 2021, 15.1% of the total hospitals in Türkiye are located within the boundaries of İstanbul. According to the 2021 Health Statistics Yearbook, the number of specialist doctors, dentists, and pharmacists per 100,000 people in İstanbul is above the national average, while the number of nurses and midwives is below the national average. The population per Family Medicine Unit in İstanbul is higher than the national average. Additionally, the number of cases per emergency ambulance in İstanbul exceeds the national average number of cases [(119)].

Due to the aging of the population, financial burden on the health system and the proportion of non-communicable diseases in the disease burden are increasing [(120)].

All healthcare institutions intersecting with the AoI refers to the health facilities located in settlements intersecting with the AoI. On the other hand, “other stakeholder health institutions” refers to the district- and province-level health directorates and units affiliated with the Ministry of Health. Special attention has been given to the health facilities in settlements intersecting with the AoI due to emergencies and other critical considerations. Please refer to Appendix-7.4: The Map of Health Institutions to see all healthcare institutions intersecting with the AoI.with the AoI.

It can be assumed that individuals with chronic illnesses may be more severely affected by the potential environmental impacts of the project compared to healthy individuals. Considering diseases such as cancer that require regular treatment and medical check-ups, it will be essential during the construction phase to ensure that these individuals’ access to healthcare facilities is not disrupted by project activities. The healthcare institutions intersecting with the AoI have already been presented within Appendices (see Appendix-7.1: Stakeholder List and Appendix-7.4:The Map of Health Institutions).

---

119 *TR10 Düzey-2 Bölgesi Bölge Planı 2024-2028. İstanbul Development Agency. https://www.istka.org.tr/media/pdf/h4fuFPWyKYFCZ0RkYV9CJVbbtcZwcSKjfWZ4nBUyJuKM7M4EiDTR.pdf. Access date: July 2025.*

120 *Presidency of the Republic of Türkiye. Presidency of Strategy and Budget. Twelfth Development Plan (2024-2028). https://www.sbb.gov.tr/wp-content/uploads/2025/03/Twelfth-Development-Plan_2024-2028.pdf. Access date: July 2025.*

At the household level, the number of households with individuals suffering from chronic illnesses is 264, which represents approximately 32% of the total households which were included in the sampling.

The representatives of the 48 settlements that agreed to participate were asked, “What are the most common illnesses (including cancer) in the settlement?” Responses showed that representatives from 7 settlements did not mention the presence of any illness. In the remaining settlements, the most frequently reported illnesses were asthma, Chronic obstructive pulmonary disease (COPD), diabetes, heart disease, hypertension, digestive system disorders, rheumatic and other musculoskeletal diseases, as well as respiratory diseases.

The neighborhood head of Tuzla Aydıntepe highlighted cases of cancer, asthma, and COPD due to their location near the shipyard area. Among the types of cancer mentioned were breast cancer, thyroid cancer, and lung cancer.

Within the scope of the Turkey Chronic Diseases and Risk Factors Prevalence Study, the prevalence of chronic diseases and risk factors was analyzed for 12 NUTS-1 regions. 18% of the participants live in Istanbul, followed by the most developed regions of the country with 14% in the Aegean region, 13% in the Mediterranean region, 10% in Eastern Marmara region. In the data from 2011, no specific or notable chronic disease prevalence was reported for İstanbul[121].

4.3.7.1 Vulnerable Groups / Persons with handicaps

There are two reasons why persons with disabilities are considered a vulnerable group in relation to the project. The first is that their access to participation activities may be hindered due to physical barriers. Especially in cases where the participation of all rights holders and/or users is highly desirable during land acquisition processes, additional measures will be required to ensure the inclusion of persons with disabilities. The second concern relates to potential traffic impacts during the project’s construction phase, which may further restrict the already limited access opportunities for these individuals. During land acquisition processes, additional measures will be required to ensure the inclusion of persons with disabilities. The second concern relates to potential traffic impacts during the project’s construction phase. Temporary traffic and access arrangements that may be implemented during the construction period have been assessed in terms of their potential to affect users’ mobility and access conditions in a limited and temporary manner, and are not expected to result in significant or permanent impacts at the Project level.

The design of stations and other publicly accessible Project facilities has been assessed within the framework of general considerations related to user access and circulation.Out of 802 participants in the household interviews, 66 household representatives responded “yes” to the question, “Are there persons with disabilities in the household?” These households constitute approximately 8% of the total households within the AoI.

During interviews with mukhtars, 46 out of 48 were able to provide approximate numbers of persons with disabilities residing in their settlements, while 2 stated that they did not have this information. One neighborhood head stated that there are no persons with disabilities in their settlement. Based on the figures provided by the 46 neighborhood heads, the total number of persons with disabilities in settlements intersecting with the AoI is estimated at 4,204. The highest number is in Tuzla Aydınlı with 2,000 persons, followed by Pendik Kavakpınar with 600 persons, and Pendik Yenişehir and Sultanbeyli Mecidiye, each with approximately 500 persons.

[121] Türkiye Halk Sağlığı Kurumu, Kronik Hastalıklar, Yaşlı Sağlığı ve Özürlüler Daire Başkanlığı. (2013). Türkiye Kronik Hastalıklar ve Risk Faktörlerinin Sıklığı Çalışması: Temel Bulgular. Ankara: T.C. Sağlık Bakanlığı Yayın No. 909. https://hsgm.saglik.gov.tr/depo/birimler/kronik-hastaliklar-ve-yasli-sagligi-db/Dokumanlar/Raporlar/KRONIK_ARASTIRMA_TEMEL_BULGULAR.pdf.

In accordance with the findings gathered by mukhtar interviews, the total number of persons with disabilities in these four settlements, 3,600, accounts for 86% of the total number of persons with disabilities (4,204) in the settlements intersecting with the AoI.

4.3.8 Education

Educational conditions across different geographical levels (NUTS), segmented by gender and age groups, have been established using the 2024 National Education Statistics provided by TurkStat. TurkStat has also offered a set of indicators to define educational levels, categorizing the educational attainment level for individuals aged 6 and above according to the International Standard Classification of Education (2011)

Among the population in Türkiye, more females tend to have primary school education only, while males tend to have high school education [(122)]. The average duration of education by province, this rate is 9.3 years in Türkiye.

As of 2022, the literacy rate in İstanbul is higher than the national average. From 2012 to 2022, the illiteracy rate in İstanbul has shown a declining trend, regardless of gender, and both for women and men, it is below the national average in Türkiye [(123)].

All educational institutions intersecting with the AoI, along with other stakeholder educational institutions, have been presented in the report (see Appendix-7.1: Stakeholder List and Appendix-7.3:The Map of Educational Institutions)

According to the National Education Statistics, the average years of schooling of the population have increased over time. In 2023, the average years of schooling in Türkiye were 9.3 years overall, 8.6 years for women and 10.1 years for men. In 2023, the proportion of women in the population who had completed at least one level of education was 87.8%, compared to 96.8% for men. In the same year, the proportion of women with a higher education degree (including associate degree, bachelor's, master's, and doctoral degrees) was 22.7%, while the corresponding proportion for men was 26.2%[124].

In the same study, the labor force participation rate was 53.3% overall, 35.8% for women and 71.2% for men. The labor force participation rate of women with higher education degrees was 68.9%. When labor force participation rates are analyzed by educational attainment, it is observed that women's participation in the labor force increases as their level of education rises. While the labor force participation rate of illiterate women was 13.8%, this rate increased to 68.9% among women with higher education degrees[125].

In accordance with the *Education at a Glance 2025* report prepared by OECD[126] in all countries, women starting bachelor's programmes are more likely than their male peers to successfully complete their tertiary studies within the three years after the theoretical end of their programme. In Türkiye, the gender gap is 11 percentage points (91% for women compared to 80% for men), which is similar to the OECD average of 12 percentage points.

---

122 *TurkStat, National Education Statistics Database, 2022-2023, https://data.tuik.gov.tr/Bulten/Index?p=Ulusal-Egitim-Istatistikleri-2023-53444, Access date: March 2025.*

123 *TR10 Düzey-2 Bölgesi Bölge Planı 2024-2028. İstanbul Development Agency. https://www.istka.org.tr/media/pdf/h4fuFPWyKYFCZ0RkYV9CJVbbtcZwcSKjfWZ4nBUyJuKM7M4EiDTR.pdf. Access date: July 2025.*

124 *Turkish Statistical Institute (TurkStat). (2025, March 6). Statistics on women, 2024 (Press Release No. 54076).* https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Kadin-2024-54076. *Access date: Decenber 2025.*

125 *Turkish Statistical Institute & UN Women Turkey. (2025). Women in Türkiye: A statistical overview, 2024 (TurkStat report). https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Kadin-2024-54076. Access date: December 2025.*

126 *Education at a Glance: Türkiye. OECD Country Report. https://www.oecd.org/en/publications/education-at-a-glance-2025_1a3543e2-en/turkiye_9648f416-en.html. December 2025.*

4.3.8.1 Vulnerable Groups / Illiterates

Literacy levels may pose a barrier in stakeholder engagement processes. It is assumed that illiterate individuals may be at a disadvantage when it comes to reading and understanding the documents produced and published related to the project. Therefore, additional measures need to be implemented within the project's participation activities specifically for illiterate adults. This is especially important in land acquisition-related processes, where the participation of all rights holders and/or users is mandatory, making the inclusion and consideration of illiterate adults particularly critical.

Out of 802 household representatives who provided information about their households during the interviews, 41 mentioned the presence of illiterate adults in their households. The proportion of illiterate adults in settlements intersecting with the AoI is approximately 5%.

4.3.9 Cultural identity & language

Both in the mukhtar interviews and the household survey, emphasis was placed on cultural identities and the presence of mother tongues other than Turkish. Within the scope of the project, individuals whose mother tongue is other than Turkish are considered disadvantaged. Further details will be provided in the next section.

Under the topic of cultural differences, it was learned that in 8 out of 48 settlements, there are places of worship other than mosques. In addition to the more detailed list provided in Appendix-7.10 Social Services, Technical Infrastructure & Common Areas, it should be noted that among these places of worship are cemevis (Çatalca Kaleiçi, Pendik Güllübağ, Pendik Kavakpınar, Sultanbeyli Akşemsettin, Tuzla Aydınlı, Tuzla Aydıntepe and Gebze Cumhuriyet) and church (Arnavutköy Yassıören).

Although their existence and values can be directly identified through the work of cultural heritage experts, the structures reported by local administrators and their distribution by settlements are presented in Table 4-50.

Table 4-50 Religious and culturally significant sites, Mukhtar Survey, July 2025

Settlement	Religious and culturally significant sites
Arnavutköy Dursunköy	Tosun Baba Shrine, Behind the Houses the Tomb of Telli Baba's Nephews, Stone Bridge, Fountain
Arnavutköy Yassıören	There is a tomb inside the mosque, there is a tomb within the village
Beykoz Anadolu Feneri	Martyr Baba Tomb, Lighthouse dating back to the 1500s, Hamidii First Mosque built by Sultan Mahmud II in the 1870s, Mahmud II Fountain
Beykoz Bozhane	Horasanlı İsmail Dede Tomb
Beykoz Poyrazköy	Poyrazköy Castle, Watchtower, Poyrazköy Central Village Mosque
Çatalca Kaleiçi	There are many historical buildings
Çatalca Nakkaş	Historical mosque, Nakkaş Baba Shrine, Historical graves
Çekmeköy Hüseyinli	Seymenler Cemetery
Çekmeköy Reşadiye	Tomb of Hünkar Yaveri Mustafa Efendi
Eyüpsultan Çiftalan	There is Hasan Dede Tomb
Eyüpsultan Işıklar	Hocapınarı Fountain, Historical cemeteries (graves dating back to the village's founding)
Eyüpsultan İhsaniye	Healing water known as "kidney water" was closed by the security forces here
Pendik Emirli	Shrine, Erendede Tomb
Pendik Harmandere	Cemetery
Pendik Kavakpınar	Cemetery
Pendik Kurtdoğmuş	Kızlar Shrine, Dede Tree, Heating Fountain
Sancaktepe Paşaköy	Ayazma (baptismal cistern) left by Greeks
Sarıyer Demirciköy	Historical graves
Sarıyer Garipçe	Garipçe Castle, Watchtower, Possible historical ruins nearby
Sarıyer Gümüşdere	Our village itself is historical. Our village is an old Greek (Rum) village; there is a church, and it is a village from the population exchange
Sarıyer Kısırkaya	Dede's Grave
Tuzla Aydınlı	Old mosque, old fountain, Necip Fazıl's school

4.3.9.1 Vulnerable Groups / Non-Turkish speakers

Both in mukhtar interviews and household surveys, the presence of mother tongues other than Turkish was investigated. At the household level, it was stated that in 71 out of 802 households, members spoke mother tongues other than Turkish. The total household population with different mother tongues is 324, which corresponds to approximately 11% of the total population in the AoI. Among the mentioned foreign languages are local languages such as Kurdish, Zazaki, Arabic, Persian, Bosnian, Pomak, and Turkmen, as well as languages like English, German, French, Spanish, Portuguese, and Russian. The study, conducted in 10 districts of Istanbul and 2 different districts of Kocaeli, has considerable linguistic and cultural diversity. It has been observed that participants occasionally confuse the concepts of “mother tongue” and “language proficiency.” Nevertheless, during the course of the project activities, special measures will be necessary when there is a need for foreign language support, especially for local languages.

The following table, compiled from data directly provided by representatives of 48 settlements who participated in the mukhtar interviews, highlights the cultural and linguistic diversity in the region. International migration, which is explained in more detail in the population movements section, also plays a significant role. Settlements where no non-Turkish ethnic group or language is mentioned are listed toward the end of this list (see Table 4-49).

Table 4-51 Ethnic identities& Non-Turkish speakers, MukhtarSurvey, July 2025 (N: 48)

Settlement	Ethnic identities	Languages other than Turkish
Pendik Emirli	Afghan	Pashto
Pendik Kurna	Afghan	Pashto
Eyüpsultan Işıklar	Afghan due to commercial enterprises	Pashto
Çekmeköy Hüseyinli	Afghans	Pashto (Afghan language)
Arnavutköy İmrahor	Afghans and Syrians	Arabic
Çatalca Nakkaş	Afghans, Syrians	Pashto, Arabic
Çekmeköy Ömerli	Afghans, Syrians	Arabic
Sarıyer Gümüşdere	Balkan migrants, Afghan, Turkmens, Uzbeks (working in livestock, agriculture, and domestic services)	Macedonian
Sarıyer Demirciköy	Highly ethnically diverse structure	None
Pendik Kavakpınar	Kurds, Syrians, Tajiks, Gypsies	Kurdish, Arabic
Çekmeköy Reşadiye	Laz, French, English	Laz, French, English
Pendik Yenişehir	Migrants (Bulgarian migrants), Arabs	Arabic
Pendik Güllübağ	Migrants are Syrians	Arabic migrants
Arnavutköy Boyalık	Migrants: a small number of Syrians	Syrians speak Arabic
Çatalca Kaleiçi	Only Turks but migrated from different provinces	None
Eyüpsultan Odayeri	Predominantly Kurds and migrants	None
Çekmeköy Nişantepe	Romans	None
Arnavutköy Dursunköy	Romans, Kurds, Laz	Kurdish
Tuzla İstasyon	Russian (10 people) present	None
Beykoz Poyrazköy	Russian (2 people), Moldovan	Russian
Çayırova Şekerpınar	Syrian	None
Çayırova Yeni Mahalle	Syrian present	None
Arnavutköy Tayakadın	Syrians, Afghans	Arabic, Pashto
Pendik Sanayi	Syrians, Afghans, Indian, Pakistani	Kurdish, Arabic
Sultanbeyli Mecidiye	Syrians, Afghans, Tajiks, Iranians, Iraqis, Kurds	Arabic, Pashto, Farsi, Kurdish
Sultanbeyli Akşemsettin	Syrians, Afghans, Uzbeks, Russians	Arabic, Pashto (Afghan language), Russian
Tuzla Aydıntepe	Syrians, Palestinians, Iraqis, Afghans, Moldovans, Azerbaijanis	Arabic, Pashto, Russian
Gebze Cumhuriyet	Syrians, Uzbeks, Russians, Koreans (2 families)	Kurdish, Arabic
Beykoz Cumhuriyet	There are Afghans and Syrians (they are not settled, come for seasonal work)	None
Sarıyer Garipçe	Turkmen	Turkish (Turkmen)
Pendik Kurtdoğmuş	Uzbek, Afghan, Iranian	Farsi, Pashto

Settlement	Ethnic identities	Languages other than Turkish
Pendik Harmandere	None	Kurdish
Arnavutköy Yassıören	*None*	*None*
Beykoz Ali Bahadır	*None*	*None*
Beykoz Anadolu Feneri	*None*	*None*
Beykoz Bozhane	*None*	*None*
Beykoz Öğümce	*None*	*None*
Beykoz Paşamandıra	*None*	*None*
Çatalca Ferhatpaşa	*None*	*None*
Çatalca İzzettin	*None*	*None*
Eyüpsultan Ağaçlı	*None*	*None*
Eyüpsultan Çiftalan	*None*	*None*
Eyüpsultan İhsaniye	*None*	*None*
Pendik Kurtköy	*None*	*None*
Pendik Şeyhli	*None*	*None*
Sancaktepe Paşaköy	*None*	*None*
Sarıyer Kısırkaya	*None*	*None*
Tuzla Aydınlı	*None*	*None*

4.3.10 Membership in NGOs&CSOs

NGOs are primarily professional organizations, such as associations, foundations, or international entities, operating at national or international levels and possessing formal legal status. CSOs, on the other hand, refer to a broader category that includes NGOs. Local associations, cooperatives, professional chambers, and other community initiatives can be categorized under CSOs. Unlike NGOs, CSOs are not required to be professional; in fact, some volunteer-based groups can also be considered CSOs. In Türkiye, the most common CSOs are hometown associations and neighborhood development or community development associations.

Both at the household and settlement levels, individuals' membership in and participation with NGOs&CSOs have been surveyed. Out of 48 neighborhood heads, 25 reported the presence of NGOs in their settlements. The information obtained is also presented in Appendix-7.1: Stakeholder List and Appendix-7.6: The Map of Stakeholders-2: NGOs and Local Media. These NGOs&CSOs generally operate as hometown aid associations and mosque committees.

During the desk review, it was found that most of the CSOs identified in official databases [127] have ceased their activities, changed, or been deregistered. As a result, many of the planned meetings with CSOs in the area could not be conducted due to the CSOs no longer existing, having closed down, or relocated. Therefore, contacting NGOs&CSOs and involving them in stakeholder engagement activities during the project implementation phase may prove to be a challenging process.

Out of 802 household representatives, only 13 (1.6%) mentioned having NGO&CSO members in their households. These NGOs&CSOs are also presented separately in Appendix 7.1 and 7.6. The activities of these NGOs&CSOs include mosque associations, hometown associations, sports, health, and public benefit organizations such as the Turkish Red Crescent (Kızılay) and the Green Crescent (Yeşilay).

4.3.11 Increasing public benefit / interest

The responses to the question "What can be done to increase the public benefit of the project?" conveyed during the interviews with the mukhtars have been evaluated in this section.

The mukhtars have most frequently expressed their views regarding the public benefit as increasing the number of stops and stations. The next most common opinions, also related to the

127 *Republic of Türkiye Ministry of Interior Directorate General of Civil Society Relations. Civil Society Information System (DERBİS). https://www.siviltoplum.gov.tr/dernekler-bilgi-sistemi-derbis. Access date: August 2025.*

number of stops and stations, concern what is desired to be constructed along the route.

At this point, it is expected that the project will be designed more like a passenger transportation project rather than just a freight transportation investment, and accordingly, the locations and number of stops and stations will be increased.

Another related issue concerning these matters is the solutions regarding roads and access routes. This has been considered essential for agricultural and livestock activities. To reduce the environmental impacts around the project, the installation of noise barriers and underpasses/overpasses has been proposed, while to mitigate social impacts, increasing employment and the use of public lands have been suggested.

According to the village heads, the group expected to benefit the most from the Project consists of the working population. During the household interviews, it was also expressed that the segment engaged in industry, transportation, and commercial activities is expected to benefit significantly from the project. It is also believed that industrialists and logistics company owners will benefit in this regard. The anticipated benefit for the local people has been associated with employment opportunities. It has been emphasized that in order for the local community to truly benefit from the project, stops and stations must be appropriately and adequately located.

During the household interviews, when discussing the problems in the settlements, the lack of infrastructure (roads and sewage), deficiencies in municipal services (garbage collection), shortages in social activity areas (for women and youth), problems caused by nearby industrial investments (odor and noise), and security concerns (substance abuse, robbery, theft, etc.) were frequently mentioned.

However, the most frequently repeated issue is related to zoning and housing permits. This was strongly emphasized during the mukhtar interviews. Restrictions related to zoning and housing make it difficult to construct buildings and facilities in settlements according to needs. As a result, spaces required by women and youth have not been developed. This highlights an existing issue in the baseline conditions. There are concerns that these problems may be exacerbated by the project. To address this concern, the construction of spaces lacking for women and youth has been considered an activity in the public interest.

Zoning and housing issues may become significant enough to amplify the project's impact, especially in residential areas likely to be heavily affected during the land acquisition process. In this context, involuntary physical resettlement effects should be avoided.

4.3.12 Stakeholder engagement

In the household-level survey, participants were asked the question, “What is the topic you are most curious about regarding the project?” Although responses varied, the main topics of interest were concentrated in the following areas:

1. The number and locations of stops
2. Exact and definitive route information (start and end points)
3. Project start and end dates
4. Noise impacts (during construction and operation)
5. Effects on current technical infrastructure
6. Impact on residences (displacement/relocation)
7. Necessity (feasibility)
8. Whether the project will actually be carried out
9. Impact on port and road transportation
10. The real contribution of the project

At the household level, participants were also asked, “Which communication channels do you prefer to be used for project information dissemination?” The preferred methods of information dissemination are presented in Table 4-52.

Table 4-52 Opinions about future informative activities, Household Survey, July 2025 (N: 802)

Preferred informative action	Number	%
Notification through the mukhtarship / district governorate / governorate	252	31.42
Social media announcements	155	19.33
Information meetings held in the settlement	148	18.45
Face-to-face meetings	58	7.23
SMS	44	5.49
TV, newspaper, and similar communication channels	44	5.49
Large-scale meetings and presentations	38	4.74
Phone calls	20	2.49
No information requested	12	1.50
E-mail	8	1.00
Billboards / posters / banners	8	1.00
No preference	6	0.75
All of the above	4	0.50
None of the above	2	0.25
Researchers	1	0.12
E-Government portal	1	0.12
No information	1	0.12
Total	**802**	**100.00**

4.3.13 Land use and land acquisition

During the household interviews, representatives were asked various questions under different topics to gain a general understanding of the nature of the lands intersecting with the AoI, their ownership status, usage patterns, and how these areas might be affected by the project.

In parallel, similar questions were used during the mukhtar interviews with the aim of establishing a framework for future studies to be carried out in relation to land acquisition processes.

However, it should be noted that the individuals participating in these interviews were randomly selected from the local population. In the studies to be carried out after the project is finalized, a full census method will be implemented for each RP separately, covering PAPs whose land is directly affected.

The issues related to land acquisition were also examined during 11 focus group meetings held in settlements assumed to have been heavily affected by previous projects. The results of these discussions are largely presented under Section 4.3.12.4.

4.3.13.1 Land use and ownership status by land type

To assess the potential impacts that may arise from the project's land acquisition requirements, certain categories of land types were addressed. These are: (1) Residential areas, (2) Agricultural land, (3) Livestock areas, (4) Grazing areas, and (5) Commercial activity areas.

The results obtained from the household interviews are indicated by Table 4-54 and Figure 4-42. According to these figures, the highest proportion of land use within the areas intersecting with the project corridor is in residential and commercial areas. The intersection with agricultural and livestock-related areas is uncertain.

Table 4-53 Land use within AoI-Intersecting Settlements, Household Survey, July 2025, (N:802)

	Residential	%	Agriculture	%	Livestock	%	Grazing	%	Commercial	%
Yes	72	8.98	12	1.50	1	0.12	1	0.12	11	1.37
No	730	91.02	790	98.50	801	99.88	801	99.88	791	98.63

The same questions were also posed during the mukhtar interviews. The results of the mukhtar interviews are presented with Table 4-54 and Figure 4-43. In 48 settlements, the highest land uses are, respectively, commercial areas, residential areas, livestock areas, agricultural lands, and grazing areas.

Table 4-54 Land use within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:48)

	Residential	%	Agriculture	%	Livestock	%	Grazing	%	Commercial	%
Yes	24	50.00	19	39.58	21	43.75	18	37.50	26	54.17
No	24	50.00	29	60.42	27	56.25	30	62.50	22	45.83

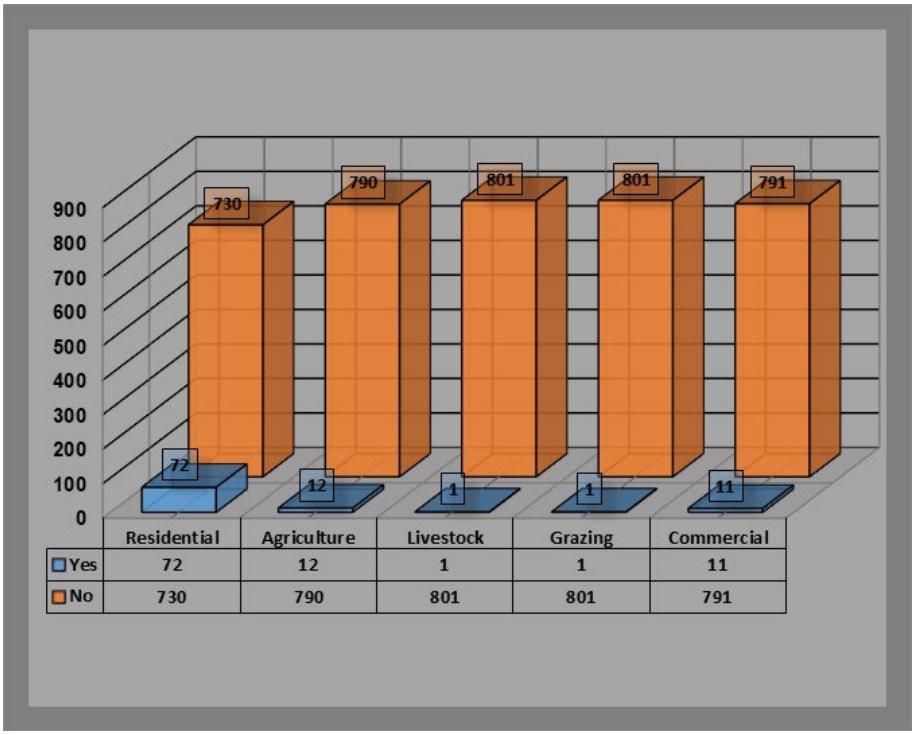


Figure 4-42 Land use within AoI-Intersecting Settlements, Household Survey, July 2025, (N:802)

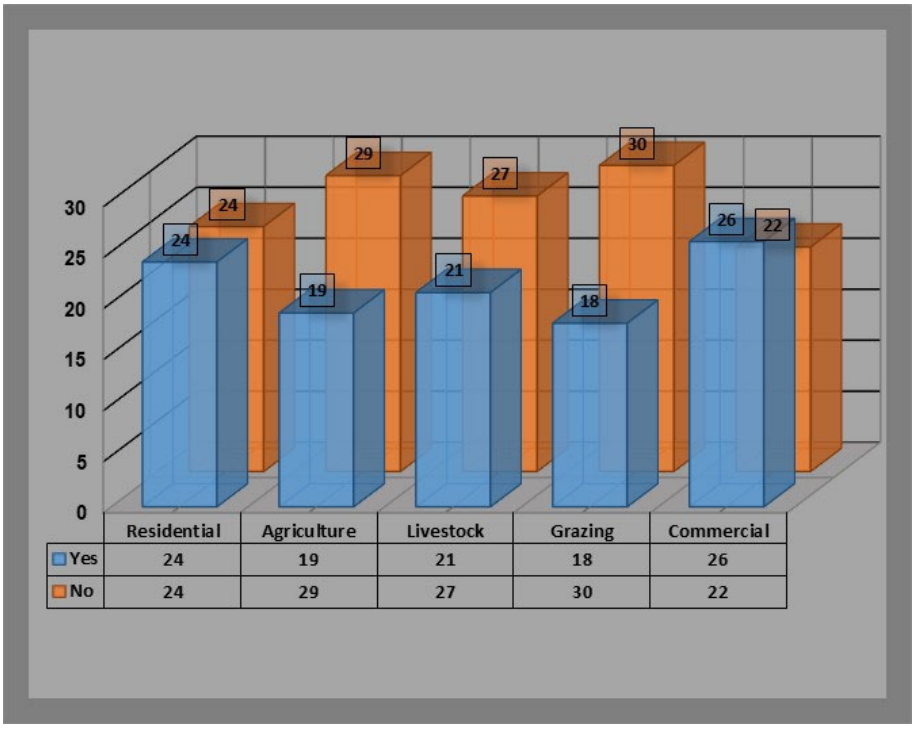


Figure 4-43 Land use within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:48)

4.3.13.1.1 Residential areas

The total population of the 72 households who stated that they have residences in the areas intersecting with the AoI is 275 people. As can be seen, the districts where residential areas are located are Beykoz, Pendik, Sancaktepe, Sarıyer, Sultanbeyli, and Tuzla.

The number of households reporting an intersection with residential areas constitutes 8.98% of the total number of households in the AoI and 9.48% of the total population.

The three settlements with the highest level of intersection with residential areas are Pendik Kavakpınar, Tuzla Aydınlı, and Pendik Harmandere (see Table 4-55).

Table 4-55 Residential areas within AoI-Intersecting Settlements, Household Survey, July 2025, (N:72/275)

Settlement	Number of household	%	% in total Household (802)	Population	%	% in total population of AoI (2,901)
Pendik Kavakpınar	23	31.94	2.87	95	34.55	3.27
Tuzla Aydınlı	18	25.00	2.24	55	20.00	1.90
Pendik Harmandere	10	13.89	1.25	45	16.36	1.55
Sultanbeyli Mecidiye	3	4.17	0.37	14	5.09	0.48
Sarıyer Uskumruköy	2	2.78	0.25	12	4.36	0.41
Pendik Güllübağ	2	2.78	0.25	9	3.27	0.31
Pendik Kurtköy	2	2.78	0.25	9	3.27	0.31
Pendik Emirli	2	2.78	0.25	8	2.91	0.28
Beykoz Poyrazköy	2	2.78	0.25	5	1.82	0.17
Sultanbeyli Akşemsettin	1	1.39	0.12	5	1.82	0.17
Beykoz Ali Bahadır	1	1.39	0.12	4	1.45	0.14
Pendik Yenişehir	1	1.39	0.12	4	1.45	0.14
Sancaktepe Paşaköy	2	2.78	0.25	4	1.45	0.14
Beykoz Öğümce	1	1.39	0.12	2	0.73	0.07
Tuzla Aydıntepe	1	1.39	0.12	2	0.73	0.07
Tuzla İstasyon	1	1.39	0.12	2	0.73	0.07
Total	**72**	**100.00**	**8.98**	**275**	**100.00**	**9.48**

Household representatives who were interviewed and stated that they own residential areas were asked the question: "In your opinion, how will the project activities affect these structures?" According to the responses received, the general overview of opinions is as follows (see Figure 4-44).

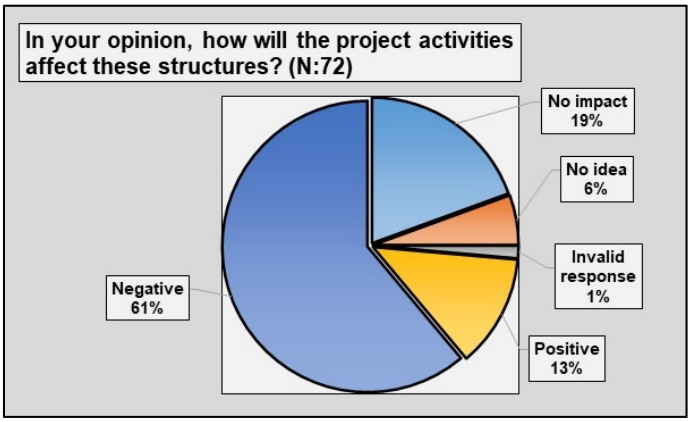


Figure 4-44 Opinions regarding residential areas, Household Survey, July 2025 (N:72)

During the consultations conducted under household survey and mukhtar survey, it was observed that neither the mukhtars nor the household representatives could provide consistent responses regarding land use and ownership. This situation is related to the uncertainty of the project route. The gaps in this process will be addressed through the census that need to be completed before construction begins. For this reason, the RP preparation process will be important due to the

scope of the research. These RP preparatory studies will be critical for the identification of eligible persons and their entitlements.

The details of these general responses shaping Figure 4-44 have been compiled especially around the positive and negative opinions.

The tendency leading to positive responses in the collected opinions is related to the potential increase in the value of the residences.

In the negative opinions, concerns such as the loss of residences stand out, while worries about noise, dust, and pollution have also significantly influenced the negative views.

Positive opinions:

- I can establish a new residence, but this is a major project that will ease traffic.
- Everyone will be positively affected.
- The value of our properties will increase.
- There may be an increase in property values there. Services will come.
- Transportation will become easier.
- It passes via a side road.
- The project will not be a problem.
- There is no problem

Negative opinions:

- I would have to change my living area in the region.
- Many people live here, and it is a quiet place; we will be negatively affected.
- It has been difficult to establish life here.
- This place is very noisy, and it will be affected as well.
- Its demographic and urban structure will change. The transition process will negatively affect the neighborhood.
- Depending on the situation, our house may be affected; the neighborhood's structure is changing due to urban transformation. If there is more demolition, we will face problems like noise, sound, and dust.
- The house is being demolished.
- I don't want the house to be damaged.
- My house may be affected; the neighborhood is already chaotic and unorganized, this will completely ruin it.
- My house may be lost; we have just settled here, it is newly built.
- Demolition of my house is possible.
- Our house will be affected; we have nowhere else to go, and there is no zoning permission in the village.
- Our house may be lost; we are tenants and finding another place won't be possible.
- A road may pass over our house.
- There will be very negative impacts during the construction phase; maybe we will lose our house.
- There will be traffic, noise, and dust problems during construction.
- Roads will be blocked during construction; maybe it will pass through our house, and we will become homeless.
- We do not want to endure construction noise.
- We are tenants and it will cause damage.
- My property may be affected; during construction we will face many problems. The streets in the neighborhood are narrow, and there will be traffic and parking issues.
- There are negative impacts; I am a tradesperson here and our business is already slow.

- It will pass near the houses where we live; because of the works, traffic will increase throughout that period, and we will experience noise and dust effects.
- I think it will be affected by noise and sound.
- Passing through the city center is negative.
- There is a possibility of demolition, and it will end the tranquility here, which is negative.
- There is already a lot of noise; it negatively affects us at night.

All findings related to residential areas obtained from the mukhtar interviews are presented with Table 4-56. The order in the table has been arranged based on the highest number of residences.

Table 4-56 Residential areas within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:24)

Settlement	Number residence	Households relying on these residences	Expected impact	Reason	Ownership status	Usage status
Pendik Kavakpınar	2,000	10,000	Negative	There will be no other place for people to go.	Private lands	Individual use
Pendik Yenişehir	150	10,000	Negative	There will be no new housing sites or other places for people to move to.	Private lands	Individual use
Tuzla Aydıntepe	3,000	5,000	Negative	Many settlements will be expropriated, dividing the neighborhood in two.	Private lands	Individual use
Sultanbeyli Mecidiye	500	2,000	Negative	They will be disturbed by construction works.	Private lands	Individual use
Pendik Harmandere	300	2,000	Negative	If the project proceeds as planned, the entire neighborhood will be negatively affected.	Private lands	Individual use
Pendik Şeyhli	650	650	Negative	There may be dust and noise; it is also close to Sabiha Gökçen.	Private lands	Individual use
Pendik Sanayi	450	500	Negative	They will be affected throughout the entire construction process.	Private lands	Individual use
Sultanbeyli Akşemsettin	60	250	Negative	They will be disturbed by noise and sound during construction and operation phases.	Private lands	Individual use (Tenants)
Beykoz Paşamandıra	100	200	Negative	They will be affected by noise during construction.	Private lands	Individual use
Çatalca Nakkaş	70	150	No impact	Houses are not being expropriated.	Private lands	Individual use
Çekmeköy Hüseyinli	100	80	Negative	They will be disturbed by construction works, noise, and environmental pollution.	Private lands	Individual use
Pendik Kurtköy	5	60	Negative	They may feel discomfort from construction works.	Private lands	Individual use
Beykoz Öğümce	50	50	Negative	From the activities during the construction process.	Private lands	Individual use
Çatalca Ferhatpaşa	40	50	Negative	It negatively affects the areas to be expropriated.	Private lands	Individual use
Sancaktepe Paşaköy	45	45	Negative	If expropriation occurs, people will be forced to migrate; there will be negative effects such as noise during construction, and harm to the environment and neighborhood during operation.	Private lands	Individual use
Arnavutköy Yassıören	40	40	No impact	No effect.	Private lands	Individual use
Beykoz Anadolu Feneri	30	30	Negative	There will be dust and noise impacts.	Private lands	Individual use

Settlement	Number residence	Households relying on these residences	Expected impact	Reason	Ownership status	Usage status
Çatalca İzzettin	25	30	No impact	Houses are not being expropriated; no effect.	Private lands	Individual use
Beykoz Cumhuriyet	20	30	Negative	Demolition may occur.	Private lands	Individual use
Pendik Emirli	20	30	Negative	People have no other place to go.	Private lands	Individual use
Beykoz Ali Bahadır	10	20	Negative	Noise will completely affect the residences.	Private lands	Individual use
Arnavutköy Dursunköy	15	15	Negative	Because access will be blocked.	Private lands	Individual use
Arnavutköy Tayakadın	10	10	Negative	A tunnel should be provided for crossing from one side to the other.	Private lands	Individual use
Beykoz Poyrazköy	5	5	Positive	They may be affected during construction works.	Private lands	Individual use
Total	**7,695**	**31,245**	**83.33% Negative; 12.50% No impact; 4.7% Positive**		**100% Private lands**	**100% Individual use**

4.3.13.1.2 Agricultural areas

During household interviews, when asked about the characteristics of the land in areas intersecting with the AoI, a total of 12 household representatives stated that there are agricultural activity areas along the project route. The total population in the 12 households where agricultural activity areas intersect with the project route is 45 people. The ownership and use status of the relevant lands were also inquired, and all household representatives stated that the areas belong to them and are used by them. In response to the question on how the project activities would affect agricultural land, 9 out of 12 households stated that they expected negative impacts. Two households anticipated positive impacts, while one household foresaw no impact. Statements underlying the positive and negative views are presented as direct quotations, indicated by Table 4-57. The order used in Table 4-57 is arranged in descending order based on the affected population.

Negative evaluations of the project in relation to agricultural lands intersecting with the route have also been influenced by experiences from previous projects carried out in the area. More detailed assessments on this matter are provided under Table 4-57 and Table 4-58, area also offers an insight into land acquisition processes. The referenced sections largely contain findings from previous project experiences, drawn from focus group discussions held separately in 11 settlements and from in-depth interviews conducted with other stakeholders.

In addition to the impacts of previous projects, concerns about losing a source of livelihood, as well as worries over potential environmental effects of the project—such as dust and pollution—have contributed to the negative views. Although a positive opinion was expressed, adverse impacts from a viaduct construction were also mentioned.

As an additional note, among the neighborhoods where households reported that the areas in which they engage in agricultural activities intersect with the project route, only two have had neighborhood status historically (Arnavutköy Dursunköy and Çatalca Nakkaş). Sancaktepe Paşaköy, which had high participation, as well as Beykoz Poyrazköy, Arnavutköy Yassıören, Pendik Emirli, and Sarıyer Gümüşdere, were rural settlements (villages) prior to 2012.

In section 4.3.5, where livelihoods in all settlements are examined in detail, 11 households were recorded as identifying agriculture as their main income source. While not all of these households have agricultural activity areas intersecting with the project route. Similarly, not all households reporting an intersection between their agricultural lands and the project route rely primarily on agriculture as their main source of livelihood. However, approximately 60% of the households

whose agricultural lands intersect with the project route identify agriculture as their main source of income, while 9% engage in daily agricultural labor specifically (see Table 4-57).

All findings related to agricultural areas obtained from the mukhtar interviews are also presented with Table 4-58. The order in the table has been arranged based on the highest number of households who use the intersecting agricultural areas.

Table 4-57 Agricultural areas within AoI-Intersecting Settlements, Household Survey, July 2025, (N:12)

Settlement	Number of Household	Main income source	Ownership	Usage	Expected impact	Reason
Sarıyer Gümüşdere	10	Agriculture	Own property	Self-occupied	Negative	Construction pollution has negative impacts
Çatalca Nakkaş	5	Agriculture	Own property	Self-occupied	Negative	In the motorway project, part of my field was taken; I don't want it to be taken again.
Pendik Emirli	4	Agriculture	Own property	Self-occupied	Negative	It's my only source of livelihood; it will be affected. I can't make a living from anything else.
Beykoz Paşamandıra	4	Engagement in commercial activities such as shops, kiosks, workshops, and other enterprises	Own property	Self-occupied	Positive	A viaduct passed through; it didn't have a negative impact, only the noise has negative effects.
Beykoz Poyrazköy	4	Pension income from domestic or overseas sources	Own property	Self-occupied	No impact	Will not be affected.
Arnavutköy Dursunköy	4	Agriculture	Own property	Self-occupied	Negative	It will pass through my land and affect farming.
Beykoz Poyrazköy	3	Pension income from domestic or overseas sources	Own property	Self-occupied	Positive	Its value will increase.
Arnavutköy Yassıören	3	Agriculture	Own property	Self-occupied	Negative	There were problems with the land expropriated in 2018.
Sancaktepe Paşaköy	2	Agriculture	Own property	Self-occupied	Negative	Farming is being carried out.
Sancaktepe Paşaköy	2	Daily wage earnings from agriculture and other jobs	Own property	Self-occupied	Negative	Even if my field isn't taken, the construction noise and dirt will still have an impact.
Sancaktepe Paşaköy	2	Pension income from domestic or overseas sources	Own property	Self-occupied	Negative	Pollution.
Çatalca Nakkaş	2	Agriculture	Own property	Self-occupied	Negative	Agricultural land will be affected.
Total	**45**	**58.33% Agriculture 25.00% Pension 8.33% Daily-wage (agriculture) 8.33% Trade**	**100% own property**	**100% self occupied**	**75.00% Negative 16.67% Positive 8.33% No impact**	

Table 4-58 Agricultural areas within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:19)

Settlement	Households relying on these lands	Expected impact	Reason	Ownership status	Usage status
Arnavutköy Dursunköy	200	Negative	Their lands will be expropriated, and they will lose their livelihoods.	Private lands	Individual use
Arnavutköy Yassıören	200	Negative	They will be negatively impacted due to expropriation.	Private lands	Individual use
Arnavutköy Tayakadın	100	Negative	Their agricultural production may be negatively affected during construction works; the activities may damage crops.	Private lands	Individual use
Çatalca Ferhatpaşa	100	Negative	They may be negatively affected because their lands will be expropriated.	Private lands	Individual use

Settlement	Households relying on these lands	Expected impact	Reason	Ownership status	Usage status
Çatalca Nakkaş	100	Negative	Their livelihoods will be negatively affected, and they will lose land due to expropriation.	Private lands	Individual use
Çatalca İzzettin	50	Negative	They may be negatively affected because their lands will be expropriated.	Private lands	Individual use
Beykoz Paşamandıra	40	No impact	No impact	Private lands	Individual use
Pendik Emirli	40	Negative	I make a living by farming. Our most important source of income will be affected.	Private lands	Individual use
Sancaktepe Paşaköy	30	Negative	Livelihoods will be negatively affected; there are no opportunities to farm or raise livestock elsewhere.	Private lands	Individual use
Beykoz Ali Bahadır	20	Negative	There will be dust and noise impacts.	Private lands	Individual use
Pendik Kurtdoğmuş	20	Negative	Livelihoods will be affected.	Private lands	Individual use
Beykoz Anadolu Feneri	12	Negative	Machine operation, dust effects, and access problems to agricultural lands may occur.	Private lands	Individual use
Çekmeköy Hüseyinli	10	No impact	No impact	Private lands	Individual use
Eyüpsultan Işıklar	10	Negative	If this area is designated as a protection zone, construction will not be allowed, thus they will be negatively affected.	Private lands	Individual use
Arnavutköy Boyalık	9	Negative	Agriculture is actively practiced.	Private lands	Individual use
Sarıyer Demirciköy	9	Negative	There was a security issue during the KMO works.	Private lands	Individual use
Beykoz Poyrazköy	5	Negative	They graze their animals freely; animals may be harmed during construction.	Private lands	Individual use
Beykoz Öğümce	1	Negative	They will be affected by the works.	Private lands	Individual use
Arnavutköy İmrahor	No exact information	No impact	No impact	Private lands	Individual use
Total	**≈956**	**84.21% Negative; 15.79% No impact**		**100% Private lands**	**100% Individual use**

During interviews with the mukhtars, information was sought about the most commonly produced agricultural products in their areas. In addition, agriculture-centered ecosystem services in the settlements have also been taken into consideration. Findings recorded based on the mukhtar responses are presented with Table 4-59.

A total of 20 different products are mentioned. In terms of product diversity, both dry farming crops and vegetable production are prominent. Findings related to fruit production are limited. Most settlements stated that they have no connection to agriculture due to being industrial areas.

The top five most frequently mentioned products are wheat, vegetables, barley, corn, and sunflower.

The prominent ecosystem service activities include the collection of forest products such as mushrooms, chestnuts, bay leaves, linden, and thyme. These are mostly used for household consumption, with limited commercial use. Activities in forest areas have decreased due to restrictions on the use of forest lands.

Table 4-59 Most common agricultural products & Ecosystem services, Mukhtar Survey, July 2025, (N:48)

Settlement	Main agricultural products, if any	Ecosystem services, if any
Arnavutköy Boyalık	Wheat, sunflower, barley, oat, canola, corn	We don't make a living from it, but we collect them
Arnavutköy Dursunköy	Wheat, sunflower, corn, barley, oat	None
Arnavutköy İmrahor	Wheat	Don't know

Settlement	Main agricultural products, if any	Ecosystem services, if any
Arnavutköy Tayakadın	Wheat, barley, corn	Mushrooms are generally collected for household livelihood
Arnavutköy Yassıören	Wheat, corn, barley, sunflower, canola	None
Beykoz Ali Bahadır	Vegetables	10 households collect mushrooms; no commercial use
Beykoz Anadolu Feneri	Hazelnut, beans, pepper, tomato, cabbage	Bay leaves are collected and sold; about 2 households do this
Beykoz Bozhane	Wheat, corn, barley, vegetable (greenhouse)	30 households collect mushrooms, chestnuts, and plants for their own consumption
Beykoz Cumhuriyet	Corn, wheat, vegetable growing (greenhouse)	Mushrooms are collected for households; part of the village has about 50 households
Beykoz Öğümce	Vegetables	100 households collect mushrooms, firewood, thyme, and other plants for use; not commercial
Beykoz Paşamandıra	Tomato, pepper, eggplant	8 households collect and sell mushrooms, linden, and rosehip plants
Beykoz Poyrazköy	Vegetables, kale	Chestnuts for household use
Çatalca Ferhatpaşa	Sunflower, wheat	None
Çatalca İzzettin	Wheat, barley, oat, sunflower, corn	None
Çatalca Kaleiçi	Sunflower, wheat, beans, melon	We collect firewood and linden
Çatalca Nakkaş	Wheat, barley, corn, sunflower	None
Çekmeköy Hüseyinli	Vegetables, corn, wheat, oat	Mushrooms, thyme, and linden are collected and consumed by households; about 15-20 households collect
Çekmeköy Nişantepe	None	Mushrooms are collected very rarely, for eating; 1-2 families
Çekmeköy Ömerli	Lettuce, eggplant, tomato, pepper, watermelon	There are mushroom collectors; some sell them, 1 household collects
Çekmeköy Reşadiye	None	Mushrooms, chestnuts, rosehip, cornelian cherry are collected for household consumption
Eyüpsultan Ağaçlı	Vegetables, fruit, beans	Mushrooms, linden, rosehip, and thyme are collected; most of the village collects for households, but very few (1-2) sell commercially
Eyüpsultan Çiftalan	No agriculture	We collect linden and chestnuts; mushrooms are collected; some sell; outsiders come, village people do not collect
Eyüpsultan Işıklar	Vegetables	Mushrooms, bayberries, cornelian cherries, medlar are collected for household consumption
Eyüpsultan İhsaniye	No agriculture	We collect mushrooms, but the business does not allow wood collection; for personal use only
Eyüpsultan Odayeri	Vegetables	Forests are protected; not on our side
Pendik Emirli	Vegetables, barley, wheat	They sell vegetables; there are greenhouse growers. Mushrooms are collected and used. Yes, we utilize them. Some in the neighborhood collect mushrooms and sell them
Pendik Güllübağ	None	Don't know
Pendik Harmandere	No agriculture	None
Pendik Kavakpınar	None	None
Pendik Kurna	Wheat, barley, vegetables	None
Pendik Kurtdoğmuş	Oat, wheat, vegetables (cucumber, tomato)	The village only sells eggs
Pendik Kurtköy	None	None
Pendik Sanayi	None	None
Pendik Şeyhli	No agriculture, industrial zone	None
Pendik Yenişehir	None	None
Sancaktepe Paşaköy	Oat, corn, barley, wheat	Mushrooms, lavender, bay leaves, and similar plants are collected and used for household consumption
Sarıyer Demirciköy	Vegetables	Don't know
Sarıyer Garipçe	Vegetables (tomato, beans)	Mushrooms, chestnuts, rosehip, and blackberries are collected and consumed at home
Sarıyer Gümüşdere	Vegetables (tomato, cucumber), melon, watermelon	We don't go anymore
Sarıyer Kısırkaya	None	Most of the neighborhood collects mushrooms, chestnuts, and linden; not for sale but for household use
Sultanbeyli Akşemsettin	None	None
Sultanbeyli Mecidiye	None	None

Settlement	Main agricultural products, if any	Ecosystem services, if any
Tuzla Aydınlı	None	None
Tuzla Aydıntepe	None	None
Tuzla İstasyon	None	None
Çayırova Şekerpınar	None	None
Çayırova Yeni Mahalle	None	None
Gebze Cumhuriyet	None	None

4.3.13.1.3 Husbandry and grazing areas

In household interviews, only one household stated that their livestock areas and grazing lands intersect with the project route. Apart from this household, no intersections were reported in livestock or grazing areas. The household in question (two people) is located in Beykoz Anadolu Feneri, and its main source of livelihood is retirement. The household representative stated that the mentioned areas belong to and are used by them. When asked about the impact of the Project's activities, they responded, *"The train will have a negative impact on me. I will be adversely affected during the construction period,"* and *"We do not want it to pass through there."*

Of the 48 mukhtars who participated in the interviews, 21 stated that the livestock areas in their settlements, and 18 stated that the grazing areas, overlap with the project route (see Table 4-60 and

Table 4-61).

Some household representatives commenting on residential and agricultural areas mentioned a few positive impacts, albeit at a low rate. However, no positive opinions were recorded regarding the impacts on either livestock areas or grazing lands.

The majority of opinions that assessed the relationship between livestock-related areas and the project negatively focused on issues such as land loss, loss of livelihood, and expropriation. Although some stated that their land intersects with the railway line, there were also people who noted that the route remains far from their own land, and therefore they do not expect any impact.

Çatalca İzzettin stands out from other settlements both because it has the highest number of users and because its livestock areas are public common property. Although the exact number is unknown, it has been observed that residents of the settlement conduct livestock activities informally in these public common areas.

Similar concerns have been raised regarding grazing areas, in parallel with livestock activities. Unlike livestock areas, grazing lands also include public common property lands and treasury lands.

Past rural settlements that came up during the discussion of agricultural lands have become more prominent for this activity. Out of 18 settlements, 11 were previously classified as villages. These settlements are;

- Arnavutköy Boyalık
- Arnavutköy Dursunköy
- Beykoz Ali Bahadır
- Beykoz Anadolu Feneri
- Beykoz Öğümce
- Beykoz Paşamandıra
- Beykoz Poyrazköy
- Eyüpsultan Işıklar
- Pendik Emirli
- Pendik Kurtdoğmuş
- Pendik Yenişehir
- Sancaktepe Paşaköy

- Sarıyer Demircköy

Table 4-60 Husbandry areas within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:21)

Settlement	Households relying on these lands	Expected impact	Reason	Ownership status	Usage status
Çatalca İzzettin	200	Negative	Pasture areas will be affected; therefore, there will be problems.	Public common area	Informal user in the settlement
Çatalca Ferhatpaşa	40	Negative	Grazing lands may be expropriated.	Private land	Individual use
Çatalca Nakkaş	40	Negative	The railway route passes through areas where animal husbandry is practiced; all will be negatively affected.	Private land	Individual use
Sancaktepe Paşaköy	30	Negative	Livelihoods will be negatively affected; they have no opportunity to engage in agriculture and animal husbandry elsewhere.	Private land	Individual use
Arnavutköy Tayakadın	20	Negative	Fences should be built to prevent animals from being affected.	Private land	Individual use
Pendik Emirli	20	Negative	An important source of livelihood is being affected.	Private land	Individual use
Arnavutköy Dursunköy	15	Negative	They will lose their land, therefore they will be negatively affected.	Private land	Individual use
Eyüpsultan Çiftalan	14	No impact	Not very close.	Private land	Individual use
Beykoz Ali Bahadır	10	Negative	Noise and dust will cause problems for reproduction.	Private land	Individual use
Tuzla Aydıntepe	10	Negative	Their land will be expropriated.	Private land	Individual use
Sarıyer Demircköy	9	Negative	Noise and security issues; their animals were stolen.	Private land	Individual use
Beykoz Anadolu Feneri	7	Negative	There are 2 households engaged in beekeeping; they will be negatively affected.	Private land	Individual use
Pendik Kurtdoğmuş	7	Negative	Livelihoods will be affected.	Private land	Individual use
Arnavutköy Boyalık	5	Negative	It used to be pastureland but has already lost its status; now, if expropriation happens, it will be a problem.	Private land	Individual use
Arnavutköy Yassıören	5	Negative	They need to provide passage.	Private land	Individual use
Beykoz Öğümce	5	Negative	They may be adversely affected by the works—noise, dust, etc.	Private land	Individual use
Beykoz Paşamandıra	5	No impact	None.	Private land	Individual use
Beykoz Poyrazköy	5	Negative	Animals are grazed freely; they could be harmed during this process.	Private land	Individual use
Çekmeköy Hüseyinli	5	No impact	No impact	Private land	Individual use
Pendik Yenişehir	4	Negative	They will lose their grazing lands and pastures.	Private land	Individual use
Sultanbeyli Mecidiye	2	Negative	Livelihood will be negatively affected.	Private land	Individual use
Total	**≈458**	**85.71% Negative; 14.29% No impact**		**95.23% Private lands 4.77% Public common area**	**95.23% Individual use 4.77% informal user**

Table 4-61 Grazing areas within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:18)

Settlement	Households relying on these lands	Expected impact	Reason	Ownership status	Usage status
Çatalca İzzettin	200	Negative	Our entire village grazes their animals in that area.	Public common area	Informal user in the settlement
Çatalca Nakkaş	40	Negative	Lands will be expropriated; therefore, the railway must allow passage for both tractors and animals.	Private land	Individual use
Çatalca Ferhatpaşa	40	Negative	Grazing lands may be expropriated.	Private land	Individual use
Sancaktepe Paşaköy	30	Negative	Livelihoods will be negatively impacted; there are no opportunities for agriculture and animal husbandry elsewhere.	Private land	Individual use
Beykoz Ali Bahadır	30	Negative	Noise impact, dust impact.	Private land	Individual use
Pendik Kurtdoğmuş	20	Negative	Livelihoods will be affected.	Private land	Individual use
Arnavutköy Dursunköy	15	Negative	They will lose their lands.	Private land	Individual use
Pendik Emirli	10	Negative	Pastures and grazing areas will be impacted.	Private land	Individual use
Sarıyer Demirciköy	9	Negative	None.	Treasury area	Individual use
Beykoz Anadolu Feneri	7	Negative	Works may block access to grazing areas.	Private land	Individual use
Beykoz Öğümce	5	No impact	No impact.	Private land	Individual use
Beykoz Paşamandıra	5	No impact	None.	Private land	Individual use
Beykoz Poyrazköy	5	Negative	They graze animals freely; therefore, animals may be harmed.	Private land	Individual use
Arnavutköy Boyalık	5	No impact	None.	Private land	Individual use
Pendik Yenişehir	4	Negative	Grazing lands and pastures will be affected.	Private land	Individual use
Eyüpsultan Işıklar	3	Negative	With the arrival of the railway, they will no longer be able to practice animal husbandry.	Public common area	Individual use
Sultanbeyli Mecidiye	2	Negative	Alternative grazing areas will also be affected.	Private land	Individual use
Tuzla Aydıntepe	No information	No information	No information	Private land	Individual use
Total	**≈430**	**83.33% Negative; 16.66% No impact 5.55% No information**		**83.33% Private lands 11.11% Public common area 5.55% Treasury land**	**94.44% Individual use 5.56% Informal user**

As an output of livestock activities, the animal products produced by settlement are presented in Table 4-62.

Table 4-62 Animal Products, Mukhtar Survey, July 2025

Settlement	Animal products
Arnavutköy Boyalık	Meat and dairy
Arnavutköy Dursunköy	Milk and dairy products, meat
Arnavutköy İmrahor	Milk and meat
Arnavutköy Tayakadın	Milk and sacrificial meat
Arnavutköy Yassıören	Milk and dairy products, meat, beekeeping

Settlement	Animal products
Beykoz Ali Bahadır	Meat and dairy
Beykoz Anadolu Feneri	Meat and dairy, fish
Beykoz Bozhane	Dairy products and meat
Beykoz Cumhuriyet	Milk and for sacrificial animals
Beykoz Öğümce	Meat and dairy
Beykoz Paşamandıra	Meat and dairy
Beykoz Poyrazköy	Milk and meat, fishing (the largest fleets are here)
Çatalca Ferhatpaşa	Milk and meat livestock
Çatalca İzzettin	Milk and meat, beekeeping
Çatalca Kaleiçi	Cattle, sheep, buffalo meat and dairy products
Çatalca Nakkaş	Milk and dairy products, meat livestock, beekeeping (hobby)
Çekmeköy Hüseyinli	For milk, for sacrificial meat
Çekmeköy Ömerli	For sacrificial meat
Eyüpsultan Ağaçlı	Meat and dairy production, beekeeping present, very little fishing
Eyüpsultan Çiftalan	From milk and meat
Eyüpsultan Işıklar	Meat and dairy (buffalo and cow), beekeeping present
Eyüpsultan Odayeri	Buffalo breeding
Pendik Kurna	Sacrificial livestock
Pendik Kurtdoğmuş	Livestock for milk production and sacrificial purposes
Sancaktepe Paşaköy	Livestock for sacrificial feast (meat), milk and dairy products
Sarıyer Demirciköy	Milk and meat
Sarıyer Garipçe	Fishing present, fresh fish
Sarıyer Gümüşdere	Milk and meat
Sarıyer Kısırkaya	Milk and meat livestock, beekeeping
Sultanbeyli Mecidiye	Milk and sacrificial meat
Tuzla Aydıntepe	Meat livestock

4.3.13.1.4 Commercial areas

In settlements intersected by the project route, local representatives were asked whether they own a commercial area crossed by the project corridor. Out of 802 households, 11 responded “yes” to this question. The total number of people in these 11 households is 49. Among other land use types, the highest positive sentiment came from the owners of commercial areas. Similar to the source of positive views received for residential areas, the owners of these commercial areas also see the project as an opportunity for economic revitalization in the region (see Table 4-63).

On the other hand, since the project is primarily a freight transportation project rather than passenger transport, there are concerns that it may reduce the local settled population in the area. In this regard, a visibly increased public benefit could help enhance the project's acceptance.

Interviews conducted with 48 mukhtars revealed that 26 of them stated the commercial areas in their settlements intersect with the project route. It is estimated that these areas host approximately 1,662 businesses and 17,177 employees. The anticipated impacts on these commercial areas are largely associated with negative consequences such as restricted access routes. The risk of job losses among employees working in these businesses also emerged as a prominent concern. In particular, the fact that a business center located in Tuzla İstasyon Neighborhood directly intersects with the project route was found to be noteworthy and concerning by the participants. The limited positive opinions expressed were driven by the possibility of commercial revitalization.

The districts of Pendik and Tuzla may be vulnerable to the impacts of the project in terms of commercial activities. Access restrictions that may arise during the project’s construction works could further increase this vulnerability (see Table 4-64).

Table 4-63 Commercial areas within AoI-Intersecting Settlements, Household Survey, July 2025, (N:11)

Settlement	Number of Households	Expected impact	Reason	Ownership status	Usage status
Pendik Kavakpınar	9	Negative	It may affect the workplace	Own property	Self occupied
Tuzla Aydınlı	6	Positive	Transportation and trade of goods will become easier	Own property	Self occupied
Pendik Kavakpınar	6	No impact	Thinks it will not have an impact	Occupying as tenant	Self occupied
Tuzla Aydınlı	4	Positive	The area will be opened up for more use	Own property	Self occupied
Pendik Kavakpınar	4	Positive	It wouldn't be a problem if the shop goes away	Own property	Self occupied
Pendik Harmandere	4	Negative	If there were a metro carrying people, it would be beneficial, but the train will greatly reduce the settled population	Own property	Self occupied
Pendik Emirli	4	Negative	My commercial activity may be affected	Own property	Self occupied
Tuzla Aydınlı	3	Positive	Because I don't think the buildings will be demolished	Own property	Self occupied
Tuzla Aydınlı	3	Positive	The neighborhood may become more lively	Own property	Self occupied
Pendik Kavakpınar	3	No idea	No idea	Occupying as tenant	Self occupied
Pendik Harmandere	3	Positive	The neighborhood will become more active	Occupying as tenant	Self occupied
Total	**49**	**54.55% Positive 27.27%Negative 9.09% No impact 9.09% No idea**		**72.73% Own property 27.27% Tenant**	**100% Self occupied**

Table 4-64 Commercial areas within AoI-Intersecting Settlements, Mukhtar Survey, July 2025, (N:26)

Settlement	Number of commercial structure	Number of worker	Expected impact	Reason	Ownership status	Usage status
Tuzla Aydıntepe	No information	No information	Negative	Many places will be affected.	Private land	Individual use
Pendik Kavakpınar	1,000	5,000	Negative	People's livelihoods will be affected.	Private land	Individual use
Pendik Sanayi	250	4,000	No impact	.	Private land	Individual use
Pendik Harmandere	150	750	Negative	All sources of livelihood will be impacted.	Private land	Occupying as tenant
Gebze Cumhuriyet	70	2,800	Negative	Certain businesses will need to be relocated, therefore workers will also be negatively affected.	Private land	Individual use
Çatalca Nakkaş	30	300	Negative	Those whose places are affected will be negatively impacted.	Private land	Individual use

Settlement	Number of commercial structure	Number of worker	Expected impact	Reason	Ownership status	Usage status
Pendik Şeyhli	23	No information	No impact	There will be no impact; everyone's work is settled.	Private land	Individual use
Sultanbeyli Akşemsettin	20	250	Negative	Transportation routes may be affected.	Private land	Occupying as tenant
Pendik Kurtköy	15	60	Positive	Due to construction works, their productivity may increase.	Private land	Individual use
Sultanbeyli Mecidiye	15	200	Negative	Because people earn their living here.	Private land	Individual use
Sancaktepe Paşaköy	15	150	Negative	People's livestock farms will be affected.	Private land	Individual use
Beykoz Öğümce	15	100	No impact	No impact	Private land	Individual use
Çekmeköy Ömerli	10	75	Positive	Their income will increase during the construction phase.	Private land	Individual use
Çatalca İzzettin	10	30	Negative	Access roads may be closed; they may be negatively affected.	Private land	Individual use
Çatalca Ferhatpaşa	10	25	Negative	Their passage may become difficult.	Private land	Individual use
Beykoz Cumhuriyet	5	100	Negative	During the construction period, logistics and transportation may be negatively affected.	Private land	Individual use
Beykoz Ali Bahadır	5	30	Negative	Access barriers will be experienced.	Private land	Individual use
Sarıyer Garipçe	4	35	No impact	No impact	Private land	Occupying as tenant
Beykoz Paşamandıra	3	20	No impact	None.	Private land	Individual use
Eyüpsultan Çiftalan	3	No information	Positive	There will be liveliness; employment will increase.	Private land	Individual use
Çekmeköy Hüseyinli	2	100	No impact	No impact	Private land	Individual use
Beykoz Anadolu Feneri	2	12	Negative	They may be negatively affected by the works.	Private land	Individual use
Sarıyer Gümüşdere	2	100	Negative	Livelihoods will be affected.	Private land	Individual use
Arnavutköy Dursunköy	2	30	Negative	Their access may be blocked; livelihoods may be affected.	Private land	Individual use
Tuzla İstasyon	1	3,000	Negative	It is a business center where many enterprises are gathered; it may be affected because it is within the coverage area.	Private land	Individual use
Beykoz Poyrazköy	1	10	No impact	No impact	Private land	Individual use

Settlement	Number of commercial structure	Number of worker	Expected impact	Reason	Ownership status	Usage status
Total	**1,662**	**17,177**	**61.54% Negative 26.92% No impact 11.54% Positive**		**100% Private lands**	**88.46% Individual use 11.54% Occupying as tenant**

4.3.13.2 General evaluation of previous & future expropriation processes

In the meeting with the Çayırova District Governorate, it was emphasized that security should be prioritized and that expropriation should not cause any grievances. Similarly, Çekmeköy Municipality, Çekmeköy District Governorate, and Arnavutköy Municipality expressed concerns that expropriations could lead to grievances. The 14th Regional Directorate of the State Hydraulic Works stressed that grievances arising from expropriation should be avoided. In the meeting with Istanbul Airport authorities, it was noted that expropriation along the route could result in negative impacts.

In the meeting with the residents of Sancaktepe Paşaköy neighborhood, it was stated that problems were experienced regarding expropriation and expropriation compensation in previous projects in the area, and that similar grievances could occur if this process happens again. Similarly, in the meetings held in Beykoz Paşamandıra neighborhood, concerns were expressed that delays in the expropriation process and problems experienced in previous projects resulted in locals being unable to regain property, raising fears of similar negative impacts in this project as well. In the focus group meeting in Beykoz Ali Bahadır neighborhood, similar concerns were voiced. It was mentioned that locals faced economic difficulties due to insufficient expropriation fees and collections. In the meetings in Eyüpsultan Işıklar neighborhood, it was emphasized that there had been grievances related to expropriation fees before, and therefore these processes need to be managed more carefully. In the meetings in Arnavutköy Tayakadın and Çatalca Nakkaş neighborhoods, it was also stated that insufficient fees were paid during the expropriation processes and rights losses occurred. It was noted that in previous projects, these processes resulted in grievances, with fees set too low and ongoing court cases.in previous projects in the area, and that similar grievances could occur if this process happens again. Similarly, in the meetings held in Beykoz Paşamandıra neighborhood, concerns were expressed that delays in the expropriation process and problems experienced in previous projects resulted in locals being unable to regain property, raising fears of similar negative impacts in this project as well. In the focus group meeting in Beykoz Ali Bahadır neighborhood, similar concerns were voiced. It was mentioned that locals faced economic difficulties due to insufficient expropriation fees and collections. In the meetings in Eyüpsultan Işıklar neighborhood, it was emphasized that there had been grievances related to expropriation fees before, and therefore these processes need to be managed more carefully. In the meetings in Arnavutköy Tayakadın and Çatalca Nakkaş neighborhoods, it was also stated that insufficient fees were paid during the expropriation processes and rights losses occurred. It was noted that in previous projects, these processes resulted in grievances, with fees set too low and ongoing court cases.

In meetings with the Mor Çatı Women's Shelter Foundation and the Istanbul Metropolitan Municipality Women's Center, it was stated that r previous similar projects had encountered problems particularly regarding expropriation and compensation. It was emphasized that transparency should be ensured in expropriation processes and that social benefits must be prioritized. Additionally, it was noted that injustice or insufficient information could lead to social unrest. İstanbul Violence Prevention and Monitoring Center highlighted that expropriation should be kept to a minimum and stressed the importance of protecting green spaces.

In summary, recurring grievances in expropriation processes, lack of transparency, and inadequate compensation increase the risk of social distrust and unrest. This situation highlights the importance of protecting the economic and social rights of the local community.

4.3.14 Current Transportation Features

Haydarpaşa and Ambarlı Ports, which are among Türkiye's most important import and export hubs, as well as İstanbul Airport and Sabiha Gökçen Airport, the country's primary national and international air transport centers, are all located in İstanbul.

At the NUTS-2 regional level, İstanbul shares land borders with two regions. To the east lies the TR42 Region, which includes the provinces of Kocaeli, Sakarya, Düzce, Bolu, and Yalova; to the west is the TR21 Region, covering the provinces of Tekirdağ, Edirne, and Kırklareli. Additionally, to the south, the TR41 Region (comprising Bursa, Eskisehir, and Bilecik) and the TR22 Region (including Balıkesir and Çanakkale) are other regions with coastlines along the Sea of Marmara.

According to data from the General Directorate of Highways, as of October 2023, 427 km of Türkiye's total 3,633 km motorway network—accounting for 11.75%—are located within the boundaries of İstanbul. Additionally, 440 km of the total 65,012 km provincial and state road network (0.68%), and 402 km of the total 13,022 km railway network are also within İstanbul.

According to TurkStat data, as of 2022, İstanbul is home to 4,940,010 motor vehicles, making up 18.7% of the total 26,482,487 motor vehicles in Türkiye. Furthermore, while the total number of registered automobiles in Türkiye is 14,269,352, 3,328,008 of these—accounting for 23.3%—are registered in İstanbul. As of 2021, the average number of automobiles per 1,000 people was 162 across Türkiye, whereas it was 200 in İstanbul.

According to TurkStat data, more than 95 million passengers were transported by air in İstanbul in 2022, accounting for 52% of the total number of passengers carried nationwide. When only international flights are considered, this ratio rises to 62%. İstanbul also holds significant potential in maritime passenger transportation. According to data from the MoTI, İstanbul Port served 414 cruise ships and 582,190 cruise passengers in 2011, whereas these figures declined to 180 cruise ships and 252,026 passengers in 2022. To reverse this downward trend in maritime transportation, integrated interventions and the promotion of Galataport on the international stage are necessary.

According to the İstanbul Sustainable Urban Mobility Plan, of the 30.3 million daily trips in 2020, 40.5% were made on foot, 27.9% by public transport, 15.7% by work and school shuttles, and 15.9% by private car. The majority of public transport is provided by rubber-wheeled vehicles (minibuses, buses, and metrobus), while only 24.6% of the modal share is made up of rail systems and 1.6% by maritime transport (İBB, 2022).

The reduction of greenhouse gas emissions from transportation is prioritized under the Green Deal framework, with a particular focus on sustainable and smart mobility. In this context, a 90% reduction in transport-related emissions by 2050 is targeted (MoTI, EU Sustainable and Smart Mobility Strategy, 2020). According to data from MoEUCC, 93% of CO_2 emissions from transportation originate from road transport, while 4.5% come from air transport, 1.1% from maritime transport, 0.5% from railways, and 0.9% from other modes of transport.

The Green Deal Action Plan, under the heading of Sustainable Smart Mobility, and the İstanbul Sustainable Urban Mobility Plan prepared by İMM, envision environmentally sustainable transportation systems. These systems focus on rail and public transport, promote the widespread use of micro-mobility vehicles, and aim to reduce the negative impacts of logistics systems [128].

When the strategic plan of the General Directorate of State Railways for the periods 2019-2023 is examined, many goals and targets have been determined for the development of railways. These;

- Developing and expanding the national railway network
- To ensure that infrastructure operations are maintained in a safe, uninterrupted and

[128] *TR10 Düzey-2 Bölgesi Bölge Planı 2024-2028. İstanbul Development Agency.* https://www.istka.org.tr/media/pdf/h4fuFPWyKYFCZ0RkYV9CJVbbtcZwcSKjfWZ4nBUyJuKM7M4EiDTR.pdf

- comfortable manner
- To ensure safe traffic and station management with effective capacity in the national
- railway network
- To ensure the integration of railway infrastructure with other transportation systems.

In line with 11th Development Plan of the Presidential Strategy and Budget Presidency İstanbul region will be aimed to become an international air cargo, maintenance and transfer center. İstanbul and Sabiha Gökçen Airports will be aimed to become an international air cargo, maintenance & repair and transfer center, the rail connection will be provided between these airports and their integration to the national rail route[129].

In accordance with 12th Development Plan, as of September 2023, with the commissioning of remaining sections of the Northern Marmara Motorway and motorway projects such as the İstanbul-Izmir Motorway, the total length of motorways has reached 3,633 km, and the total length of divided roads including motorways has reached 29,139 km[130].

Railways are considered one of the most important links of development in the field of transportation within the scope of sustainable development strategies. In recent years, accessibility of railway investments has been considered important among transportation investments in Türkiye.

4.3.14.1 General evaluation of current &future transportation condition

Çayırova Municipality has stated that the use of rail transportation will provide benefits in terms of cost reduction, traffic alleviation, and air pollution control. Similarly, in discussions with the Çayırova District Governorship, it was emphasized that the Gebze region, especially with its 9 Organized Industrial Zones in Çayırova, is an important hub for manufacturing and logistics in Turkey. Increasing traffic and heavy vehicle density are identified as the region's main issues. It was highlighted that rail transportation would reduce costs and traffic, while strengthening connectivity between the two airports. The inclusion of passenger transportation and the integration of stations with OIZs are expected to enhance the project's benefits. The Çayırova District Directorate of Agriculture and Forestry pointed out that establishing a station in Çayırova would improve local access to Istanbul and the airports, making the area more attractive. Direct connections to the airport are expected to reduce transportation difficulties. The project's dual focus on both passenger and freight transport is expected to reduce traffic congestion, improve accessibility, and provide both economic and social benefits to the region. The İzmit Maintenance Directorate of Turkish State Railway (TCDD) emphasized the project's importance for intercontinental transit and freight transport, as well as its potential to reduce traffic and air pollution. Similarly, the Kocaeli Metropolitan Municipality discussed how the project would ease traffic by reducing heavy vehicle congestion. The meeting with the East Marmara Development Agency underscored that the project will improve logistics efficiency by providing fast, secure, and low-cost connections between OIZs and ports. In meetings with AFAD, it was mentioned that the project will ease the entry and exit to Istanbul, thus reducing traffic congestion. It was also stated that Sabiha Gökçen Airport could be integrated with Istanbul Airport, as it will serve as a base during disaster situations. The Istanbul Provincial Directorate of Disaster and Emergency Management highlighted the transportation advantages of the rail connection. The need to review the train passage over the bridge in terms of earthquake safety was emphasized. During talks with the Sabiha Gökçen Airport Authority, it was noted that the project, passing through the north, will contribute to logistics and cargo transport, solve traffic issues by providing a crossing to the Gulf, and reduce costs. However, it was stressed that underground construction should not be

[129] *Presidency of the Republic of Türkiye. Presidency of Strategy and Budget. Eleventh Development Plan (2019-2023).* https://www.sbb.gov.tr/wp-content/uploads/2022/07/Eleventh_Development_Plan_2019-2023.pdf

[130] *Presidency of the Republic of Türkiye. Presidency of Strategy and Budget. Twelfth Development Plan (2024-2028).* https://www.sbb.gov.tr/wp-content/uploads/2025/03/Twelfth-Development-Plan_2024-2028.pdf.

allowed in strategically sensitive areas beneath the runways, and tunnel excavation should be avoided due to concerns regarding soil liquefaction and vibrations.

The Istanbul Metropolitan Municipality stated that the project could provide benefits in terms of energy and transportation, with the potential for integration of rail systems for logistics purposes. Furthermore, it was evaluated that integrating rail system projects with Hızray and other public transportation systems would enhance transportation efficiency. In discussions with other institutions in Istanbul[131], it was emphasized that the project would reduce heavy vehicle traffic, strengthen transportation infrastructure, improve logistics capabilities, stimulate the regional economy, and consequently increase employment. In a meeting with the TCDD 1st Regional Directorate, it was highlighted that the project's integration with Sabiha Gökçen and Istanbul Airports, linking them to Trakya, would be crucial. Similarly, the DSİ 14th Regional Directorate expressed support for the project and stressed the importance of further integrating passenger transportation. Pendik Cultural Arts and Sports Club stated that the project would contribute to improving the current transportation conditions, especially by reducing transportation issues through passenger transport. In FGDs with the local communities[132], it was highlighted that previous projects had caused negative impacts, and transportation problems arising from these projects persist. There were calls for the construction of underpasses and fences for safety reasons. Tünaydın Newspaper noted that the project would positively impact traffic in the region and suggested increasing the number of passenger stations to enhance its benefits. The Istanbul Development Agency emphasized the importance of green transformation in logistics and disaster logistics planning, stating that traffic load could be reduced through integration with sea, air, and other transport lines. Similarly, the Istanbul Metropolitan Municipality Women's Center, Çatalca Women's Cooperative, and the Arnavutköy Disabled Association all indicated that the project would have positive effects on transportation and logistics.

This project has the potential to improve the quality of life for the local residents by enhancing transportation and reducing traffic congestion. Additionally, increased logistical efficiency and support for employment will contribute to regional economic development. However, the negative impacts and transportation issues stemming from previous projects have raised the public's expectations regarding safety and infrastructure. Therefore, the project should be planned with consideration of both its environmental and social impacts.

4.3.15 Evaluation of previous projects

Beykoz Municipality has stated that similar projects in the past have caused issues with noise and vibrations, emphasizing the necessity of taking appropriate measures to address these problems. In a meeting with the local people of Eyüpsultan Ağaçlı, it was shared that previous projects had led to the near extinction of livestock farming, deforestation, dumping of debris into the sea, and environmental pollution. Additionally, the passage of excavation trucks through the village has been reported to have made transportation difficult and caused damage to the roads. It has been reported that emergency service vehicles, such as ambulances, have had difficulty reaching the village. Additionally, restricted sea access and the inability for the local population to access the sea were highlighted. In FGDs with the local people of Eyüpsultan Odayeri, it was emphasized that previous projects did not benefit neighboring villages; these projects primarily served large infrastructure initiatives and brought no positive outcomes to rural settlements, only causing harm. However, it was noted that such projects did create employment opportunities. The residents of Eyüpsultan Işıklar village expressed their concerns about past negative impacts, including unfulfilled employment promises, and stated that they do not want to experience similar hardships

[131] *Tuzla District Governorship, Tuzla Municipality, Pendik Municipality, Çekmeköy Municipality, Çekmeköy District Governorship, Sancaktepe Municipality, Sancaktepe District Governorship, Arnavutköy Municipality, Çatalca Municipality, Eyüpsultan District Governorship, Sarıyer District Governorship, Beykoz District Governorship, Beykoz Municipality*

[132] *Sarıyer Uskumruköy Neighborhood, Sarıyer Gümüşdere Neighborhood, Eyüpsultan Ağaçlı Neighborhood, Eyüpsultan Odayeri Neighborhood, Eyüpsultan Işıklar Neighborhood, Arnavutköy Tayakadın Neighborhood*

again. Moreover, they pointed out an 80% decline in livestock farming and grazing land due to the restrictions. In Arnavutköy Tayakadın village, while some negative impacts were acknowledged from previous projects, it was noted that they brought partial value to the neighborhood, especially in terms of service sectors. Furthermore, issues in the land expropriation and rights loss processes were raised. In Çatalca Nakkaş village, discussions highlighted that explosions during projects caused tremors and noise pollution, and similar issues with land expropriation were mentioned. Finally, in Beykoz Ali Bahadır village, problems with compensation amounts during the expropriation process were also reported.

Previous projects have had significant environmental, economic, and social impacts on the local people. Issues such as noise, vibration, and environmental pollution have negatively affected the quality of life. Expropriation processes and loss of rights have undermined the sense of social justice and security, leading to public grievances. Overall, these projects have restricted the living spaces of the local people and caused problems such as environmental degradation and transportation difficulties.

4.3.15.1 Concerns and suggestions about environmental impacts

In the meeting with the Çayırova District Governorate, it was projected that considering the intense industrial and logistics activities in the Gebze region, including Çayırova, the project would contribute to the industry by reducing transportation costs and truck traffic, while also decreasing traffic congestion and air pollution. In the meeting with the Kocaeli Metropolitan Municipality, it was pointed out that issues such as air pollution and traffic caused by industrialization in Kocaeli already exist, and the project might not be beneficial to the public, potentially leading to negative effects by increasing heavy vehicle traffic. The Pendik District Governorate noted that negative impacts such as noise and environmental pollution might occur during the construction process. During the meeting with the East Marmara Development Agency, concerns were raised about the impacts on forest destruction and water basins, as the route passes through northern areas with forests and water resources. It was emphasized that the projects should be planned in a way that avoids damage to these areas, coordination with the Forestry Directorate should be ensured, and watershed protection plans should be taken into account. Sancaktepe Municipality emphasized that, since the project passes through the northeastern districts with dense green areas, environmental degradation must be avoided, and care should be taken not to harm the environment. Similarly, in the meeting with the Sancaktepe District Governorate, it was reported that negative impacts such as noise, dust, environmental pollution, damage to agricultural and natural habitats, effects on existing infrastructure, and social unrest due to expropriation might occur during the project process. Additionally, it was highlighted that since the project route passes through environmentally and socially sensitive areas such as forests, water basins, natural conservation areas, and densely populated regions, these values must be taken into account during the planning process. In the meeting with the Beykoz District Governorate, it was emphasized that the project might cause various problems related to noise and natural habitats, and that the local community in the villages is resistant to interventions in their natural living areas, thus requiring careful communication. Furthermore, it was stated that agricultural directorates, municipalities, and other public institutions should actively participate in the process. In the meeting with the DSİ 14th Regional Directorate, it was emphasized that the project route could affect many existing, under-construction, and planned dams, particularly the Ömerli, Alibey, Büyükçekmece, Sungurlu, Osmangazi, Kabakoz, and Hamzalı Dams, and that the protection of water basins is crucial. Therefore, it was stated that compliance with the Water Basin Protection Regulation and DSİ criteria is essential, and decisions regarding stream crossings, floodplains, and agricultural lands should be made in coordination with the relevant institutions. In the meeting with the Eyüpsultan District Governorate, it was noted that some areas in the district have environmentally sensitive features such as forest areas, water basins, and natural conservation areas. In the meeting with the Sarıyer District Governorate, it was emphasized that no tree cutting should occur in the northern forests. In the meeting with the Tünaydın Newspaper, it was stressed

that particular attention should be paid to the forest areas in Çatalca and Beykoz, as well as to the Ömerli Dam.

In the meeting with the Ömerli Cultural Heritage Protection and Preservation Association, it was stated that if no precautions are taken in the context of previously completed projects, ecological life could be adversely affected. In this regard, it was emphasized that the installation of fences and wires along the railway tracks is necessary to mitigate negative impacts and potential risks. The Environmental Organizations Solidarity Association highlighted that if sensitivity towards ecological balance and nature is not maintained, irreversible consequences could arise. In the meeting with Istanbul Metropolitan Municipality, the possibility of expanding the residential area towards the north was emphasized, with the warning that any route passing through the natural areas in the north could lead to irreversible consequences. Therefore, it was suggested that the route should pass through areas that are particularly non-forested, not used for agriculture, and ecologically less sensitive. Additionally, it was pointed out that agriculture and livestock activities are ongoing in the regions of Eyüp, Çatalca, Silivri, and Şile, and that urbanization pressure in these areas should not increase. The route should not overlap with critical ecological assets of Istanbul, such as the northern forests and water basins, as the protection of these areas is considered a strategic priority for the city. During the meeting with the Istanbul Provincial Disaster and Emergency Management Directorate, it was mentioned that blasting and noise problems could create disadvantages. The Istanbul Development Agency stressed that it is essential to ensure agricultural and natural living areas are not harmed. Çatalca Women's Cooperative, Arnavutköy Disabled Association, and Giresun Provincial and Districts Solidarity Association all expressed concerns that project activities could threaten nature and ecological life.

In the focus group meeting with the local community of Sancaktepe Paşaköy, concerns were raised that impacts such as noise, ground vibrations, and environmental pollution would affect daily life. Another major concern was the direct exposure of the northern forests to construction activities. In the meeting with the local community of Beykoz Ali Bahadır, concerns were also voiced regarding the negative impact on ecological life and nature. According to the information shared, due to the destruction of much of the region’s forests by previous projects, unfamiliar wild animals have been spotted, which poses a threat to both natural life and daily activities. In Sarıyer Uskumruköy, the local community stated that the project could have negative impacts on nature and livelihood, and during the construction process, noise pollution could become a significant issue. Additionally, they emphasized the importance of choosing regionally suitable tree species (such as oak and chestnut) for reforestation and highlighted the need for sensitivity to environmental impacts. In discussions with the local community of Sarıyer Gümüşdere, it was stated that no significant environmental impact was expected from the project. However, they emphasized the need for animal crossing bridges to protect the migratory paths of wild animals living in the forest. The local community of Eyüpsultan Ağaçlı expressed concerns about the potential impact of excavation on lakes and natural areas, particularly regarding the effects on water bodies. The local community of Eyüpsultan Odayeri pointed out the necessity of constructing noise barriers to prevent noise pollution during construction. They also noted that the intensity of excavation truck traffic should be considered, as it could increase traffic and environmental pollution risks. The local community of Eyüpsultan Işıklar highlighted the importance of protecting the only pond used for fire-fighting purposes and requested the construction of animal crossing bridges to preserve natural life. Similarly, the local community of Arnavutköy Tayakadın expressed concerns about the potential negative environmental and forest-related impacts of the project.

Concerns about environmental impacts and potential threats to ecological balance have been raised during the consultations regarding the project. Specifically, the effects on forests, water basins, agricultural lands, and wildlife have been highlighted. Local communities have expressed worries about noise, dust, air pollution, and the destruction of natural habitats during the construction phase. Additionally, it has been emphasized that the destruction of forests in some

areas has led to the displacement of wildlife, threatening daily life. It has been repeatedly stressed that the project route should be carefully chosen, avoiding ecologically sensitive areas and ensuring the protection of natural resources. In this process, a more careful planning approach and continuous communication with local communities are crucial to maintaining ecological balance.

Based on the findings obtained from the consultations conducted to date, a Frequently Asked Questions (FAQ) list will be prepared, and the responses will be shared with stakeholders as part of the planned stakeholder engagement activities. Where timing permits, the D&B contractor will also be invited to participate in the meetings. The findings emerging from these meetings will additionally be shared with the D&B contractor to ensure that the concerns raised are duly reviewed and considered. Relevant revisions will be primarily reflected under Section 4.13.12, without being limited to this section.

4.3.16 Cultural Heritage

The ESIA studies for the identification, assessment and management of the potential Project impacts on the cultural heritage assets have been performed by REGIO Cultural Heritage Management Consultancy (“REGIO”) within the cultural heritage study area.

The cultural heritage study area was defined as the Project route and a 400-meter impact corridor, based on the potential direct physical impacts of construction activities. The study area does not include auxiliary or ancillary facilities such as worker camps, soil disposal sites, or other temporary construction-related areas. These areas will be addressed separately, where applicable, through site-specific assessments and management measures.

Impact mitigation for potential cultural heritage sites and elements within the defined project impact area is addressed through the Cultural Heritage Management Plan included in the ESMP. The Project area is located in a geographical setting that has historically been suitable for human settlement due to the presence of natural resources, such as water resources and proximity to agricultural areas. Therefore, there is a possibility that tangible cultural heritage assets, including chance finds that are currently buried or undocumented, may exist within the Project area or its close vicinity and may be identified through advanced investigation methods or uncovered during construction.

Accordingly, all construction activities will be carried out in compliance with the Cultural Heritage Management Plan and the Chance Finds Procedure. Within this scope, a walkover survey was conducted along the Project route between 22 and 25 May 2025 to identify visible cultural heritage features. As a result of desktop studies and field surveys, a total of 51 registered and unregistered cultural heritage sites/assets were identified within the Project route and the 400-meter impact corridor.

The cultural heritage impact assessment studies were conducted by a team of qualified experts (Senior Archaeologist Serkan Akdemir, MA., Senior Archaeologist H. Uğur Dağ, PhD.). A walkover survey along the project route and its’ impact areas was conducted between 22 and 25 May 2025 in order to gather field data on the location and features of the tangible and intangible cultural heritage elements. The field studies for the “intangible cultural heritage” were carried out using the "qualitative interview technique" with individuals who are knowledgeable about the history and geography of the region, who value those areas, and who know, live, sustain and transfer the intangible cultural elements in those areas. In this research method, face-to-face interviews were conducted with representatives of the local people and the data on intangible cultural heritage elements were collected.

4.3.16.1 Desktop Studies Findings

4.3.16.1.1 Tangible Cultural Heritage

The route of the “İstanbul North Railway Crossing Project”, including its connection roads,

traverses a region that has witnessed nearly every historical period of Anatolia. Due to intense migration, rapid and unplanned urban development, and the presence of large-scale industrial zones, combined with the limited number of cultural inventory studies conducted in the area, the exact locations, quantity, and current condition of archaeological and immovable cultural assets remain largely unknown.

As part of the archaeological and cultural impact assessment efforts, a comprehensive study of the historical geography of the project route and its surroundings was carried out through literature reviews and archival research. According to ancient sources, the project route lies within a geographical area that encompasses two distinct historical regions. The eastern side of the Bosporus was known as "Bithynia," while the western side was referred to as "Thrace." The Bosporus itself served as the boundary between these regions. Accordingly, the historical context of the project route has been evaluated based on these ancient geographical distinctions.

Accordingly, the historical background of the project route and impact areas was analysed within the framework of ancient regional definitions.

Bithynia Region:

The ancient Bithynia region covered Anatolian side of İstanbul, the provinces of Kocaeli, Yalova, Sakarya, Düzce and Bolu and greater parts of the provinces of Bartın, Zonguldak and Bursa. Kocaeli is located in the centre of the Bithynia region. In the ancient sources, the borders of Bithynia are defined as the Bosporus and the Marmara Sea (Propontis) in the west, Black Sea (Pontus Euxinus) in the north, Bartın Stream (Parthenius) in the east and Orhaneli River (Rhyndacus) in the south [133]. The region was named after “Bithyni Tribe” of Thracian origin, which left the Thrace in order to escape from the Scythians and took shelter in Anatolia [134]. The Asia side (Project Section 1 and Part of Project Section 2 [135] of the INRAIL Project are located within the borders of Bithynia Region.

Evidence of the Palaeolithic and subsequently the Mesolithic (or Epi-Palaeolithic) periods in the region has been identified at several sites, including Parganlı-Kerpe and Kefken-Cebeci in Kandıra (Kocaeli), İbonun Rampası in Akköy (Yalova), Çallıca in Çınarcık (Yalova), İçerenköy in Kadıköy (İstanbul), Göksu in Dudullu (Ümraniye, İstanbul), Hacet Creek in Pendik (İstanbul), Fikirtepe in Kadıköy (İstanbul), Domalı-Alaçalı in Şile (İstanbul), Ağadere and Dağazlı 1st and 2nd localities in Kaynarca (Sakarya), as well as the Ayıyatağı site in the same district. These settlements have yielded findings such as stone hand axes and flaked tools [136].

Currently, evidence of the Neolithic Period is primarily concentrated along the coastline bordering the Marmara Sea and in the vicinity of Lake İznik [137]. The settlements of Fikirtepe, Pendik-Temenye, and Tuzla, recently linked to the European side of İstanbul through Neolithic discoveries unearthed during the Marmaray construction, represent distinctive, marine-oriented local cultures with unique characteristics. Conversely, although there are indications of interaction, the Neolithic communities around Lake İznik appear to have developed a distinct cultural identity, separate from other contemporary civilizations. Traces of Neolithic occupation in the broader region have been documented at several sites, including Dudullu (Ümraniye, İstanbul), İçerenköy and Fikirtepe (Kadıköy, İstanbul), Tuzla and Temenye (İstanbul), Göztepe (Yalova), Ilıpınar (Orhangazi, Bursa), Yüğücek (İznik), Barcın Höyük and Marmarcık (Yenişehir, Bursa), Menteşe (Yenişehir, Bursa), and Tepetarla (Kartepe, Kocaeli).

Although limited, artifacts from the Chalcolithic Period and the Early Bronze Age have also been

133 *Beksaç 2015: 41-45*
134 *Güçlü 2007:3*
135 *Starts from Km.38+330, passes YSS Bridge, and ends about 12 km before Istanbul Airport. The length is 40.802 km.*
136 *TAY I*
137 *Beksaç 2015:43*

discovered in the region, with the majority of these finds concentrated around Lake İznik. Additional material evidence from these periods has been unearthed in excavations near Karamürsel (Kocaeli) and Geyve (Sakarya). Specifically, Ilıpınar (Orhangazi, Bursa) has yielded significant Chalcolithic remains, while traces of the Early Bronze Age have been identified at the Elmabahçesi site in Taraklı District, Sakarya.

Although limited in number, artifacts dated to the Chalcolithic Period and the Early Bronze Age have been identified within the region. The majority of these findings have been concentrated in the vicinity of Lake İznik. In addition to the settlements surrounding the lake, material remains from these periods have also been unearthed during excavations conducted near Karamürsel (Kocaeli) and Geyve (Sakarya). Notably, Chalcolithic traces have been identified at the Ilıpınar site in Orhangazi (Bursa), while Early Bronze Age evidence has been discovered in the Elmabahçesi locality of Taraklı District (Sakarya) [138].

Between 1200 and 700 BCE, the region was inhabited by Thracian tribes. Up until the 7th century BCE, it was annexed by the Lydian Kingdom, before coming under Persian rule around 513 BCE. Following the defeat of the Persian army by Alexander the Great near the Granicus River (modern-day Biga River) in 334 BCE, the region gained its independence by 326 BCE.

Several ancient cities of considerable importance were located within the region, including: Chalcedon (Kadıköy), Chrysopolis (Üsküdar), Lybissa (Diliskelesi), Dacibyza (Gebze), Nicomedia (İzmit), Kalpe (Kerpe), Olbia (Başiskele), Astacos (Gölcük), Prainetos (Karamürsel), Pylai-Strobilos (Çiftlikköy/Karakilise), Drepanon (Hersek), Chios–Prusias ad Mare (Gemlik), Apameia/Myrleia (Mudanya), Prusa ad Olympium (Bursa), Helicore–Nicaea (İznik), Prusias ad Hypium (Konuralp), Bithynion–Claudiopolis (Bolu), Dia–Diospolis (Akçakoca), Teion–Tieion–Tion (Filyos/Hisarönü), Heraclea Pontica (Ereğli), Otroia (Yenişehir), Modrene (Mudurnu), Malagina (Mekece), Agrilion (Bilecik), and Kabaia (Geyve).

Due to its strategic location near major trade routes, its fertile agricultural lands, abundant freshwater resources, and harbours that facilitated maritime commerce, the region has been continuously and densely inhabited since antiquity. Among the most significant freshwater sources in the area are the Sangarios (Sakarya River), Aisepos (Gönen Stream), Hypios (Melen Stream), Makestos (Susurluk–Simav Stream), Parthenios (Bartın Stream), Siberis (Aladağ Stream), Psillis (Ağva), Kalpas (possibly the Anadere Stream near Kefken), Lykos–Rhyndakos (Orhaneli Stream), Rhebas (Riva), Kaleks (Gülünç Stream), Billaios (Filyos Stream), Artanos (Hiciz Creek), Askania (Lake İznik), Sophon/Sunensis (Lake Sapanca), and Apolyont (Lake Ulubat). Prominent elevations in the region include Olympos of Mysia (Uludağ), Astacus (Samanlı Mountains), and Sophon (Kartepe). Beyond settlements, the region also contains remains of Roman infrastructure such as road networks, bridges, defensive outposts, fortifications, and harbors, dating to the period following its annexation into the Roman Empire in 74 BCE. A notable example is the “Roman Road” located near Yağcılar Village in Kandıra District (Kocaeli). In the 6th century CE, during the reign of Byzantine Emperor Justinian I (527–565), substantial development took place in Sakarya and its surroundings. One of the most remarkable architectural works from this period is the Justinian Bridge, located in Karaaptiler Village (Sakarya), constructed across the Sangarios (Sakarya River). Additionally, fortified structures were built in strategically important locations during this time, including Çobankale (Geyve, Sakarya), Paşalar (Pamukova, Adapazarı), and Mekece (Pamukova, Adapazarı), reflecting the military and administrative significance of the region during the Byzantine period [139]. Located approximately 1 km from the project's starting point, Değirmenaltı Church is a significant archaeological site dating back to the Byzantine period. As a result of recent archaeological

138 *TAY II*

139 *Çetin, 1999:6*

excavations, important findings belonging to this period have been obtained [140].

The region, under Byzantine rule from the 5th to the 11th centuries, was conquered by the Anatolian Seljuk State in 1078. By 1354, the entire area, except for Constantinople (İstanbul), had come under Ottoman control.

One of the most significant settlements in the historical Bithynia region has been İzmit (Kocaeli). Thanks to its strategic geographic position, natural harbour (İzmit Bay), surrounding forests, and accessible transportation routes, İzmit remained an important centre throughout various historical periods. Among the key Ottoman structures in the city is the Orhan Mosque, constructed in the 14th century by Süleyman Paşa, the son of Orhan Gazi. Also notable is the Akçakoca Mosque, located in Akçakoca Neighbourhood, Yukarı Pazar, and built between 1327 and 1328 by Akçakoca, the commander who conquered the İzmit region. Another significant structure is the İmaret Mosque, erected in the city centre in the 16th century. Following the Ottoman conquest of İzmit in the 14th century, a number of military, administrative, and civil buildings, primarily religious, civic, and water-related structures, were constructed in and around the city.

In antiquity and the medieval period, this region saw limited habitation due to the frequently changing course of the Sakarya River and the presence of extensive marshlands. However, beginning in the 16th century, the number of settlements increased significantly as forested and scrubland areas were cleared. The renowned 17th-century Ottoman scholar Katip Çelebi, in his Cihannüma, refers to Sakarya as a notable location. A major flood of the Sakarya River in 1640 resulted in significant devastation, including the loss of many historic structures [141].

“The Hünkar Fountain, Bridge, open-air prayer platform (namazgah), and Sultan's Otağ Alanı”, located in the Gebze district of Kocaeli province approximately 400 metres from the starting point of the INRAIL Project, date back to the Ottoman Period (1659). These registered structures and area comprising a fountain, a bridge, and an open-air prayer platform (namazgah) were constructed in the 17th century to commemorate Sultan Mehmed II (Mehmed the Conqueror) after his death. Today, the site also serves as the venue for traditional oil wrestling events held in his honour, reflecting the region’s intangible cultural heritage [142].

In his celebrated Seyahatname (Book of Travels), Evliya Çelebi provides descriptions of settlements such as Sapanca and Hendek, and details prominent Ottoman monuments in the region, including the Sarı Rüstem Paşa Mosque, the Pertev Paşa Caravanserai, and various significant structures in Geyve.

The region was occupied by Greek forces in March 1921 during the Turkish War of Independence and was liberated in June 1921.

Thrace Region:

In general scholarship, Thrace is defined as the region located between Macedonia and Bosporus. The Europe side (Part of Project Section 2 and Project Section 3) of INRAIL Project are located within the borders of the Thrace region.

Thrace consists largely of expansive plains and fertile agricultural lands. Beyond these flat areas, the region’s main elevations include Mons Aticus (modern-day Istranca Mountains) in the north, Hieron Oros, meaning "Holy Mountain", known today as Ganos Mountain in the south, and the Koru Mountains in the southwest, whose ancient name remains unknown [143]. While the highlands

[140] *Asal, R., Curku, Y., Tokgöz, Y. & Köroğlu, T. (2025). Evaluations of the Byzantine Period Data Obtained from the Archaeological Excavations of the Tuzla Değirmenaltı Monastery in Istanbul. Anatolian Archaeology, 5, 35-59.*

[141] *Çetin 1999:7-8*

[142] *https://kulturportali.gov.tr/turkiye/kocaeli/gezilecekyer/hunkar-cesmesi-ve-cayiri*

[143] *Sevin, 2000:18*

are densely forested, the interior and coastal plains are characterized by steppe vegetation. These plains are highly suitable for agriculture and therefore have long been favourable for human settlement. Timber from the forested areas is also a significant trade commodity [144]. The eastern part of Thrace experiences a Black Sea climate with high rainfall, whereas the areas closer to the Sea of Marmara exhibit the so-called Marmara transitional climate, which resembles that of the Mediterranean. In the inland zones between these two climatic regions, which are isolated from direct maritime influence, a continental climate prevails.

The major rivers of the region flowing from north to south include the Tonzos (modern Tunca), Ardeskos (Arda), and Hebros (Meriç). The Agrianes (Ergene) flows from east to west. In addition to these main rivers, there are several smaller streams: Arzos (Çorlu Stream), Tearos (Kaynarca), Apsinthos (Derbent Creek), Melas (Kavak Stream), Athyra (Çekmece Creek), Kydaris (Alibey Creek), and Barbyses (Kağıthane Creek). The primary lakes of the region include Delkos (modern Terkos Lake) and Stentaris (Gala Lake) ([145]).

Thrace is also rich in mineral resources. Since antiquity, the region has been known for its copper and zinc mines in Mons Asticus (modern Istranca Mountains), copper deposits in Dereköy, Şükrüpaşa, and Armutveren, iron mines in Demirköy, and gold deposits near the Rezve Creek.

Agriculture plays a vital role in the regional economy. Ancient authors such as Herodotus and Xenophon mention the cultivation of barley, wheat, and hemp in the area ([146]). Thrace was also highly developed in viticulture and was renowned for its vineyards. In terms of livestock, sheep and horse breeding were particularly important. Additionally, fishing has historically been a major livelihood in the coastal areas. According to the ancient geographer Strabo, the Keras (Golden Horn) was especially rich in tuna and Atlantic bonito.

Important settlements were established in the Thrace region during the Palaeolithic, Neolithic, and Chalcolithic periods. The Balkan Peninsula has been highly suitable for human habitation since the Quaternary period (the 4th geological era), thanks to its favourable climatic and geographical conditions ([147]). Ancient settlements discovered on Eskice Ridge near Lake Büyükçekmece, as well as in Kefken and Gümüşdere near Kilyos, support this view. The artifacts unearthed at these sites, together with those found in Yarımburgaz Cave, shed light on the westward spread of human populations from the Near East into Europe. Although only a few settlements from the Palaeolithic period have been identified in Thrace, the most important of these is Yarımburgaz Cave. It provided a natural environment conducive to both habitation and defence. Later Palaeolithic remains have also been discovered near Ağaçlı Village, located along the Black Sea coast north of Kemerburgaz. These sites, found on fossilized sand dunes, date to the Mesolithic (or Epi-Palaeolithic) period [148]. During this era, when modern climatic conditions began to dominate, the Black Sea was still a freshwater lake. Archaeological evidence reveals that numerous settlements emerged around its shores. Among the richest findings from this period are collections of small tools recovered from the dunes at Ağaçlı. This assemblage, referred to as the “Ağaçlı Culture,” represents the most significant and extensive set of artifacts from this period found in Türkiye [149].

It is known that the number of settlements in Thrace increased significantly after this period. Some of the well-documented prehistoric settlements include Hoca Çeşme Mound, Toptepe, Aşağı Pınar, Kanlıgeçit, and Çardakaltı. During the 7th and 6th millennia BCE, the Balkan Peninsula

144 *Sevin, 2000: 19*
145 *Sevin, 2000: 19*
146 *Sevin, 2000: 19*
147 *Erzen, 1994:35*
148 *TAY 1*
149 *Özdoğan,2000: 309*

and the Carpathian region were inhabited by Neolithic farmers migrating from the Near East. In this context, the Marmara region served as a critical crossroads between Anatolia and Europe [150]. Key Neolithic sites in the Marmara region from this transformative era, often referred to as the "Agricultural Revolution" include Menteşe, Ilıpınar, Fikirtepe, and Pendik [151]. This period marked a major turning point in human history, as communities transitioned from foraging to settled farming life. According to scholarly research, a new wave of migrants from Central Anatolia and the Aegean region arrived toward the end of the Neolithic period [152]. While indigenous cultures initially persisted and developed, they were eventually replaced by these incoming groups with the onset of the Chalcolithic period. Archaeological surveys and excavations have revealed that all known Chalcolithic settlements in Thrace were destroyed by fire at the end of this period, indicating a widespread and possibly violent cultural transformation [153].

Among the significant Early Bronze Age settlements in Thrace are the Gladina locality, situated within the administrative boundaries of Büyükçekmece District; the Kanallı Bridge (also known as Kınalı Bridge) near Silivri; and the Selimpaşa Mound, located within the municipality of Selimpaşa in the Silivri District. In addition to these, evidence of Early Bronze Age activity has also been identified in the necropolis area above the İncegiz Caves, located in a deep valley to the north of Çatalca District, as well as in the Kartepe (also known as Karatepe) Caves, which lie in a mountainous and forested area northeast of Dağyenice Village [154].

The 2nd millennium BCE, encompassing the Middle and Late Bronze Ages, was a period marked by the rise and expansion of powerful empires such as the Hittites in Anatolia and the Mycenaeans in the Aegean region. Until recently, it was widely believed that Thrace during this era was inhabited solely by nomadic communities [155]. However, excavations at Bathonea (Küçükçekmece, İstanbul) have challenged this view. The discovery of ceramics and figurines dating to the Hittite period provides strong evidence for the presence and influence of Hittite civilization in Thrace. Around the 1200s BCE, Thrace began to be settled by Thracian tribes migrating from the north [156]. By the 8th century BCE, these settlements had evolved and continued to exist as Hellenized colonies under the cultural influence of the Greek world [157]. In the 4th century BCE, an independent Thracian state emerged in the region [158]. In 333 BCE, Alexander the Great launched a military campaign in Thrace to suppress local unrest [159]. Following his death, the region maintained a degree of autonomy for a time. In the 1st century BCE, Thrace came under Roman influence and was officially annexed as a Roman province in 45 BCE. During the Roman period, the strategic importance of the region grew significantly, particularly due to the construction of the Via Egnatia, a major road that connected Rome with Anatolia and facilitated trade, communication, and military movement across the empire [160].

In 333 CE, the Roman Emperor Constantine the Great (Constantine I), anticipating that the vast empire could no longer be effectively governed from Rome, renamed the city of Byzantium after himself as Constantinople and declared it the new capital of the empire. This pivotal decision led to the formal division of the Roman Empire into two distinct entities: the Western Roman Empire and the Eastern Roman Empire. This moment is widely regarded as the foundational event in the

150 *Hoddinott, 1981: 15.*
151 *Özdoğan,2000: 310.*
152 *Hoddinott, 1981: 15*
153 *Özdoğan, 2000: 310*
154 *Aydıngün, 2014: 22*
155 *Aydıngün 2015 b:31*
156 *Erzen, 1994: 28-30.*
157 *Sevin, 2000: 22*
158 *Erzen, 1994: 94 – 98*
159 *Sayar, 2008: 61*
160 *Aydıngün, 2015a:164*

establishment of the Byzantine Empire [161]. Following this division, the region of Thrace became part of the Eastern Roman Empire, later known as the Byzantine Empire. In 394 CE, Emperor Theodosius I temporarily reunited the Eastern and Western Roman Empires. However, upon his death in 395 CE, the empire was permanently divided once more into Eastern and Western halves, marking the final separation of the Roman world.

During the Byzantine period, extensive defensive systems were constructed throughout the region. Silivri—known in antiquity as Selymbria or Selybria, served as a key fortress, guarding the road to Constantinople throughout the Byzantine period [162]. In addition to the Silivri Citadel, a massive defensive structure known as the Anastasian Wall (or the Long Walls of Thrace) was commissioned by Emperor Anastasius I (r. 491–518 CE) to protect Constantinople from potential invasions originating from the Thracian hinterland. The wall, stretching approximately 56 kilometres in length, began on the Black Sea coast, passed through the villages of Fenerköy and Kurfalı, and terminated at the Sea of Marmara.

Although their remains have not yet been clearly identified, the Hagias Spyrion Church and the Fatih (Hünkar) Mosque are considered among the most significant architectural structures from the Byzantine period in the region. The Fatih Mosque, originally the largest church within the Silivri Citadel, was converted into a mosque by Sultan Mehmed the Conqueror following the Ottoman conquest of Silivri in 1453. The mosque began to fall into ruin after the 1920s, and its minaret was demolished in the 1960s [163]. Its stones were subsequently reused as spolia in other constructions. Despite historical records indicating the existence of several important Byzantine monuments in Silivri, Selimpaşa, and their surroundings, most of these structures were demolished due to rapid urbanization. The region remained under Byzantine control until the 14th century and was permanently incorporated into the Ottoman Empire following the conquest of Constantinople in 1453.

In addition to ancient and medieval ruins, the region also contains defensive structures dating from the Balkan Wars and World War II. One of the most significant is the Çatalca Entrenchment Line, constructed in 1877 to defend against possible invasions. It spanned a total length of 50 km between Lake Terkos in the north and Lake Büyükçekmece in the south, approximately 35–40 km west of İstanbul. The entrenchment line consisted of a 6.5 km corridor with 10 redoubts, each strategically located on hilltops and equipped with machine guns and light artillery ([164]). Below the redoubts were armoires, and communication was maintained through underground telephone and telegraph lines connecting the fortifications and the rear. Another significant defensive structure was the Çakmak Line, built during World War II by the government of the time as a precaution against a potential German invasion. This line extended from the Black Sea to the Sea of Marmara, running parallel to both the Anastasian Wall and the Çatalca Entrenchment Line. It was named after Marshal Fevzi Çakmak, then Chief of the General Staff. The Çakmak Line consisted of two parallel lines of bunkers, trenches, and outposts stretching from Lake Durusu to Lake Büyükçekmece. Some of these defensive elements lie within the impact zone of the Inrail Project route. Known assets having archaeological and historical importance on the Project route and its vicinity are presented in Table 4-65, Table 4-65, Figure 4-45, and Figure 4-45.

Table 4-65 Recognised National Tangible Cultural Heritage Assets within the vicinity of the Project's AoI

No	Name of Heritage Asset	Province	District	Neighb.	Distance to Project Route (km)	Period
1	Catalca Station Structures	İstanbul	Çatalca	Ferhatpaşa	0,1	Ottoman
2	Catalca Ferhatpasa Bridge				0,1	Roman

161 *Sayar, 2008:62*
162 *Eyice, 1969:354*
163 *Eyice 1969:355-356*
164 *Akyüz 2012:131-136*

No	Name of Heritage Asset	Province	District	Neighb.	Distance to Project Route (km)	Period
3	Katırcı Bridge				0,4	Ottoman
4	Degirmenalti Church		Tuzla	Merkez	0,6	Byzantine
5	Tepeoren Cemetery			Tepeören	5	Ottoman
6	Kurna Cemetery		Pendik	Kurna	1	Ottoman
7	Fatih Otağı Protected Area	Kocaeli	Gebze	Çayırova	0,3	Ottoman
8	Gebze Agriculture Facilities and Lodgings		Gebze	Çayırova	0,4	Early Rebublic
9	Garipce Castle	İstanbul	Beykoz	Garipce	1	Ottoman
10	Poyrazkoy Castle		Beykoz	Poyraz	1,5	Ottoman
11	Aydos Castle		Sultanbeyli	Mehmet Akif Ersoy	4	Byzantine
12	Gumusdere Greek Church		Sarıyer	Gümüşdere	1,1	Byzantine
13	Ağaçlı Culture		Eyüpsultan	Ağaçlı	4	Epipalaeolithic
14	Spradon		Avcılar	Firüzköy	17	Roman/ Byzantine
15	Bathonea				21	Roman/ Byzantine
16	Yarımburgaz Cave		Başakşehir	Altınşehir	19	Palaeolithic
17	Filiboz		Arnavutköy	Sazlıbosna	10	Roman/ Byzantine
18	İnceğiz Caves and Maltepe Necropolis		Çatalca	İnceğiz	9	Byzantine
19	Historic Peninsula- İstanbul		Fatih	-	24	Iron/ Helenistic/ Roman/ Byzantine/ Ottoman
20	Roman Waterways		Silivri Çatalca Arnavutköy Sultangazi	-	0	Roman
21	Terkos Waterways Route		Arnavutköy Eyüpsultan Kağıthane	-	0	Ottoman
22	Anastasius Wall		Çatalca Silivri	Karacaköy Ihsaniye Bekirli Fenerköy Alipaşa Mimarsinan Kurfallı	20	Byzantine
23	Alibahadir Cemetery		Beykoz	Alibahadır	0,9	Ottoman
24	Poyrazköy- Example of Civil Architecture			Poyraz	0,9	Ottoman
25	Çakmak Line		Çatalca Arnavutköy Küçükçekmece Avcılar	-	0	World War II
26	Öğümce- Example of Civil Architectures		Beykoz	Öğümce	0,8	Ottoman
27	Aydınlı Cemetery		Tuzla	Aydınlı	0,4	Ottoman
28	Tekkeciktepe Tumulus		Pendik	Kurna	2	Roman
29	Pendik Hoyuk			Kaynarca	2,5	Paleolithic/ Neolithic/ Chalcolithic/Byzantine
30	Kavakpınar Cemetery			Yayalar	0	Ottoman
31	Cinardere Monastery			Çınardere	3,5	Byzantine

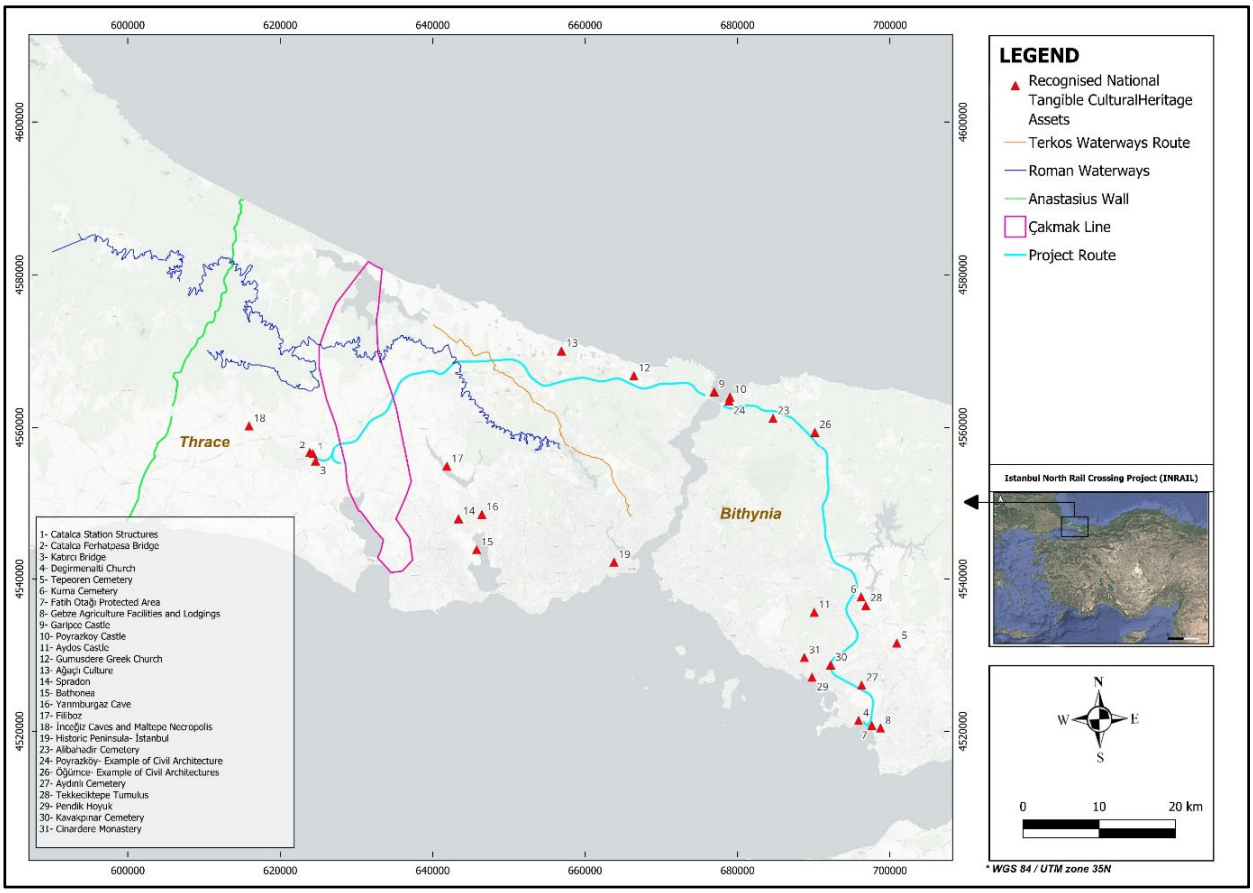


Figure 4-45 Recognized National Tangible Cultural Heritage Assets Within and Around the Project Route

World Heritage List ([165]) and World Heritage Tentative ([166]) List of UNESCO are considered under the internationally recognized cultural heritage sites. Türkiye has 21 sites inscribed on the World Heritage List of UNESCO (as of 3 June 2025). Those located in the wider region of the Project are listed in Table 4-66Table 4-66 and shown in Figure 4-46. The closest site to the Project is the "Historic Areas of İstanbul", which is located at a distance of 21 km to the south of the project route.

Among the sites included in the World Heritage Tentative List of UNESCO, 2 sites are located in the wider region of the Project. The closest sites to the Project are the "Yoros Fortress" in İstanbul-Beykoz, which is located at a distance of 3 km to the south of the Project route and "Galata Tower" in İstanbul- Beyoğlu, which is located at a distance of 21 km in the east of the Project route.

Table 4-66 Recognised International Tangible Cultural Heritage Assets Within and Around the Project Route

No	World Heritage List of UNESCO	Province	District	Distance to Project (km)
1	Historic Areas of İstanbul	İstanbul	Fatih	21
World Heritage Tentative List of UNESCO				
2	Trading Posts and Fortifications on Genoese Trade Routes from the Mediterranean to the Black Sea *2a: Yoros Fortress *2b: Galata Tower	İstanbul	2a: Beykoz 2b: Beyoğlu	2a: 3 2b: 21
3	Nuruosmaniye Complex	İstanbul	Fatih	24
4	Yıldız Palace Complex	İstanbul	Beşiktaş	18

[165] *Please check the following link; obtained on 28.04.2025 from https://whc.unesco.org/en/statesparties/tr*

[166] *Please check the following link; obtained on 28.04.2025 from https://whc.unesco.org/en/tentativelists/?action=listtentative&state=tr&order=states*

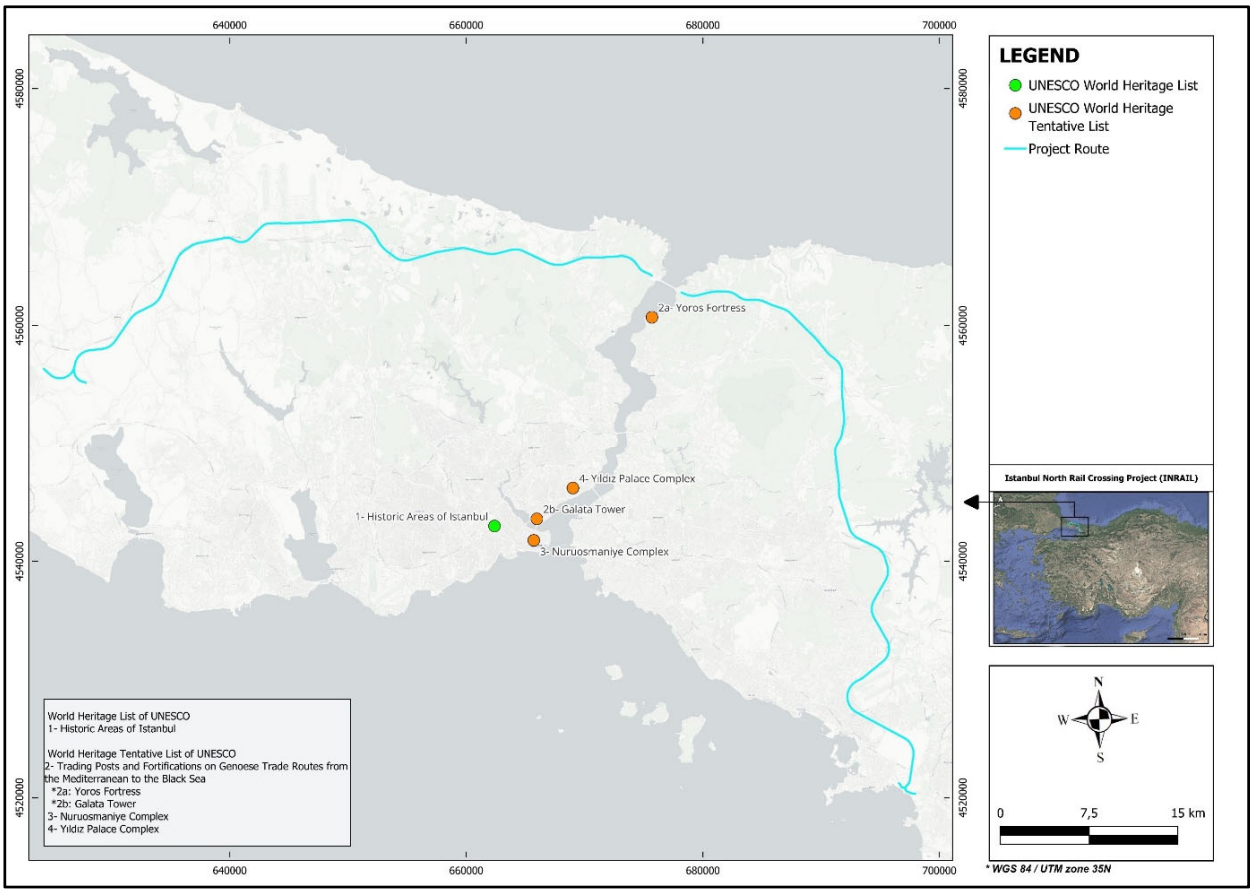


Figure 4-46 Recognized International Tangible Cultural Heritage Assets Within and Around the Project Route

4.3.16.1.2 Intangible Cultural Heritage

The region which is at an important location from a geographical perspective was preferred by people as a settlement location since the early periods of history due to its arable fields and natural riches such as water resources. The region witnessed occasional migration movements in time. Migration movements have greatly contributed to the intangible cultural heritage values in the region.

A variety of settlement policies were implemented in the region in different periods in the past. As per general settlement policies of the Ottoman Period, many Turkish families from Central Anatolian Region (Karaman Turks) and Crimea (Tatar and Noghai) were settled in the region in order to turkify the Balkan region. These people who lived in the Balkan lands for almost three centuries had to go through a forced migration to Eastern Thrace in connection with “The War of 93 “(i.e. 1877-1878 Ottoman-Russian War) and the following Balkan Wars.

In the Ottoman Period, families from Anatolia who were engaged in farming were brought to İstanbul and its vicinity in order to work on the foundation lands. Nakkaş Neighbourhood located in the study area is the settlement established by 18 families who were brought with this purpose from Nevşehir (Muşkara) to the lands endowed by Fatih Sultan Mehmet to his miniature artist (Nakkaş). A population exchange was experienced in 1924 as per the protocol made as a result of Lausanne Treaty signed by the Republic of Türkiye. There are settlements in the study area that include families who came and settled there with the population exchange.

During the survey it was determined that some of the traditions related to the transition periods of life are still alive in the Project route and its vicinity. Transition periods of life starting with birth and ending with death are reflected in the local customs in the region. The cultural qualities of the region are as notable as its natural structure and history.

Agriculture, animal husbandry, historical structures, and safeguarding and conserving natural environment are prevailing elements among the residents of the region. Along with the transition periods of life, national and religious festivals also have great significance for local people. Traditional economy in the region depends on agriculture and animal husbandry.

Nationally and internationally known intangible cultural heritage assets in the close vicinity of the Project route are presented in Table 4-67 and Table 4-68. As of 2025, there are 31 elements of Türkiye inscribed on the UNESCO Representative List of Intangible Cultural Heritage. Among these elements, there are 13 elements registered in İstanbul province where the Project route took place, as shown in Table 4-67.

Table 4-67 Recognised International Intangible Cultural Heritage Elements Within and Around the Project[167]

No	Intangible Cultural Heritage Element	Year of Admission to the UNESCO List
1	Âşıklık (Minstrelsy) Tradition	2009
2	Traditional Sohbet Meetings	2010
3	Ceremonial Keşkek tradition	2011
4	Turkish Coffee Culture and Tradition	2013
6	Flatbread Making and Sharing Culture: Lavash, Katyrma, Jupka, Yufka Katrıma, Jupka, Yufka	2016
7	Spring celebration, Hıdrellez	2017
8	Traditional Turkish Archery	2019
9	Traditional intelligence and strategy game: Togyzqumalaq, Toguz Korgool, Mangala/ Göçürme	2020
10	Culture of Çay (Tea), a Symbol of Identity, Hospitality and Social Interaction	2022
11	Craftsmanship of mother of pearl inlay	2023
12	Iftar/ Eftari/ Iftar/ Iftor and Its Socio-Cultural Traditions	2023
13	Art of illumination: Təzhib/Tazhib/Zarhalkori/Tezhip/Naqqoshlik	2023

Table 4-68 Intangible Cultural Heritage Items Registered in the National Inventory of the Project's AoI[168]

No	Element Group Titles	Inventory / Local Applications
1	Traditional Turkish Decoration and Handicrafts	Paper Marbling, Calligraphy, Miniature Work, Katı' Craftsmanship, Book Art, Mother of Pearl Inlay, Engraving Art, Illumination Art, Geometric shaped pattern, shape design and application, Bookbinding
2	Master of Traditional Handicraft (Traditional Craftsmanship)	Wood Engraving
3	Weaving Art and Traditions	Şile Cloth
4	Traditional Instrument Production and Performance	Ney Production
5	Traditional Children's Games And Toys	Eyüp Toys Production
6	Traditions and Practices Based on Beliefs	Mevleviyeh, Mosque Ridge, Ramadan Pita
7	Faith, Celebration and Traditions Linked to the Calendar	Hıdrellez, Saint Georges
8	Lamentation Traditions	Mersiyehanlık
9	Traditional Theatrical Arts and Acting	Meddahlık, Karagöz ve Hacivat, Canbazhane/Körmük Tradition, Mehter (Ottoman Military Band)
10	Traditional Sports	Pedestrian Archery, Köçürme ve Mangala Game
11	Turkish Culinary Culture/ Traditional Food and Beverage Making and Social Practices	Simit, Eyüp halkası, Döner Kebap, Izmit's Famous Cotton Candy, Keşkek

4.3.16.1.3 Field Survey Findings

Tangible Cultural Heritage based on Field Surveys

The walk-over survey (field survey) was conducted in the project area and the project's buffer zone between 22 and 25 of May 2025. Two different definitions were developed as a result of the

167 *Please check the following link; https://ich.unesco.org/en/state/turkiye-TR?info=elements-on-the-lists (28.05.2025)*

168 *Please check the following link;*
https://aregem.ktb.gov.tr/TR-344757/somut-olmayan-kulturel-miras-turkiye-ulusal-envanteri.html
https://kenansahin60.wordpress.com/wp-content/uploads/2014/01/03050604_gelenekselelsanatlari.pdf

observations that were made by taking the surface materials into consideration and the results of desktop research ([169]). Distribution of the sites identified within the study area is presented in Table 4-69.

Table 4-69 Tangible Cultural Heritage Site Encountered within the Study Area

Province	District	Neighbourhood	Registered Sites	Unregistered Sites		Total
				Archaeological Site	Other Cultural Heritage Sites	
İstanbul	Çatalca	Ferhatpaşa	1	-	-	1
		Nakkaş	-	2	21	23
	Arnavutköy	Tayakadın	1	-	-	1
		İmrahor	1	-	-	1
		Yassıören	-	1	21	22
		Baklalı	-	1	-	1
	Pendik	Yayalar	1	-	-	1
Total			**4**	**4**	**42**	**50**

Distribution of the sites identified with respect to their location/position within the study area is provided in Table 4-70 and shown in Figure 4-47.

Table 4-70 Distribution of Tangible Cultural Heritage Sites

Legal Registration Status	Location/ Position of the Site/ Asset	
	Within the Construction Corridor	Outside the Construction Corridor
Registered	3	1
Unregistered	7	39
Total	**10**	**41**

[169] *Registered Sites (Sites (1st, 2nd and 3rd degrees) that are registered and protected by the Law No. 2863). Unregistered Sites (Archaeological and Other Cultural Heritage Sites sub-classifications.).*

Table 4-71 Tangible Cultural Heritage Sites within the Cultural Heritage Impact Assessment (CHIA) Study Area

No	Cultural Heritage Name	Province/ District	Neighbourhood	Location to the Project		Project Section	Estimated Project KM	Planned Activities			Approximate Distance to the Project (m.)	Period	Classification of Heritage Sites			Site Definition	Site Descriptions
				Within the Construction Corridor	Outside the Construction Corridor			Excavation and/ or Filling	Tunnel	Bridge/ Viaduct			Registered Site	Unregistered Site			
														Arch. Site	Oth. Site		
1	Çatalca Train Station Structures	İstanbul/ Çatalca	Ferhatpaşa		x	Section 3	28+500				60	Ottoman	x			Train Station Structures	The feet of the bridge have survived. A concrete platform was added to the upper part of the historical bridge feet in order to use the modern road within the last 50 years. Then a viaduct has been built on this historical bridge, to the continuation of Münif Sevi Street within the last decade. For this reason, the visual landscape of the historical bridge has disappeared.
2	Military Bunker_1	İstanbul/ Çatalca	Nakkaş		x	Section 3	23+160				160	WWII ([170])			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 13x8 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation. Beekeeping activities are conducted on the bunker.
3	Military Bunker_2	İstanbul/ Çatalca	Nakkaş		x	Section 3	23+100				69	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 5x4 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
4	Military Bunker_3	İstanbul/ Çatalca	Nakkaş		x	Section 3	23+110				169	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 4x4 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
5	Military Bunker_4	İstanbul/ Çatalca	Nakkaş		x	Section 3	23+100				46	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 4x4 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
6	Military Bunker_5	İstanbul/ Çatalca	Nakkaş		x	Section 3	23+045				58	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 6x4 meters in size. The Bunker was built with concrete frame and stone masonry.
7	Military Bunker_6	İstanbul/ Çatalca	Nakkaş	x		Section 3	23+890	x			0	WWII			x	Military Bunker	The “Military Bunker” is located on the Project route. The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
8	Military Bunker_7	İstanbul/ Çatalca	Nakkaş		x	Section 3	22+800				142	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
9	Military Bunker_8	İstanbul/ Çatalca	Nakkaş		x	Section 3	22+635				96	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
10	Hasanbey Flat Settlement	İstanbul/ Çatalca	Nakkaş	x		Section 3	22+000	x		x	0	Byzantine/ Ottoman		x		Flat Settlement	“Hasanbey Flat Settlement” is located on the Project route. Lots of ceramics sherds and architectural remans were observed on the surface. The archaeological site is dated back to the Byzantine/ Ottoman period in line with the surface materials.
11	Kolviran Military Structure	İstanbul/ Çatalca	Nakkaş		x	Section 3	20+200				13	WWII			x	Military Structure	The military structure belonging to the Cakmak Line is approximately 17x9 meters in size. The military structure was built with concrete frame and stone masonry. The function of the structure has not been determined with certainty.
12	Kolviran Military Ditch	İstanbul/ Çatalca	Nakkaş		x	Section 3	20+000				84	WWII			x	Military Ditch	Kolviran military ditch belonging to the Cakmak Line measures approximately 210 x 5 meters. The ditch extends along the slope in the northwest-southeast direction. In front of the military ditch is a stone wall approximately 1,5 meters high and 1 meter wide.
13	Kolviran Bridge	İstanbul/ Çatalca	Nakkaş		x	Section 3	19+600				166	WWII			x	Roman Bridge	This well preserved, historic, arched bridge is located 1 kilometre south of Nakkaş Neighbourhoodoutside the construction area. The bridge, which was constructed in the Roman Period is stone masonry. Its length is around 14,5 m and width is 4,61 m. The arches of the bridge are in the form of single-centred semicircles. It is a part of the historic road network, named "Via Egnatia", which was most possibly constructed by Emperor Constantine in the first half of the 4th century CE and connected İstanbul (ancient Constantinople) with Europe.
14	Military Bunker_9	İstanbul/ Çatalca	Nakkaş		x	Section 3	19+040				90	WWII			x	Military Bunker	The “Military Bunker” is located on the Project route. The military bunker belonging to the Cakmak Line is approximately 4x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
15	Military Bunker_10	İstanbul/ Çatalca	Nakkaş	x		Section 3	18+540	x			0	WWII			x	Military Bunker	The “Military Bunker” is located on the Project route. The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
16	Military Bunker_11	İstanbul/ Çatalca	Nakkaş		x	Section 3	19+535				1	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 5x5 meters in size. The Bunker was built with concrete frame and stone masonry.
17	Military Bunker_12	İstanbul/ Çatalca	Nakkaş		x	Section 3	19+530				19	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 5x5 meters in size. The Bunker was built with concrete frame and stone masonry.
18	Military Bunker_13	İstanbul/ Çatalca	Nakkaş		x	Section 3	19+525				39	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 5x5 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.

[170] *Türkiye was not involved in World War II. However, the Çakmak Line and the associated structures along the line, which were specifically prepared against a potential German attack, are considered culturally significant. These sites are acknowledged for their historical importance, although they have not been officially registered by the Ministry.*

No	Cultural Heritage Name	Province/ District	Neighbourhood	Location to the Project		Project Section	Estimated Project KM	Planned Activities			Approximate Distance to the Project (m.)	Period	Classification of Heritage Sites			Site Definition	Site Descriptions
				Within the Construction Corridor	Outside the Construction Corridor			Excavation and/ or Filling	Tunnel	Bridge/ Viaduct			Registered Site	Unregistered Site			
														Arch. Site	Oth. Site		
19	Örenbayırı Slope Settlement	İstanbul/ Çatalca	Nakkaş		x	Section 3	18+300				7	Byzantine/ Ottoman		x		Slope Settlement	"Örenbayırı Slope Settlement" is located outside the construction corridor. Ceramic, roof tile shards and some architectural cut limestone blocks, which may be dated to the Byzantine/ Ottoman Period, were observed on the surface of the site.
20	Military Bunker_14	İstanbul/ Çatalca	Nakkaş		x	Section 3	18+300				125	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
21	Military Bunker_15	İstanbul/ Çatalca	Nakkaş		x	Section 3	18+270				123	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
22	Military Bunker_16	İstanbul/ Çatalca	Nakkaş		x	Section 3	17+990				176	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
23	Military Bunker_17	İstanbul/ Çatalca	Nakkaş		x	Section 3	17+995				133	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
24	Military Bunker_18	İstanbul/ Çatalca	Nakkaş		x	Section 3	17+990				93	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
25	Akpınarçiftliği Military Bridge	İstanbul/ Arnavutköy	Yassıören		x	Section 3	15+860				10	WWII		x		Military Bridge	It is a bridge built for military purposes belonging to the Çakmak Line. The bridge is approximately 5x5 meters in size.
26	Military Bunker_19	İstanbul/ Arnavutköy	Yassıören		x	Section 3	15+310				180	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
27	Military Bunker_20	İstanbul/ Arnavutköy	Yassıören		x	Section 3	15+310				199	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
28	Military Bunker_21	İstanbul/ Arnavutköy	Yassıören		x	Section 3	15+220				125	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
29	Military Bunker_22	İstanbul/ Arnavutköy	Yassıören		x	Section 3	15+220				125	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
30	Military Bunker_23	İstanbul/ Arnavutköy	Yassıören		x	Section 3	15+250				97	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
31	Military Bunker_24	İstanbul/ Arnavutköy	Yassıören		x	Section 3	15+115				65	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
32	Military Bunker_25	İstanbul/ Arnavutköy	Yassıören		x	Section 3	15+115				44	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
33	Military Bunker_26	İstanbul/ Arnavutköy	Yassıören	x		Section 3	15+151		x		0	WWII			x	Military Bunker	The "Military Bunker" is located on the Project route. However, a tunnel is planned in this section of the route. Therefore, no impact on the cemetery area is expected. The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
34	Military Bunker_27	İstanbul/ Arnavutköy	Yassıören	x		Section 3	15+130		x		0	WWII			x	Military Bunker	The "Military Bunker" is located on the Project route. However, a tunnel is planned in this section of the route. Therefore, no impact on the cemetery area is expected. The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
35	Military Bunker_28	İstanbul/ Arnavutköy	Yassıören	x		Section 3	14+947		x		0	WWII			x	Military Bunker	The "Military Bunker" is located on the Project route. However, a tunnel is planned in this section of the route. Therefore, no impact on the cemetery area is expected. The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
36	Military Bunker_29	İstanbul/ Arnavutköy	Yassıören	x		Section 3	14+923		x		0	WWII			x	Military Bunker	The "Military Bunker" is located on the Project route. However, a tunnel is planned in this section of the route. Therefore, no impact on the cemetery area is expected. The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
37	Military Bunker_30	İstanbul/ Arnavutköy	Yassıören		x	Section 3	14+897				136	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
38	Military Bunker_31	İstanbul/ Arnavutköy	Yassıören		x	Section 3	14+420				1	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
39	Military	İstanbul/	Yassıören		x	Section	14+325				86	WWII			x	Military	The military bunker belonging to the Cakmak Line is approximately 3x3 meters

No	Cultural Heritage Name	Province/ District	Neighbourhood	Location to the Project		Project Section	Estimated Project KM	Planned Activities			Approximate Distance to the Project (m.)	Period	Classification of Heritage Sites			Site Definition	Site Descriptions
				Within the Construction Corridor	Outside the Construction Corridor			Excavation and/ or Filling	Tunnel	Bridge/ Viaduct			Registered Site	Unregistered Site			
														Arch. Site	Oth. Site		
	Bunker_32	Arnavutköy				3										Bunker	in size. The Bunker was built with concrete frame and stone masonry. It is covered with vegetation.
40	Military Bunker_33	İstanbul/ Arnavutköy	Yassıören		x	Section 3	14+312				46	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
41	Military Bunker_34	İstanbul/ Arnavutköy	Yassıören		x	Section 3	14+306				65	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
42	Military Bunker_35	İstanbul/ Arnavutköy	Yassıören		x	Section 3	14+289				103	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
43	Military Bunker_36	İstanbul/ Arnavutköy	Yassıören		x	Section 3	14+200				55	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
44	Military Bunker_37	İstanbul/ Arnavutköy	Yassıören		x	Section 3	14+178				124	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
45	Military Bunker_38	İstanbul/ Arnavutköy	Yassıören		x	Section 3	14+129				107	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
46	Military Bunker_39	İstanbul/ Arnavutköy	Yassıören		x	Section 3	14+120				95	WWII			x	Military Bunker	The military bunker belonging to the Cakmak Line is approximately 3x3 meters in size. The Bunker was built with concrete frame and stone masonry.
47	Kurtdere Slope Settlement	İstanbul/ Arnavutköy	Baklalı		x	Section 3	7+200				74	Byzantine		x		Slope Settlement	“Kurtdere Slope Settlement” is located outside the construction corridor. Ample amount of glazed ceramic and roof tile shards were encountered on the surface of the site. In addition to that, better preserved roof tiles, pithoi shards and cut limestone blocks were observed in the eastern part of the site.
48	Roman Waterways (Aquaduct)	İstanbul/ Arnavutköy	Tayakadın	x		Section 3	3+563		x		0	Roman	x			Waterway	A Roman waterway is officially registered by the İstanbul Regional Council for the Conservation of Cultural Property No. 1. According to the official letter of the Council (Ref: E-39682869-165.02.02-6753367), the spatial data related to the Roman waterway (referred to as "Roman Waterways / Aqueduct") has been generated based on literature sources. The letter explicitly states that the provided data may include a margin of error. At present, there are no visible remains of the aqueduct along the proposed INRAIL Project corridor. However, even if the provided data by the Council suggests a potential overlap with the project alignment, no adverse impacts are anticipated in this section of the project that will be crossed by a tunnel. Therefore, considering the absence of observable surface remains and the underground construction method (tunnelling), no direct physical impact on the registered heritage asset is expected at this stage.
49	Terkos Water Transmission Line	İstanbul/ Arnavutköy	İmrahor	x		Section 2	30+000		x		0	Ottoman	x			Water Transmission Line	The “Terkos Water Transmission Line” is located within the INRAIL Project corridor, and it is officially registered by the İstanbul Regional Council for the Conservation of Cultural Property No. 1. According to satellite imagery (Google Earth), the sections of the transmission line that are expected to overlap with the INRAIL Project alignment, within the boundaries of İstanbul Airport, are no longer physically visible. As noted in the official correspondence from the Council (Ref: E-39682869-165.02.02-6753367), the spatial data related to the Terkos Water Transmission Line was produced based on literature sources, and the letter indicates that a margin of error may exist in the provided data. However, even if the provided data by the Council suggests a potential overlap with the project alignment, no adverse impacts are anticipated in this section of the project that will be crossed by a tunnel. Therefore, considering the absence of observable surface remains and the underground construction method (tunnelling), no direct physical impact on the registered heritage asset is expected at this stage.
50	Kavakpınar Cemetery	İstanbul/ Pendik	Yayalar	x		Section 1	10+800		x		0	Ottoman	x			Cemetery	“Kavakpınar Cemetery” is located on the Project route. However, a tunnel is planned in this section of the route. Therefore, no impact on the cemetery area is expected. Graves belonging to late Ottoman period and today are located in the cemetery.

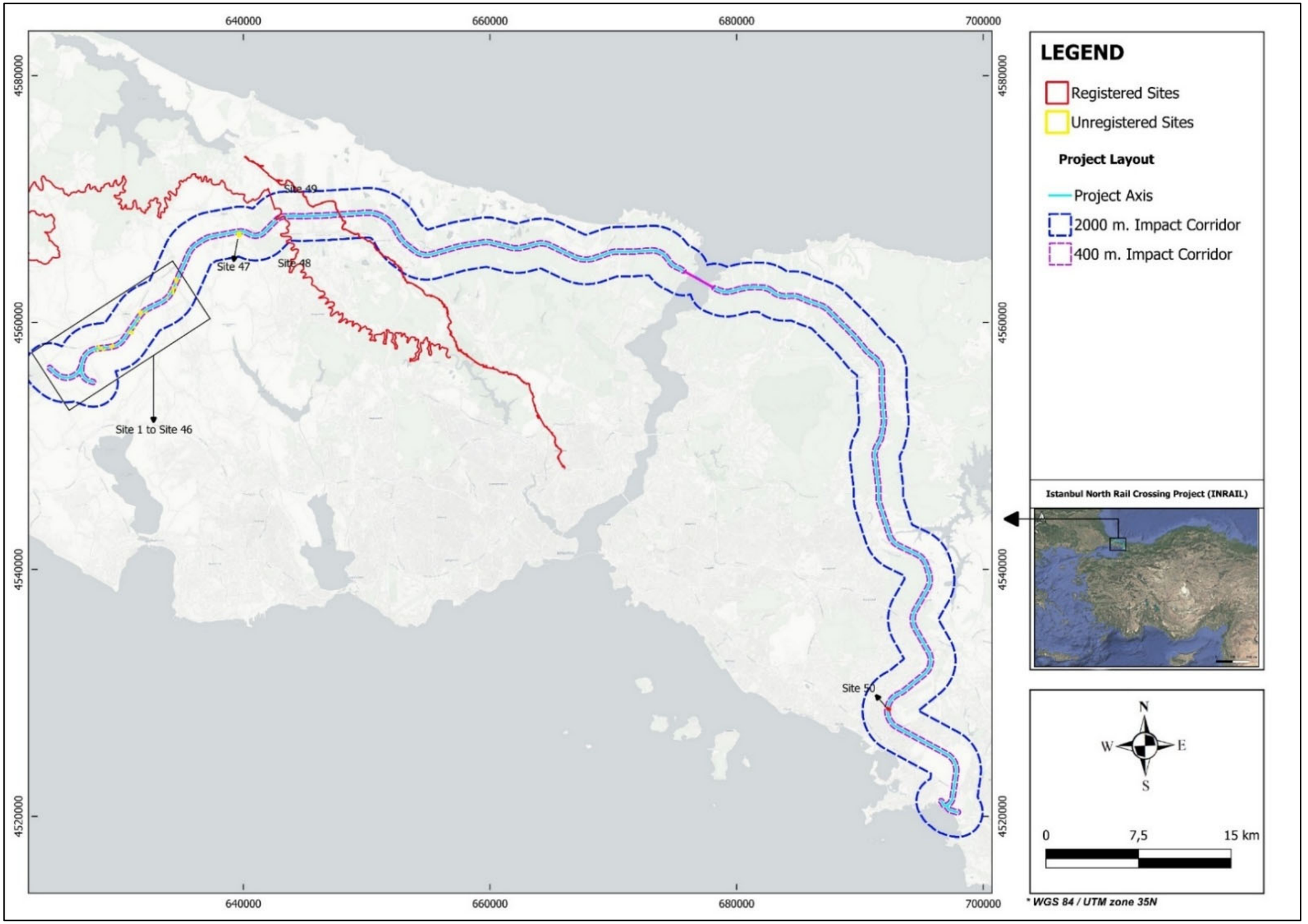


Figure 4-47 Locations of the Tangible Cultural Heritage Sites within the CHIA Study Area

Intangible Cultural Heritage based on Field Surveys

Findings of the ICH (Intangible Cultural Heritage) studies conducted within the project are presented below.

- İstanbul province where the Project route and impact area is located, cultural elements such as birth, circumcision, traditional sending-off ceremonies associated with military drafting, marriage, pilgrimage and death are among the main transition periods of life. It can be stated that these transition periods are beliefs and practices that have been maintained for centuries from the past to the present. Many beliefs and practices followed during the transition periods of life are mostly practiced in rural or villages located in the close vicinity of the Project route.
- All the neighbourhoods in the study area are Sunni Muslims. Yuruk (including Balkan immigrants), Turkmen and Manav Turks live around the Project route and its surroundings.
- In scope of oral traditions conveyed from generation to generation, 3 neighbourhoods (Nakkaş, Yassıören, Baklalı) located within the study area know their ancestors' stories who came in the region with migration and the heroic stories of Balkan Wars.
- Project route vicinity through Sunni Muslims settlements. Therefore, in some settlements covered with the study, there are places of worship and places of visit such as mosques, shrines and graves built following to the beliefs of Muslims.
- Ramadan and Feast of Sacrifice are religious holidays. The Republic Day is important for the local people. Other than religious and official holidays, Hıdırellez is celebrated in the region. Hıdırellez celebrations used to be a collective and enthusiastic occasion with picnics in the past, however they have lost their importance today. For religious holidays, preparations start as of the day of eve and ceremonial celebrations of the holiday take place after salat al Eid. Holidays are happy occasions for the children
- as they receive pocket money and candies.
- The dead are buried in the cemeteries of the village in accordance with the Muslim traditions.
- In villages, everyday life (socialization) is a gathering in common village room / village coffee house for men and visiting neighbours for women.
- Weather forecasting traditions are still alive.
- Turbahs/ Shrines and cemeteries also have a significant place in traditional folk beliefs. Tosunbaba Turbah/ Shrine in Dursunköy neighbourhood; Baba Nakkaş Turbah/ Shrine in Nakkaş neighbourhood (Figure 4-48); and cemetery located in Tepeören, Yayalar (Kavakpınar) and Aydınlı neighbourhoods may be listed as examples of these. There are Ottoman Period Mosque examples in the settlements located within our study field. The listed Turbahs/Shrines and cemeteries are located outside the Project's Area of Influence (AoI).



Figure 4-48 Dursunköy, Tosunbaba Turbah and Nakkaş, Nakkaşbaba Turbah

Impact assessment studies with regards to the intangible cultural heritage within the vicinity of

project route were conducted according to the international standards and national regulations. None of the ICH examples determined as the result of the studies conducted within scope of this report are negatively affected by the planned INRAIL Project. Impact assessment studies with regards to the intangible cultural heritage within the vicinity of project route were conducted according to the international standards and national regulations. None of the ICH examples determined as the result of the studies conducted within scope of this report are negatively affected by the planned INRAIL Project.

5 ENVIRONMENTAL AND SOCIAL RISKS AND IMPACTS

This section provides a comprehensive overview of the E&S risks and impacts associated with the INRAIL Project, taking into account the specific characteristics of the project and its geographic, ecological, and socio-economic context. In accordance with the requirements of IFIs, including the applicable ESSs, the assessment covers all potential direct, indirect, cumulative, and transboundary impacts across all phases of the project—pre-construction, construction, and operation. The analysis includes both risks explicitly identified in IFI frameworks and those arising from the unique nature and location of the project. A structured risk assessment methodology has been applied to identify and evaluate these risks and impacts, laying the foundation for the development of appropriate mitigation, management, and monitoring measures described in subsequent sections.

5.1 Environmental Risks and Impacts

In this section, all environmental risks and impacts identified along the project alignment determined within the scope of the ESIA process have been addressed through a comprehensive approach, including all associated structures. Considering the physical, biological, and ecological characteristics of the project area, the potential impacts on environmental components such as soil, air, water, flora-fauna, noise, and vibration have been evaluated. The current analysis is based on the preliminary assessment of the alignment; however, the ESIA will be further detailed and finalized by AYGM upon completion of the final engineering designs.

5.1.1 Impacts on Air Quality

5.1.1.1 Construction Period

Excavation, filling, and material transport activities to be carried out during the construction phase, along with emissions from motor vehicles operating at the construction site, may have temporary but measurable impacts on air quality within the Project's AoI. However, since the number of vehicles to be used under the Project is not yet determined at this stage, the current assessment focuses solely on estimating emissions arising from excavation-related activities—such as digging and filling *(The tunnels in the project will be excavated using TBM or NATM, and blasting is not anticipated. However, if blasting is deemed necessary as a result of the final design studies and the Contrctor's working methodology, the quantities of explosives, their sources and methods of procurement, and the conditions under which they will be stored will be determined in C-ESMP to be prepared by the D+B Contractor)*.

An air quality assessment related to construction activities planned during the project implementation phase has been conducted. The assessment reviewed relevant legal regulations, key policies, and guidelines, and provided an overview of the current air quality conditions in İstanbul. Existing conditions were determined using data from national websites, current air quality data presented in Section 4.2, Air Quality Review and Assessment Reports prepared by local authorities, and the results of additional monitoring surveys conducted as part of this assessment.

In this context, a detailed air quality impact assessment study, including dispersion modelling, has been prepared.

For the air dispersion modeling study, the AERMOD (AERMIC Modeling System) model developed by the U.S. Environmental Protection Agency was employed. This model is widely used and officially accepted by the EPA for EIA studies in the United States.

The model was run under worst-case scenario assumptions, assuming no wet or dry deposition, radioactive decay, or chemical transformation of the emitted pollutants. Among the pollutants, particular focus was given to particulate matter (PM) emissions, such as PM_{10} and $PM_{2.5}$, originating from excavation, earthmoving, and vehicle movement activities.

The modeling outcomes include hourly, daily, and annual average GLC values, which were then compared against applicable regulatory thresholds to determine the potential impact of emissions on local air quality.

5.1.1.1.1 Technical Summary – Air Quality Dispersion Modeling Study

The air quality dispersion modeling study focused on the Project's AoI, defined as a 500-meter buffer zone on either side of the railway alignment. The assessment considered emissions generated by earthworks, including excavation, backfilling, and the operation of heavy machinery. A conservative, worst-case scenario approach was adopted, assuming continuous operation of all emission sources, no pollutant removal through deposition or decay, and full temporal overlap of all construction activities.

The modeling estimated annual and 24-hour average ground-level concentrations of PM_{10} and $PM_{2.5}$, which were then compared against national and international air quality standards to assess potential impacts.

The methodology followed the "Implementation Guide for Qualified Companies on Air Quality Dispersion Modeling in Mining Projects", published by MoEUCC, Directorate General of EIA, Permit and Inspection. The guideline states that for area sources of dust (e.g., quarry sites), the mass flow rate input should be calculated based not on the entire EIA project area but only on the area to be operated within the year. Furthermore, the coordinates of this annually operated area should represent the worst-case scenario and be located as close as possible to the nearest sensitive receptor.

Given the similarity between the nature of the Project's construction activities and open-pit mining operations, this guideline was taken as the primary reference for modeling dust emissions.

At this stage, the modeling has been limited to emissions expected from earthmoving and excavation works. Three representative locations along the alignment were selected based on the intensity of anticipated excavation activities and the proximity of sensitive receptors listed in Table 3-1:

1. Çayırova Section – This area includes the construction of the Project's two longest viaducts (Viaduct-1 and Viaduct-2), along with an excavation area (Cut-1) at the entrance of Tunnel 1A and a fill area (Fill-1).
2. Uskumruköy Neighborhood, Sarıyer District – Located between the exit of Tunnel-14 and the entrance of Tunnel-15, this section includes multiple structures: Cut-53, Fill-37, Cut-54, Fill-38, Bridge-22, Fill-39, Cut-55, Fill-40, and Cut-56.
3. Boyalık Neighborhood, Arnavutköy District – This section spans from the exit of Tunnel-22 to the entrance of Tunnel-23 and includes Cut-86, Fill-61, Bridge-35, Fill-62, and Cut-87.

5.1.1.1.2 Model Results

Air dispersion modeling was conducted at three construction zones along the INRAIL Project route — Çayırova, Uskumruköy, and Boyalık — focusing on PM_{10} and $PM_{2.5}$ emissions. Both modeled concentrations and cumulative values (including baseline measurements) were evaluated against national and international air quality standards.

<u>Çayırova Construction Zone</u>

Max. Daily PM_{10}: 32.8 µg/m³ | Annual PM_{10}: 18.1 µg/m³ (Standard: 50 µg/m³)
Max. Daily $PM_{2.5}$: 96.6 µg/m³ | Annual $PM_{2.5}$: 18.1 µg/m³ (Standard: 25 µg/m³)

Highest cumulative concentrations at sensitive receptors remain below applicable standards for

both pollutants ([171]).

Uskumruköy Construction Zone

Max. Daily PM_{10}: 12.9 µg/m³ | Annual PM_{10}: 8.2 µg/m³ (Standard: 50 µg/m³)
Max. Daily $PM_{2.5}$: 32.9 µg/m³ | Annual $PM_{2.5}$: 8.2 µg/m³ (Standard: 25 µg/m³)

Cumulative concentrations at nearby receptors for PM_{10} remain below limits, while $PM_{2.5}$ slightly exceeds the 25 µg/m³ standard at both points ([172]).

Boyalık Construction Zone

Max. Daily PM_{10}: 10.6 µg/m³ | Annual PM_{10}: 6.1 µg/m³ (Standard: 50 µg/m³)
Max. Daily $PM_{2.5}$: 20.5 µg/m³ | Annual $PM_{2.5}$: 6.1 µg/m³ (Standard: 25 µg/m³)

Cumulative concentrations at receptor remain within limits for both PM_{10} and $PM_{2.5}$ ([173]).

All details related to the modeling are provided in the “Air Dispersion Modelling Report” presented in Appendix-9.

5.1.1.1.3 Assessment

The air dispersion modeling conducted for the INRAIL Project’s construction phase revealed that while national air quality standards are not expected to be widely exceeded, localized exceedances of WHO guideline values for PM_{10} and $PM_{2.5}$ are predicted, particularly in Çayırova and Uskumruköy. These exceedances are primarily linked to intensive earthworks and the use of heavy machinery near sensitive receptors such as residential areas.

To address the anticipated exceedances of PM levels, enhanced dust suppression and air quality control measures must be implemented, especially in the affected zones.

Considering that similar earthmoving and construction activities will occur throughout the INRAIL Project corridor, the following integrated mitigation measures shall be applied project-wide to minimize potential dust (particulate matter) emissions, in line with international best practices and WHO air quality guidelines:

Dust Suppression and Emission Control

- Frequent water spraying on exposed surfaces, stockpiles, and unpaved haul/access roads, particularly during dry and windy weather conditions.
- Covering of trucks transporting loose materials, and using enclosed conveyor belts where applicable.
- Application of dust-binding agents (e.g., polymers or wetting agents) on material storage areas and completed earthworks.
- Minimization of simultaneous operation of multiple heavy equipment units in close proximity to sensitive receptors.
- Staging and scheduling of high-dust activities to avoid peak wind periods or community activity hours.
- Construction activities shall be restricted to daytime hours only, typically between 07:00 and 19:00, in accordance with local regulations, unless otherwise approved by the relevant authorities.

Site Traffic and Access Management

- Enforcement of speed limits on unpaved roads and within the construction sites to reduce dust resuspension.

[171] *This refers to the sensitive receptors measured by ‘PM-1’ and ‘PM-2’; details are provided in Section 4.2.9.*
[172] *This refers to the sensitive receptors measured by ‘PM-8’ and ‘PM-9’; details are provided in Section 4.2.9.*
[173] *This refers to the sensitive receptors measured by ‘PM-10’; details are provided in Section 4.2.9.*

- Use of wheel washing systems or gravel pads at site entry/exit points to prevent off-site dust tracking.
- Designated haul routes should avoid passing through densely populated or environmentally sensitive areas wherever possible.

Physical Barriers and Buffer Zones

- Installation of temporary green screens, dust fencing, or other physical barriers between work areas and nearby receptors such as residential neighborhoods, schools, or hospitals.
- Preservation or establishment of vegetative buffer strips along the project corridor to act as natural filters for airborne dust.

Air Quality Monitoring and Adaptive Management

- Deployment of air quality monitoring stations at key locations to track PM_{10} and $PM_{2.5}$ levels in real time, especially near sensitive receptors.
- Use of threshold-based alerts to trigger intensified mitigation when pollutant levels approach or exceed WHO guidelines.
- Regular data review and reporting, feeding into a feedback mechanism for adjusting construction methods and schedules when needed.

All the above measures should be integrated into the C-ESMP and enforced through site-specific Environmental Control Plans (ECPs). Regular training of site personnel, contractor supervision, and community engagement will be essential to ensure effectiveness and accountability in implementation.

Precautionary Measures for Potential Blasting Activities

In the event that blasting is required during construction (e.g., for tunnel entrances or deep rock cuts), the following mitigation and safety measures shall be implemented to minimize potential environmental and social impacts:

- Blasting operations shall be carried out in accordance with national legislation and subject to prior approval from the relevant authorities (e.g., Provincial Directorate of Environment, Gendarmerie, and local municipalities).
- A Blasting Management Plan shall be prepared by a certified explosives engineer and integrated into the site-specific Environmental Control Plan (ECP).
- Local communities shall be notified at least 48 hours in advance of any planned blasting activities, through appropriate channels (e.g., public announcements, SMS alerts, or signage).
- Visible and audible signals (e.g., sirens) shall be used before and after each blast to ensure awareness and safety.
- A controlled exclusion zone shall be established around the blasting site to prevent unauthorized access. Only trained and authorized personnel may enter the zone.
- Blast mats or covers shall be used to reduce flyrock risk and contain debris, especially in proximity to sensitive receptors.
- Blasting-induced vibration and air overpressure shall be monitored in real time using ground vibration monitors placed at nearby structures and sensitive receptors (e.g., residential buildings, cultural heritage sites).
- If measurements exceed regulatory or guideline thresholds (e.g., DIN 4150-3), blasting parameters shall be adjusted accordingly.
- Water spraying shall be performed immediately before and after blasting to suppress dust emissions.
- Blasting shall only be carried out during permitted daytime hours (typically between 07:00 and 19:00) to minimize noise disturbance.
- If necessary, temporary noise and dust barriers shall be erected between the blasting site and nearby settlements.

- Emergency response procedures (e.g., evacuation plans, fire safety protocols) shall be established and communicated to all personnel and relevant stakeholders.
- First aid and fire-fighting equipment must be readily available on site during all blasting activities.

All blasting-related mitigation measures shall be included in the D+B Contractor's OHS Plan and audited regularly by the supervising engineer and E&S Monitoring Team.

5.1.1.2 Operation Period

During the operational phase of the INRAIL Project, air quality impacts are expected to be limited in both scope and intensity. The railway will operate with electric trains, which significantly reduces direct emissions from the line itself, especially when compared to diesel-based alternatives. Therefore, no significant air pollutant emissions are expected from train operations under normal conditions.

However, some indirect and localized emissions may arise from auxiliary operations and support facilities such as:

- Traction power substations,
- Maintenance depots, and
- Associated traffic (e.g., access roads, staff vehicles, logistics activities).

These sources may contribute to limited emissions of PM_{10}, $PM_{2.5}$, NO_2, and VOCs, though well below thresholds defined in national legislation and international guidelines (e.g., WHO and WBG EHSGs for Railways).

In addition, air quality benefits are anticipated at a broader scale. By shifting freight and passenger transport from road to rail, the Project is expected to contribute to:

- Reduction of road congestion and vehicular emissions, particularly around urban areas such as İstanbul,
- Improvement of regional air quality through decreased use of fossil fuel-dependent transport modes,
- Positive contribution to Türkiye's GHG emissions reduction targets in line with its net-zero by 2053 objective.

To ensure that potential air quality impacts during the operational period remain minimal, the following monitoring and management measures are recommended:

- Regular maintenance of electric locomotives and infrastructure to avoid unintended emissions (e.g., from generators or malfunctioning systems),
- Periodic inspection of support facilities for emissions control,
- Continuous implementation of green logistics principles, including low-emission support fleet and efficient freight scheduling,
- If emergency diesel generators or similar backup systems are used, their operation must be limited to testing and emergencies only, and comply with local emission standards.

No cumulative or transboundary air quality impacts are foreseen from normal operation, provided that the system is operated as designed.

5.1.2 Impacts on Climate Change

Climate change refers to long-term shifts in temperature, precipitation, and other atmospheric conditions, primarily caused by the accumulation of greenhouse gases (GHGs) in the atmosphere. Human activities such as fossil fuel use, deforestation, and industrial processes accelerate this trend, resulting in extreme weather events, rising sea levels, and ecosystem disruptions.

Greenhouse gases are both naturally occurring and human-made gases that trap heat in the atmosphere through the greenhouse effect. This intensification of the greenhouse effect is the main driver of global warming, with serious implications for climate systems, environmental balance, and socio-economic conditions.

5.1.2.1 Türkiye's Commitments and Relevance to Project

Türkiye is a party to major international climate-related agreements, including the UNFCCC, Paris Agreement, Kyoto Protocol, CBD, UNCCD, and the Stockholm Convention. These frameworks guide national climate actions but do not directly regulate individual projects, instead encouraging countries to implement their own regulations.

Seven major GHGs that are focused on within the Paris Agreement are:

- Carbon dioxide (CO_2),
- Methane (CH_4),
- Nitrous oxide (N_2O),
- Sulphur hexafluoride (SF_6),
- Hydrofluorocarbons (HFCs),
- Perfluorocarbons (PFCs), and
- Nitrogen trifluoride (NF3).

Türkiye's strategic location enhances its role in global logistics, with plans to become a logistics hub in the Trans-Caspian Middle Corridor and develop new rail routes. This will support low-carbon, multimodal logistics, aligning with Türkiye's 2053 net-zero goal.

The IFC offer standards for managing climate risks and GHG emissions, particularly in renewable energy projects. These frameworks will guide climate impact assessments throughout this Project. Also, IFC's Performance Standard 3 (PS3) on Resource Efficiency and Pollution Prevention is relevant, requiring GHG assessments if Scope 1 and 2 emissions exceed 25,000 tCO_2e annually. Although the Project focuses on renewable energy, it must still evaluate and mitigate operational emissions, aligning with IFC's emphasis on sustainability and emission avoidance throughout the project lifecycle.

In accordance with relevant international standards, the potential impact of the INRAIL Project on climate change has been assessed. The evaluation was conducted by comparing the greenhouse gas (GHG) emissions generated by a conventional diesel-powered heavy goods vehicle (HGV) with those produced by the electric trains planned for the INRAIL Project, over a 127 km distance under typical operating conditions.

5.1.2.2 Emission Scenarios and Comparative Analysis

To assess the potential climate change impacts associated with the INRAIL Project, three comparative emission scenarios have been analyzed: (i) freight transport by diesel-powered heavy goods vehicles (HGVs), (ii) freight and passenger transport by electric trains, and (iii) passenger transport by intercity buses. Each scenario represents a simplified model of typical operating conditions over a distance of 127 km.

5.1.2.2.1 Scenario 1: Electric Train for INRAIL Project

Electricity Source: Supplied through Turkish Electricity Transmission Corporation (TEİAŞ) high-voltage transmission lines and converted at TCDD traction substations before distribution to catenary systems.

Assumptions:

- Emission Factor (EF): 0.445 kg CO_2e per kWh [174]
- Distance (d): 127 km
- Energy Consumption (EC): 25 kWh/km [175]
- Total CO_2e emissions: **0.445 × 25 × 127 = 1,412.875 kg CO_2e per train trip**

5.1.2.2.2 Scenario 2: Diesel-Powered Heavy Goods Vehicle (HGV):

Assumptions:

- 50% laden HGV
- Diesel consumption: 30 L/100 km (approximately 40 L for 127 km)
- Emission factors (per km) [176]:
  - CO_2: 0.82378 kg
  - CH_4: 0.00016 kg
  - N_2O: 0.01195 kg
- Total CO_2e emissions over 127 km: ≈ 102.6 kg CO_2e per HGV

One electric freight train carries the equivalent of 20 heavy goods vehicles (HGVs) in terms of freight capacity. Total HGV emissions to match one train trip:

20 × 102.6 = **2,052 kg CO_2e**

To transport the same amount of freight that one electric train can carry, approximately 20 diesel-powered HGVs would be required. These trucks would collectively emit around 2,052 kg CO_2e over the same distance.

In contrast, a single electric train emits only 1,412.875 kg CO_2e, resulting in an emissions reduction of approximately 34% per train-equivalent shipment.

5.1.2.2.3 Scenario 3: Passenger Transport by Intercity Bus

Assumptions:

- 100 passengers
- Distance: 127 km
- Emission factors (per passenger-km) ([177]):
  - CO_2: 0.10311 kg
  - CH_4: 0.00001 kg
  - N_2O: 0.00073 kg
- Total CO_2e emissions: 100 × 127 × (0.10311 + 0.00001 + 0.00073) = 1,318.895 kg CO_2e per trip

Assuming that one electric train carries 500 passengers, and that 5 buses (with 100 passengers each) would be required to transport the same load by road, the total emissions from bus transport would be:

5 × 1,318.895 kg CO_2e = **6,594.475 kg CO_2e per train-equivalent trip**

In contrast, the electric train emits 1,356.25 kg CO_2e, resulting in approximately 80% reduction in emissions.

5.1.2.3 Comparative Assessment and Interpretation

While the absolute emissions per trip from an electric train may seem higher than a single HGV

174 Source: Emission Factors for Electricity Generation and Consumption in Türkiye, https://enerji.gov.tr/evced-cevre-ve-iklim-elektrik-uretim-tuketim-emisyon-faktorleri
175 Source: International Union of Railways, "Carbon Footprint of High Speed Rail, HSR_Sustainability_carbon_footprint_FINAL _5_)
176 Source: UK Government GHG Conversion Factors for Company Reporting , ghg-conversion-factors-2025-full-set.xlsx
177 Source: UK Government GHG Conversion Factors for Company Reporting , ghg-conversion-factors-2025-full-set.xlsx

or bus, this comparison is misleading without factoring in transport capacity and trip frequency. Rail transport provides:

- Substantially higher capacity per trip (freight and passengers),
- Greater energy efficiency per ton-kilometer and passenger-kilometer,
- Fewer total trips required, leading to cumulative GHG reductions.

Moreover, road vehicles are affected by traffic conditions, acceleration-deceleration cycles, and gradient changes, all of which increase emissions. Rail operations, by contrast, occur in controlled environments with consistent speeds and optimized energy use.

As Türkiye continues to increase the share of renewables in the national electricity grid, the emission factor for rail electricity consumption is expected to decrease, further enhancing the climate benefits of rail-based transport.

5.1.3 Environmental Noise Risks and Impacts

5.1.3.1 Construction Phase

During the construction phase of the Project, elevated noise levels are expected due to the use of heavy machinery and equipment. Activities such as site preparation, excavation, grading, bridge and tunnel works, station construction, and installation of railway infrastructure (signalling, electrification, culverts, level crossings, etc.) are likely to generate intermittent but potentially disturbing noise emissions. These potential impacts may pose a risk to nearby communities and ecological receptors, especially in locations where construction activities are conducted near sensitive areas.

Construction and operational noise and vibration impacts have been further assessed through the Supplementary Noise and Vibration Assessment provided in Appendix 12. The supplementary assessment includes receptor-based noise modelling and vibration assessment based on the Project information currently available and further develops the assessment presented in this ESIA. The findings and mitigation requirements of Appendix 12 shall be taken into account together with the relevant provisions of this ESIA and the ESMP. Further refinement will be undertaken, as necessary, during detailed design and the Lot-specific ESIA process once final construction methodologies, equipment, alignment details and operational parameters are confirmed.

In the interim, the Project will adhere to the daytime noise limits established in the WB-EHSGs, which are considered more stringent than national “Environmental Noise Control Regulation” (published in 30.11.2022 dated 32029 numbered Official Gazette). Construction activities will be limited to daytime hours (07:00–22:00) wherever feasible to minimize disturbance. General mitigation measures such as use of well-maintained equipment, implementation of noise barriers where necessary, and scheduling of high-noise activities during less sensitive times are integrated into the Section 7 of this ESIA Report and the ESMP.

5.1.3.2 Operation Phase

During the operational phase, noise will primarily result from train movement, interaction between wheels and tracks, station operations, and intermittent maintenance activities. Compared to construction, the operational phase is expected to generate lower and more predictable noise levels, particularly due to the use of modern electric trains, which produce significantly less noise than diesel alternatives.

Key noise sources during operation may include:

- Rolling stock noise (wheel-rail interaction and aerodynamic effects),
- Stationary activities (braking, idling, coupling/decoupling),
- Audible warning signals at crossings and stations,
- Regular maintenance and inspection works,

- Increased human and vehicular activity near station areas.

Although some noise may occur during night-time hours, it is anticipated to be within acceptable limits, particularly given the use of modern, low-noise technology and the distance of many receptors from the railway line.

Similar to the construction phase, a detailed noise modelling study for the operational phase should be undertaken by AYGM. This will include an assessment of daytime and night-time noise levels based on finalized train specifications and operational schedules.

5.1.4 Impacts on National Resources

There are no geologically important geological heritage sites in the area and region where the project route is located, and the project has no geological impact.

5.1.4.1 Impact on Surface Water

In the area where the project route passes, stream beds with seasonal and continuous flow are crossed, and the surface waters in question will be crossed by culverts and bridges designed in an appropriate engineering manner.

There are 4 important drinking water dams in the region where the Project route is located. The Project route intersects with the reservoir areas of Ömerli and Büyükçekmece Dams and passes through the absolute, short, medium and long distance protection areas of these dams. The Project route does not intersect with the remaining Sazlıdere and Alibey dams, but remains within the long-distance protection areas of these dams. Crossings over the Ömerli and Büyükçekmece Dams will be provided via bridges to be constructed within the scope of project.

Activities to be carried out within the scope of the Ömerli, Büyükçekmece, Alibey and Sazlıdere Dams will be conducted in accordance with Article 9-10-11-12 of the Regulation on the Protection of Drinking and Utility Water Basins, which came into force with the Official Gazette dated 28.10.2017 and numbered 30224 (Amendment: Official Gazette dated 27.08.2020 and numbered 31226).

In addition, prior to mobilization, the D+B Contractors will prepare and implement a Reservoir Protection Protocol as an annex to the C-ESMP. This Protocol will include:

- zone-specific method statements for activities near reservoir buffer zones,
- secondary containment for fuel and chemical storage,
- hot-work permit procedures,
- designated concrete washout areas with impermeable liners,
- real-time turbidity monitoring at sentinel points with stop-work thresholds (e.g., exceedance above baseline levels),
- immediate notification procedures to İSKİ in case of any exceedance or incident, and
- a pre-works emergency drill coordinated with the managing utility.

The Protocol will be approved by the Employer prior to the commencement of reservoir-adjacent works and subject to weekly inspections during implementation.

5.1.4.2 Impact on Groundwater

The Project route generally passes through hydro geologically low permeable and impermeable geological units and there are no groundwater sources on the route. The following precautions will be taken against accidents and leakages that may occur due to hazardous materials in permeable areas containing local and limited groundwater which are few and localized on the route.

Project's construction activities—particularly tunnel excavation, deep cut-and-cover works, and potential controlled blasting—are expected to interact with local groundwater systems. These

interactions may result in temporary or permanent drawdown of groundwater levels, interception of aquifers, or changes in local hydrogeological flow paths.

Tunnel alignments and deep excavations may encounter pressurized or fractured aquifers, leading to water ingress into construction areas. This may necessitate dewatering operations, which, if not properly managed, could impact surrounding wells, springs, or wetland ecosystems. Moreover, the use of drilling fluids, cement grouting, or chemical sealants during underground works could pose a risk of groundwater contamination, particularly in karstic or high-permeability formations.

To address these potential impacts, the D+B Contractor will carry out detailed hydrogeological surveys prior to major excavation activities. Where groundwater inflow is anticipated, dewatering and drainage plans will be prepared, including water balance assessments and mitigation strategies to protect nearby receptors. Monitoring wells will be installed around sensitive zones to track fluctuations in groundwater levels and quality throughout construction.

All fuels and chemicals will be stored in designated impermeable areas with secondary containment systems to minimize the risk of spills or leaks.

When determining the locations of temporary fuel or oil storage areas, location of water resources will be taken into account. Accidental spill of hazardous materials such as fuel oil, oil, cement etc. will be taken under control immediately.

Drip trays and other secondary containment structures will be used for storage of the fuels and potentially hazardous construction materials.

Spill kits will be kept on site to be deployed in the event of a spillage, and site staff will be trained in their use.

Potential impacts of tunnel-boring chemicals and grouting agents on groundwater quality have been assessed, with particular consideration given to the aquifer units identified in the hydrogeology section. During tunneling activities, the use of TBM conditioning agents (such as foams and polymers) and grouting materials may be required. At this stage, specific products have not been defined; however, it is committed that only environmentally compatible, low-toxicity and, where feasible, biodegradable products will be used.

The potential risk to groundwater quality is mainly associated with accidental release, uncontrolled injection, or excessive use of grouting agents in aquifer zones. With the implementation of controlled application procedures, avoidance of chemical grouting in aquifer areas unless technically unavoidable, and adherence to good international industry practice, the impact on groundwater quality is expected to be minor and manageable.

Additional mitigation measures, including groundwater quality monitoring during construction in sensitive hydrogeological areas, will be implemented as part of the Environmental and Social Management Plan.

Within the scope of the Project, the provisions of the Law No. 167 on Groundwater and the “Regulation on the Protection of Groundwater against Pollution and Degradation” published in the Official Gazette dated April 07, 2012 and numbered 28257 will be complied with within the framework of the protection of groundwater and resources.

5.1.5 Impacts on Biodiversity

The INRAIL Project is located within a highly developed metropolitan area extending across the Asian and European sides of İstanbul. In this context, route selection is shaped by a combination of technical requirements, existing land use, urban constraints and environmental considerations. The selected alignment reflects this set of constraints rather than an idealised, impact-free option.

From a biodiversity perspective, the route largely passes through areas that are already affected

by human activity, including existing transport infrastructure, settlements and modified land uses. This reduces the extent to which new corridors are introduced into less disturbed landscapes and helps limit additional fragmentation of remaining natural habitats at a wider scale.

While biodiversity sensitivities are present within the wider Project area, the selected alignment avoids extensive traversal of large, continuous natural areas. As a result, potential impacts are mainly confined to a defined corridor and can be addressed through targeted design and construction measures.

The location of the Project within an already pressured region such as İstanbul also requires consideration of cumulative effects. In this regard, the selected alignment does not introduce a new development axis into relatively intact areas but instead follows a pattern that aligns with existing development trends. It helps limit the Project's incremental contribution to broader landscape-level impacts.

As detailed in the CHA and Biodiversity Baseline Sections (see Section 4.2.8) the project alignment intersects areas with varying levels of ecological value, including natural and modified habitats. While no site along the project corridor qualifies as a Critical Habitat under the strict thresholds of WB-ESS6 or IFC PS6, several species of conservation concern have been identified, including Cirsium polycephalum (CR), Ferulago confusa (CR), Centautrea hermannii (EN), and others.

Field surveys revealed the presence of threatened plant species and habitat features that warrant precautionary conservation. In line with ESS6 and the mitigation hierarchy, the following key measures are proposed:

- Avoidance of high-biodiversity-value habitats during construction,
- Seed collection and transfer to the TÜBİTAK National Seed Gene Bank,
- Biodiversity monitoring before and during construction,
- Implementation of a BMP,
- Restoration of disturbed natural habitats post-construction.

Overall, although environmental sensitivities cannot be entirely avoided in a metropolitan setting of this scale, the selected alignment allows biodiversity risks to be identified, managed and monitored in a structured manner. In addition, the presence of numerous tunnels and bridge/viaduct structures along the project route minimizes the destruction of natural habitats. An ecological overpass ("Ecological Bridge") has been constructed on the North Marmara Motorway and is aligned approximately with km 2 on the European section of the INRAIL alignment. At this location, the railway will be implemented as a cut-and-cover structure (Cut & Cover-7), which will be excavated during construction and subsequently closed to operate as a covered tunnel upon completion (see Appendix-8). The horizontal distance between the INRAIL alignment and the existing Ecological Bridge, including the cut-and-cover footprint, is approximately 70 meters. From this point, the tunnel portal is located at approximately 225 meters toward the Asian direction, and a bridge crossing is located at approximately 200 meters toward the European direction.

In line with this configuration, the railway will be in tunnel at the ecological crossing location. To ensure continuity of wildlife movement during the construction phase;

- A temporary wildlife passage will be established so that crossings remain functional.
- The reinstated surface over the covered railway will be designed to meet ecological overpass best practice, including minimum effective width and substrate continuity, native vegetation cover, perimeter fencing to guide fauna, exclusion from construction zones, noise and light minimization, and post-construction monitoring.
- In areas where linear features such as valleys, forest edges, or watercourses are present, bat flyways will be established and integrated with the existing KMO crossings. These structures should be designed to be align with natural flight paths extend across the full

width of the railway corridor. Where feasible, the flyways will connect habitat features on both sides (e.g., forest patches and water bodies) and will be supported by appropriate vegetation structure to guide bat movements.

- Where the railway alignment is above ground and parallel to the North Marmara Motorway, additional underpasses for small fauna will be considered, with exact locations to be determined during the detailed design phase.
- Culverts will also be designed at stream crossings to maintain watercourse continuity and enable safe passage for aquatic and semi-aquatic species, with their precise placement determined during detailed design.
- Coordination with the motorway operator and relevant authorities will be undertaken to align timing, fencing tie-ins, and maintenance responsibilities.
- If monitoring indicates residual barrier effects, adaptive measures (e.g., widening of the vegetated platform or enhancements to guide fencing) will be implemented.
- Upon completion of the cut-and-cover works and reinstatement of the surface, the land bridge function will be preserved and the wildlife movement corridor will be restored to its original condition.
- If, during detailed design, additional continuity is warranted, the effective width of the ecological crossing will be extended over the railway section through the covered structure and surface reinstatement to maintain habitat connectivity equivalent to, or better than, current conditions.

The railway alignment was strategically selected to follow an existing transport corridor in many segments, reducing the risk of new habitat fragmentation. Also, no direct impact on protected areas (e.g., national parks or Ramsar sites) has been identified.

Habitat loss along the INRAIL alignment has been quantified through GIS-based overlay analysis using 1:5,000–1:10,000 scale habitat mapping and verified through field surveys. The permanent project footprint—including the railway platform, cut-and-cover structures, embankments, tunnel portals, and permanent access roads—results in an estimated 134.5 ha of permanent habitat conversion. Within these areas, approximately 79.32 ha corresponds to natural habitats (e.g., shrublands, riparian strips, steppe vegetation) and 55.17 ha to modified habitats such as agricultural mosaics. The most sensitive losses occur where the alignment intersects microhabitats supporting CR and EN flora (including *Cirsium polycephalum*, *Ferulago confusa*, and *Centaurea hermannii*) identified around mapped occurrences. Beyond direct land take, indirect impacts were assessed within a 50–100 m ecological influence buffer, resulting in a reduced habitat functionality due to noise, vibration, edge effects, and temporary fragmentation during construction. Although the use of an existing transport corridor substantially reduces new fragmentation risk, the quantification confirms that habitat connectivity will be temporarily reduced at several locations until reinstatement of the cut-and-cover section and associated ecological passage is completed. These quantified results guide the design of avoidance, targeted micro-siting, restoration measures, and species-specific mitigation to ensure compliance with ESS6 and to minimize the net ecological footprint of the project.

If changes are made to the current Project design before or during construction stage, ecologically sensitive areas should be considered when developing new designs. This should include tunnel designs to reduce the risk of collisions in areas sensitive to birds and bats, the creation of parallel crossing areas with the NMM for other fauna species, or the evaluation of tunnel or bridge crossing designs in those areas.

5.1.6 Resource Efficiency and Pollution Prevention

5.1.6.1 Topsoil Management

Topsoil, which contains the most biologically active and fertile layer of soil, plays a critical role in supporting vegetation, regulating hydrology, and preserving local biodiversity. In large-scale linear

infrastructure projects like the INRAIL Project, where extensive excavation and land clearance activities are planned, the protection and reuse of topsoil is a fundamental element of responsible resource management and environmental restoration.

During the construction phase, topsoil will be stripped from all work areas where permanent structures (e.g., railway substructure, stations, viaducts, access roads) are to be built. This includes areas designated for temporary use such as construction camps, storage yards, spoil disposal areas, and diversion roads. The removed topsoil will be stockpiled separately from subsoil and construction waste materials, ensuring it remains uncontaminated and retains its organic and seed content.

Topsoil will be stockpiled in a controlled manner, preferably in windrow formations, and in limited height (not exceeding 2 meters), to prevent compaction and anaerobic conditions. Erosion prevention measures, such as temporary vegetation or geotextile coverings, will be applied to long-term stockpiles. Topsoil stockpiles will also be protected from stormwater runoff to avoid sedimentation and nutrient loss.

Once construction is completed, the stored topsoil will be reused in rehabilitation and landscaping works, including the restoration of temporarily disturbed areas (e.g., material storage sites, diversion channels, temporary access roads), and for the revegetation of embankments, cut slopes, and buffer zones. This approach not only supports soil fertility and erosion control but also promotes the regeneration of native plant species.

D+B Contractors will be required to develop and implement a Topsoil Management Plan as part of the C-ESMP, in line with the Turkish Soil Protection and Land Use Law (No. 5403) and relevant WB's guidance. Monitoring of topsoil stripping, storage, and reuse will be carried out by the Construction Supervision Consultant (CSC) under the oversight of the Project Implementation Unit (PIU).

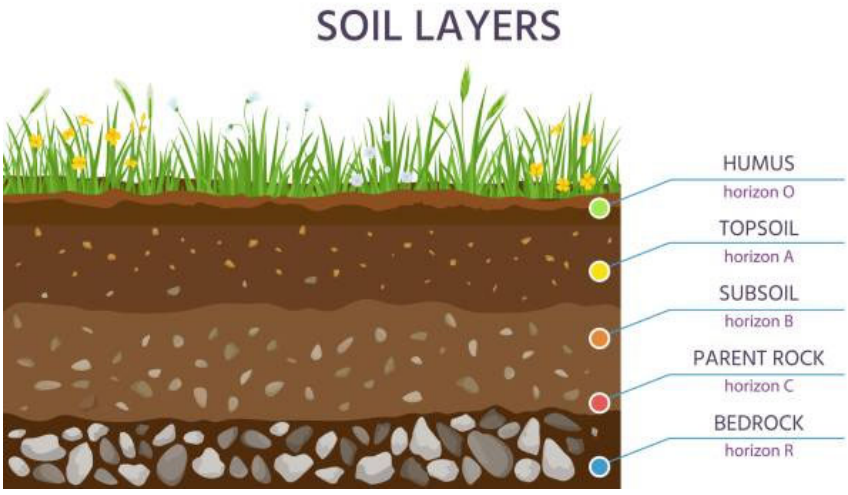


Figure 5-1 Soil Structure Layers [178]

5.1.6.1 Management of Excavated Material

During the construction phase of the INRAIL Project, approximately 30 million cubic meters of excavated material are expected to be generated, including spoil from tunnel excavation works. Of this total volume, an estimated 3 million cubic meters will be reused on-site, primarily as backfill for embankments, structural foundations, and other civil works.

A preliminary breakdown of estimated excavation and backfill volumes for major engineering

[178] *https://www.istockphoto.com/tr/foto%C4%9Fraflar/%C3%BCst-toprak-ill%C3%BCstrasyonlar*

structures is provided in Appendix-8.

The remaining surplus material will be managed in accordance with the provisions of the Regulation on the Control of Excavation Soil, Construction and Demolition Waste (Official Gazette No. 25406, dated 18.03.2004). Disposal activities will be carried out at sites approved by the İBB, which is the competent authority for construction waste management within the province.

The volume of excavated material to be generated in each section of the alignment will be calculated by the D+B Contractor, based on the final construction design. These quantities will be reported in the C-ESMP and in the detailed Waste Management Plan to be developed during project implementation.

To minimize potential environmental impacts related to the generation and management of surplus excavation material, the following mitigation measures will be implemented:

- Excavated materials suitable for reuse shall be prioritized for on-site applications such as backfilling, embankment construction, and landscape shaping, to reduce the need for new material extraction and minimize transport-related emissions.
- Material transportation routes and methods shall be optimized to avoid sensitive receptors, minimize traffic congestion, and reduce dust and noise emissions.
- Temporary storage and loading areas shall be located away from water bodies, drainage channels, and residential areas, and shall be equipped with sediment control and dust suppression measures.
- Disposal of excess material shall be conducted only at licensed and approved facilities designated by the İBB, in compliance with applicable national regulations.
- The D+B Contractor shall prepare a Spoil and Excavated Material Management Plan, including tracking, documentation, and reporting of quantities reused, temporarily stored, or disposed of.
- The largest licensed excavation waste storage areas in İstanbul are presented in Table 4-5, while the complete detailed list is provided in Appendix-11. The spatial relationship of these areas with the project site is illustrated in the satellite image given in Appendix 2.14. These sites constitute the primary officially permitted facilities for excavation material management within the metropolitan area.
- According to publicly available information from İBB, the overall licensed storage capacity across Istanbul is approximately 49 million m³. However, information on the currently utilized and remaining capacities of these facilities is not available.
- Similarly, in Kocaeli Province, excavation waste disposal areas are listed and licensed, yet no publicly accessible data could be obtained on their current or remaining capacities.
- In this context, while potential disposal areas have been identified at a general level, the final determination of the specific sites to be used, the volumes to be disposed of, and the operational arrangements will be agreed upon between the D+B Contractor and the relevant authorities (including the owners/operators of the disposal sites). These details will be set out in the Waste Management Plan to be prepared and submitted prior to the commencement of excavation activities.

In addition to the requirements outlined above, the Contractor will prepare a Excavated Material & Land Management Plan within the C-ESMPduring the early implementation phase. This plan will provide strategic guidance on section-based spoil forecasts, reuse and disposal principles, and coordination with licensed disposal facilities in İstanbul and Kocaeli.

5.1.6.2 Waste Management

In general, wastes need to be properly managed to avoid/minimize potential impacts on community health, safety and environment and unbalanced loads on local waste management facilities (i.e. landfills). Assessment of the impacts and measures to be taken for the minimization of resources use and management of wastes is provided below during construction and operation

phases of the Project.

5.1.6.2.1 Construction Phase

Wastes anticipated to be generated during the construction phase include; municipal solid waste including the recyclable (packaging) waste, excavation waste (i.e. the portion of excavation material that will not be reused on site for cut and fill works), construction waste, wood and timber scraps, and hazardous waste such as waste oils, waste vegetable oils, end-of-life tires, waste batteries and accumulators, waste electric and electronic equipment, and medical waste. Even though the number of workforce and construction machinery and equipment to be involved in the construction will be high and significant volumes of earthworks will take place, the Project will avoid and/or minimize impacts due to waste generation by complying with the requirement of national legislation and applying international standards on waste management.

Municipal Solid Wastes

During the construction phase, maximum of 2,000 personnel is planned to be employed at the Project. As the majority of the Project area is located within the boundaries of İstanbul Province, most of the workforce is expected to be deployed in this region. The exact distribution of personnel between İstanbul and Kocaeli provinces is not clearly defined. Therefore, the estimated calculations for domestic waste generation have been based on the average per capita daily domestic waste generation rate specific to İstanbul Province.

In consideration of these peak personnel numbers and assuming that the daily municipal waste generation rate will be 1.13 kg per person[179], amount of waste estimated to be generated at the Project sites has been calculated. The approximate amount of total municipal waste to be generated daily has been calculated as 2.26 tons.

According to the Environmental Indicators published by the MoEUCC, 35% of generated municipal waste (by weight) would consist of recyclable waste. Therefore, the daily packaging waste that will be generated would be approximately 0.79 tons.

Domestic waste generated within the scope of the Project will be disposed of in waste containers operated by the İstanbul Metropolitan Municipality and the Kocaeli Metropolitan Municipality. The transfer and final disposal of domestic waste will be carried out by the respective municipalities. Formal applications will be submitted to the relevant municipalities, and official correspondence and/or protocols will be obtained accordingly.

Hazardous and Non-Hazardous Wastes

During the construction phase of the Project, various hazardous wastes will be generated as a result of the activities/works involving used fuels, chemicals, paints, oils, solvents, etc. If not managed properly, hazardous wastes may result in soil, surface water and groundwater contamination, as well as health and safety issues for the local communities and the Project personnel.

The following hazardous and non-hazardous wastes are anticipated to be generated as a result of the construction activities. It should be noted that the earthworks will constitute a major part of the construction phase and the amount of chemicals/hazardous substances to be used for the construction works are anticipated to be limited:

Hazardous Wastes

- Personal protective equipment (PPE), absorbent materials, cleaning rags, and work clothes contaminated with oils, greases, fuels, or hydraulic fluids used during railway construction and machinery maintenance,

[179] *Average Municipal Waste Quantity per Person (kg/person-day) of İstanbul Province, 2022, https://biruni.tuik.gov.tr/medas/?kn=119&locale=tr*

- Waste oils, lubricants, and filters resulting from the maintenance and servicing of construction machinery, track-laying equipment, and transport vehicles,
- Paints, thinners, and solvents used in the coating and protection of steel railway structures, bridges, or culverts,
- Waste adhesives, sealants, and epoxy resins used in structural works or rail fastening systems,
- Contaminated packaging (metal or plastic drums, containers) previously used for hazardous substances such as fuel additives, degreasers, or concrete admixtures,
- Spent batteries and accumulators from rail maintenance equipment, temporary lighting systems, or construction site tools,
- Electronic and electrical waste, including circuit boards, cabling, lighting fixtures, or control panels from temporary facilities,
- Herbicides and pesticide residues used in vegetation clearing along the rail corridor and rights-of-way,
- Medical waste (e.g., sharps, dressings, gloves) generated at health unit,
- Soil or absorbent materials contaminated due to spills or leaks of fuel or chemical substances at refueling stations or maintenance areas.

Non-Hazardous Wastes

- Excavated soil, ballast, gravel, and construction debris (e.g., broken concrete, bricks, and excess track bed materials) generated during grading, earthworks, and substructure works,
- Scrap rails, metal offcuts, and other ferrous/non-ferrous materials not contaminated by hazardous substances, arising from track laying and steel structure works,
- Waste wood, plastic, cardboard, and paper from packaging of railway materials, tools, and equipment,
- PVC piping off cuts, insulation foam, and other synthetic materials used in temporary or permanent site installations,
- Domestic waste (e.g., food waste, beverage containers, hygiene products) generated by construction workers at camps and site offices,
- Inert concrete and asphalt waste generated during demolition of old infrastructure or road crossings,
- Textile waste (e.g., worn-out uniforms, blankets, linen, rugs etc.) is used in worker accommodation areas.

As the Project is a linear infrastructure development and construction works will progress in sections, it is difficult to designate permanent waste storage locations. Therefore, the D+B Contractor will establish one or more temporary waste storage areas for hazardous and non-hazardous waste, depending on site conditions and construction progress. Waste generated during construction activities will be collected daily on-site and transported to the designated temporary storage areas. In accordance with the Waste Management Regulation, non-hazardous waste may be stored temporarily for a maximum of 1 year, and hazardous waste for a maximum of 6 months. All such waste will be delivered to licensed waste disposal or recycling companies.

Hazardous and non-hazardous wastes need to be properly managed to avoid significant impacts on both environmental receptors and human health. Waste management activities shall be carried out in full compliance with the requirements of the ESIA Report, the C-ESMP, and the Waste Management Plan to be prepared by the D+B Contractor.

5.1.6.2.2 Operation Phase

During the operation phase of the INRAIL Railway Project, limited but diverse types of waste will be generated as a result of routine activities such as the use and maintenance of railway lines, stations, underpasses, overpasses, and bridges. Although waste generation during this phase is

not expected to be intensive, proper management practices will be essential to minimize environmental impacts and ensure regulatory compliance.

Waste management efforts will primarily focus on the handling of municipal solid waste, recyclable materials, and maintenance-related hazardous waste. All waste management activities will be carried out in accordance with the Waste Management Regulation (Official Gazette No. 29314, dated 02.04.2015) and applicable national legislation.

Municipal Solid Waste and Recyclable Waste

Solid waste will be generated from day-to-day activities of staff and visitors at stations and other operational units. Waste sources will include food waste, packaging, paper, plastics, and other general refuse. Waste quantities will be estimated based on the finalized number of operational staff and expected passenger flow.

These wastes will be collected regularly by the municipal waste collection services from designated collection points to be established at each station. Additionally, visual inspections and periodic waste collection will be conducted along the railway route to remove litter and illegally dumped non-hazardous waste. Recyclable waste will be separated at the source and placed in designated containers for recovery and proper disposal.

Sediment and sludge accumulated in stormwater drainage systems, along with non-hazardous vegetation waste (e.g., grass clippings, tree trimmings), will also be managed as part of routine maintenance activities.

Hazardous and Special Waste

Although limited in volume, certain hazardous and special waste streams may be generated during maintenance works, including:

- Waste oils and lubricants from maintenance vehicles and rail systems,
- Used oil filters, grease-contaminated rags, PPEs, and packaging of hazardous substances,
- Residual paint and paint containers,
- Herbicide and pesticide containers from vegetation control activities,
- Illegally dumped waste with potentially hazardous content (to be analyzed and classified accordingly).

All hazardous waste will be temporarily stored in dedicated and properly labeled containers at secured areas and will be transferred to licensed disposal or recovery facilities within the legally permitted timeframes (6 months maximum).

Maintenance-Related Waste

Maintenance and repair activities—such as ballast screening, superstructure renewal (e.g., replacement of sleepers), and occasional infrastructure repair—will also result in specific waste streams, including:

- Metal components (screws, bolts, fasteners, small machinery parts),
- Plastic and rubber materials (cable insulation, seals, polypropylene/polyethylene parts),
- Glass and wood (broken cab windows, wagon interiors, loading sleepers),
- Used oils (engine and gear oils),
- Welding slag and paint residues,
- Contaminated materials (oil-soaked rags, gloves, cleaning cloths).

These wastes will be managed according to their classification—hazardous or non-hazardous—and handled in compliance with the Waste Management Regulation. Temporary storage areas will be established near key maintenance points, and all waste will be transferred to licensed facilities by authorized transporters. The maintenance / repair work on the railway lines will be carried out at large intervals or in one-off situations.

5.1.6.3 Water Use and Wastewater Management

This section describes the expected water demand and wastewater generation during both construction and operation phases of the Project, along with related management measures. The assessment considers national regulations, international standards, and good industry practices to minimize water consumption and ensure appropriate wastewater handling.

5.1.6.3.1 Construction Phase

The construction phase of the INRAIL Project is expected to involve considerable water consumption, primarily driven by activities such as dust suppression, concrete mixing and curing, tunnel excavation works, and the domestic needs of workers stationed at temporary camps. Water demand will vary depending on the season and the intensity of construction activities, with peak usage anticipated during large-scale excavation and civil works operations.

Water will be sourced from legally authorized suppliers, including municipal networks where available, licensed tanker deliveries, or, if required and approved, permitted groundwater wells. Special attention will be paid to ensuring that water abstraction, if needed, does not adversely impact local water availability or ecosystems.

In the ESIA process, issues such as camp locations, the number of workers to be employed, and the source of concrete materials have not yet been finalised. However, it is estimated that approximately 2,000 people will be employed during the construction phase of the Project, and the amount of water required in this context has been calculated as 380 m^3/day ([180]).

Wastewater generation during construction will mainly originate from worker camps (domestic wastewater), equipment and vehicle washing areas (potentially containing oils or hydrocarbons), and washing operations related to concrete batching plants. To manage these outputs, wastewater will be collected in holding tanks or directed to mobile treatment units installed onsite. For vehicle washing areas, oil-water separators will be used to prevent the discharge of hydrocarbons into the environment. No untreated wastewater will be discharged directly into natural watercourses or municipal stormwater systems.

All wastewater management practices will be carried out in line with the provisions of Türkiye's Regulation on the Control of Water Pollution and the Regulation on Wastewater Discharge. Additionally, water-saving practices, such as the reuse of treated greywater for dust suppression, will be encouraged wherever technically feasible. These measures will be detailed in the C-ESMP and monitored regularly throughout the construction phase.

5.1.6.3.2 Operation Phase

During the operation phase, the Project's water demand is expected to be relatively limited and stable. Water will primarily be used for the cleaning and maintenance of trains, stations, and depot facilities, along with sanitary use by personnel in administrative and technical areas. Routine activities such as train exterior washing and general facility cleaning will be carried out using water supplied from municipal sources, and consumption will be monitored for efficiency.

The wastewater generated during this phase will consist mostly of sanitary effluents from staff use and occasional wash water from cleaning operations. Wherever possible, these will be discharged into the municipal sewer system. In locations where such connections are not feasible, localized treatment solutions—such as septic tanks or compact modular treatment units—will be deployed to ensure compliance with national discharge standards.

To promote resource efficiency, the use of water-saving fixtures in stations and depots will be incorporated into the design. In addition, the potential for integrating rainwater harvesting systems for non-potable uses, such as irrigation or cleaning, will be assessed during the detailed

[180] *Water consumption: 190 l/person-day has been taken. Source: https://biruni.tuik.gov.tr/medas/?kn=121&locale=tr*

engineering phase.

Water and wastewater management throughout the operation phase will remain aligned with relevant national regulations and good international industry practice, ensuring that environmental impacts are minimized and operational efficiency is sustained.

5.1.6.4 Energy Consumption and Efficiency

This section assesses energy consumption patterns and energy efficiency considerations during the construction and operation phases of the INRAIL Project. The analysis is based on the Project's anticipated energy demands, available supply sources, and potential for energy-efficient practices, in line with national regulations and international sustainability principles.

5.1.6.4.1 Construction Phase

During the construction phase, energy demand will be primarily met through the use of diesel fuel and electricity. Diesel will be used to power heavy machinery, generators, and construction vehicles operating on-site, while electricity will be required for lighting, administrative facilities, worker accommodation units, and temporary offices.

The level of energy consumption will vary depending on the scale and duration of construction activities. Tunnel excavation, viaduct construction, and material processing (e.g., concrete batching) are expected to represent the most energy-intensive operations. Temporary diesel generators may be deployed in areas not connected to the grid, particularly in remote segments of the corridor.

In accordance with the principles of resource efficiency, energy-saving measures will be implemented during construction. These include the use of energy-efficient lighting and electrical appliances in site offices and camps, scheduled maintenance of construction equipment to ensure optimal fuel use, and proper operator training to reduce unnecessary idling of machinery. Where possible, low-emission or hybrid construction equipment may also be preferred.

All construction-related energy consumption will be recorded and monitored by the D+B Contractor as part of the C-ESMP, and efforts will be made to reduce the Project's overall construction-phase carbon footprint.

5.1.6.4.2 Operation Phase

The operational phase of the INRAIL Project is designed to be energy-efficient by nature, as it will rely on electrified rail systems for both passenger and freight transport. Electricity for train operations will be supplied by the national grid through high-voltage lines operated by the TEİAŞ and delivered to traction substations managed by the TCDD. These substations will then distribute electricity to the overhead catenary systems.

Energy consumption during operation will primarily include:

- Electricity for train propulsion,
- Power supply to stations and depots (lighting, HVAC, security systems),
- Ancillary systems such as signalling, communication, and control systems.

To enhance efficiency, the system design incorporates modern rail technologies, regenerative braking (if applicable), and centralized energy management systems. Energy-efficient fixtures and equipment will also be used in station buildings and maintenance depots.

Although energy consumption is inevitable during operation, the Project is expected to significantly reduce energy use on a per-unit basis (i.e., per passenger-kilometer or ton-kilometer) when compared to conventional road transport. This modal shift supports Türkiye's long-term decarbonization targets, including the 2053 net-zero commitment, by enabling lower-emission mobility and reducing reliance on fossil fuels.

Energy use and efficiency performance during operation will be tracked through the Project's Monitoring and Evaluation (M&E) system and reviewed periodically to identify opportunities for further improvements.

5.1.6.5 Chemical Material Management and Spill Prevention

This section outlines the management approach for hazardous and chemical substances to be used throughout the Project lifecycle, with a focus on preventing soil, water, and air contamination resulting from improper storage, handling, or accidental spills. The Project commits to applying GIIP in managing fuels, lubricants, paints, solvents, and other potentially harmful materials.

5.1.6.5.1 Construction Phase

During the construction phase, various chemical substances will be used for equipment maintenance, concrete works, and utility installations. These include fuels (e.g., diesel, gasoline), oils, hydraulic fluids, lubricants, welding gases, paints, adhesives, and cleaning agents. The potential environmental risks associated with these materials include accidental leaks, spills, improper disposal, and fire hazards.

All chemical materials will be stored in designated, secure, and clearly labelled storage areas, with proper secondary containment systems (e.g., bunded pallets, impermeable surfaces) to prevent leakages. Fuel and oil storage tanks will be located away from watercourses, drainage ditches, or sensitive ecological areas.

Refueling and maintenance will be carried out in designated service areas, equipped with spill response kits and trained personnel. A Spill Prevention and Response Plan (SPRP) will be developed and included in the C-ESMP, detailing procedures for containment, cleanup, and reporting in the event of a spill.

Contractors will be responsible for maintaining an updated Chemical Inventory Register, including Safety Data Sheets (SDS) for all chemicals on-site, and for ensuring that all personnel handling such substances receive appropriate training.

5.1.6.5.2 Operation Phase

In the operation phase, the use of chemical substances will be limited and primarily related to train maintenance, station cleaning, HVAC systems, and fire suppression equipment. These materials may include cleaning solvents, lubricants, refrigerants, and small quantities of flammable or reactive chemicals.

All materials will be stored and handled in accordance with national regulations and manufacturer recommendations. Maintenance depots will be equipped with appropriate containment systems, ventilation, and fire protection mechanisms. Emergency spill response equipment will be available at strategic locations, and staff will receive periodic training on hazardous materials handling and emergency procedures.

A Chemical Management Plan will be prepared and maintained and regularly reviewed as part of the overall E&S Management System (ESMS). The plan will include procedures for chemical procurement, safe storage, usage tracking, disposal, and spill response protocols.

5.1.6.6 Materials Sourcing and Sustainability

This section addresses the Project's approach to sourcing raw and construction materials in an environmentally and socially responsible manner. It also outlines efforts to enhance sustainability by minimizing the environmental footprint associated with material extraction, processing, and transportation.

5.1.6.6.1 Construction Phase

The construction phase will require substantial quantities of materials such as concrete, aggregates, steel, and ballast. Where technically and economically feasible, materials will be procured from local and permitted suppliers to minimize transportation-related emissions and support local economies.

Priority will be given to materials that meet environmental and social performance standards, including certifications (e.g., ISO 14001), responsible mining practices, and documented labor conditions. Where possible, recycled or reused materials (e.g., crushed concrete, steel rebar) will be integrated into construction works.

The D+B Contractor will be required to prepare and implement a Materials Sourcing Plan, which outlines procurement procedures, supplier selection criteria, and documentation protocols. This plan will also include measures to prevent illegal resource extraction, avoid supply chain-related environmental degradation, and ensure traceability.

5.1.6.6.2 Operation Phase

During the operation phase, materials use will be limited to maintenance and replacement activities related to infrastructure, rolling stock, signaling systems, and station operations. The Project will continue to prioritize the procurement of durable, energy-efficient, and recyclable materials in accordance with long-term sustainability goals.

Wherever possible, products with low embodied carbon, eco-label certifications, or extended service life will be preferred to reduce lifecycle environmental impacts. For example, environmentally friendly cleaning products, energy-efficient lighting, and recyclable construction components will be used in station upgrades or maintenance works.

Procurement procedures will require suppliers to comply with national environmental standards and international best practices related to sustainable production and ethical labor practices. Over time, the Project will seek to integrate sustainability criteria into its procurement policy, contributing to broader low-carbon development goals.

5.1.7 Cumulative Impacts

Cumulative impacts refer to the combined effects of the INRAIL Project with other past, present, or reasonably foreseeable projects in the region. The Project corridor intersects several major infrastructure developments, including:

- Northern Marmara Motorway [181],
- Urban expansion corridors around İstanbul [182] [183] and Kocaeli [184].

When combined with these activities, the Project may contribute to:

- Increased habitat fragmentation and loss of ecological connectivity,
- Higher cumulative noise and air pollution levels near urban and semi-natural areas,
- Greater cumulative pressure on sensitive receptors such as wetlands, streams, and protected species.

The Cumulative Impact Assessment (CIA) has been undertaken using a spatial and temporal scope that differs from the ESIA AoI. While the ESIA AoI focuses on the direct and indirect impacts

[181] *Final ESIA Report of the North Marmara Motorway Project, ENCON Environmental Consultancy Co., March 2018, https://www.kuzeymarmaraotoyolu.com/en/environmental-management*

[182] *Environmental Status Report of İstanbul – 2023, İstanbul Provincial Directorate of Environment, Urbanism and Climate Change, 2024, https://ced.csb.gov.tr/2023-yili-il-cevre-durum-raporlari-i-112399*

[183] *Istanbul Urban Regeneration Strategic Plan and Master Plan (2015-2025), İstanbul Metropolitan Municipality and İstanbul Technical University,March 2015, https://sehirplanlama.ibb.istanbul/stratejik-planlar/*

[184] *Environmental Status Report of Kocaeli – 2023, Kocaeli Provincial Directorate of Environment, Urbanism and Climate Change, 2024, https://ced.csb.gov.tr/2023-yili-il-cevre-durum-raporlari-i-112399*

of the INRAIL Project alone, the CIA AoI encompasses a broader regional context, including other past, present, and reasonably foreseeable projects that interact with the same environmental and social receptors. The temporal scope of the CIA covers historical baseline conditions, the construction and operation phases of the Project, and long-term regional development trends.

The cumulative impact assessment presented in this section has been further developed through the Supplementary Cumulative Impact Assessment provided in Appendix 14. The supplementary assessment considers the Project together with existing, ongoing and reasonably foreseeable developments and environmental drivers affecting shared Valued Environmental and Social Components (VECs), and further informs the Project's cumulative impact management approach.

5.1.7.1 Valued Environmental Components (VECs) and Selection Criteria

For the purposes of the CIA, Valued Environmental Components (VECs) were identified to focus the assessment on receptors that are sensitive to cumulative stressors and may be affected by multiple projects over space and time. VECs were selected based on the following criteria: (i) sensitivity and vulnerability to disturbance, (ii) potential for interaction with other existing or reasonably foreseeable projects, (iii) regulatory or stakeholder importance, and (iv) likelihood of cumulative change beyond project-specific impacts.

Based on these criteria, the following VECs were assessed within the CIA framework:

- Physical environment and natural resources (soil, groundwater, surface water, air quality, noise and vibration),
- Biodiversity and land use, including habitat connectivity,
- Community and socio-economic conditions,
- Urban development dynamics and induced development patterns.

5.1.7.2 Summary of Cumulative Impacts

The Cumulative Impact Assessment carried out through GIS-based mapping of overlapping projects and review of regional development plans adopts a VEC-centered approach, whereby cumulative effects are assessed in relation to each identified VEC rather than individual project activities alone.

Mitigation recommendations include:

- Aligning construction schedules to minimize overlap with other large-scale projects,
- Joint biodiversity offset strategies where multiple projects affect shared ecological features,
- Integrated monitoring of air, noise, and biodiversity parameters across infrastructure networks.

5.1.7.2.1 This Physical Environment & Resources

- Excavation and material handling activities will result in cumulative increases in soil movement and spoil generation, particularly when considered together with other linear infrastructure construction works in the region.
- Cumulative reuse and disposal of excavation materials will put additional pressure on licensed disposal sites and will require coordinated spoil management across projects.
- Construction activities associated with the Project and neighbouring infrastructure developments will lead to cumulative increases in noise and vibration levels, especially for sensitive receptors located near multiple project corridors.
- Groundwater abstraction and dewatering requirements will have cumulative impacts on local groundwater levels and recharge rates, particularly if construction timelines overlap with nearby infrastructure projects.

- The Project, in combination with regional land-use changes, will increase cumulative pressure on surface water and groundwater quality due to construction runoff, accidental spills, and increased impervious surfaces.

5.1.7.2.2 Biodiversity & Land Use

- Habitat disturbance and vegetation clearance will have cumulative impacts on local biodiversity, especially for species dependent on fragmented habitats.
- The combined footprint of multiple infrastructure projects will increase habitat fragmentation and reduce ecological connectivity, potentially limiting species movement across the region.
- Reinstatement works of individual projects alone may not fully offset landscape-level fragmentation; therefore, cumulative biodiversity loss risk remains without coordinated ecological corridor planning.

5.1.7.2.3 Community & Socio-Economic Conditions

- Construction traffic from the Project and nearby infrastructure projects will result in cumulative increases in traffic density and road safety risks for communities located along shared access routes.
- Cumulative construction workforce presence may increase pressure on local services and utilities, such as accommodation, waste management, and health facilities, during peak construction periods.
- Once operational, improved regional transport connectivity will have cumulative positive economic impacts by enhancing mobility, logistics efficiency, and access to employment markets.

5.1.7.2.4 Urban Development Dynamics (Induced Impacts)

- The Project, together with regional transport corridors and ongoing urban expansion, will accelerate induced urban development along transport axes, increasing demand for land conversion from agricultural/peri-urban to urban uses.
- Improved accessibility will likely result in long-term cumulative land development pressure, increasing the likelihood of unplanned or speculative development unless managed through regional planning controls.

For clarity, induced impacts, as described above, are not considered part of the Project's Environmental and Social risk and impact assessment under the World Bank ESF. These dynamics are presented for contextual and informational purposes only and are not assessed as Project-related impacts within the scope of the ESIA.

5.1.7.3 Mitigation Measures and ESMP Integration

To manage the cumulative impacts identified above, a combination of project-specific and coordinated regional mitigation measures will be implemented. The proposed measures aim to minimise cumulative adverse effects, enhance regional synergies, and ensure alignment with national planning authorities and neighbouring infrastructure projects. All measures below are reflected or will be incorporated in the ESMP, C-ESMP and relevant sub-plans.

Physical Environment & Resources

- A coordinated spoil and material management scheme will be established with neighbouring infrastructure projects to avoid capacity exceedance at licensed disposal sites and to maximise beneficial reuse of excavation material (e.g., backfilling, landscaping, agricultural land improvement), in accordance with Waste Management Plan (See Appendix-1 of the ESMP).
- Noise and vibration control measures (use of silencers, equipment maintenance, selection of low-vibration construction methods, scheduling restrictions near settlements) will be

fully implemented and harmonised with nearby construction projects, as outlined in Noise Management Plan (See Appendix-1 of the ESMP).

- Groundwater abstraction and dewatering activities will be coordinated with the regional water authority to avoid cumulative drawdown and maintain aquifer recharge balance, with monitoring requirements defined in Water and Wastewater Management Plan (See Appendix-1 of the ESMP).
- Spill prevention and surface water quality protection measures (secondary containment, refuelling protocols and emergency spill response) will be maintained and reinforced through Pollution Prevention and Control Plan (See Appendix-1 of the ESMP).

Biodiversity & Land Use

- Habitat disturbance will be minimised through prioritisation of already altered or low-value habitats for temporary land-take, and reinstatement will occur progressively to reduce temporal habitat loss, as per Biodiversity Management Plan (See Appendix-2 of the ESMP).
- Where feasible, ecological connectivity measures (e.g., wildlife crossings, green buffers, hedgerow reinstatement) will be coordinated with other projects and local municipalities to reduce landscape-level fragmentation and ensure species movement corridors are preserved.
- Post-construction reinstatement and biodiversity monitoring results will be shared with relevant stakeholders to explore regional scale cumulative habitat enhancement, in accordance with Biodiversity Management Plan.

Community & Socio-Economic Conditions

- Traffic management will be aligned with municipal and regional infrastructure schedules to minimise cumulative traffic load. Joint traffic planning meetings will be initiated with other project operators and authorities, consistent with ESMP–Traffic Management Plan (ESMP-TMP-06).
- Workforce accommodation and local resource use (water, waste, services) will be monitored and, where required, coordinated with municipality service providers to avoid capacity strain, in line with ESMP–Community Health & Safety Plan (ESMP-CHSP-07).
- Stakeholder engagement activities will include communication on cumulative issues (traffic, noise, spoil transport, development interactions) and be addressed through the Stakeholder Engagement Plan (SEP-08).

Urban Development Dynamics (Induced Impacts)

- Engagement with municipalities and planning authorities will be maintained to ensure the Project's infrastructure integration is consistent with regional land-use planning strategies and avoids unplanned land conversion or speculative development pressure.
- Collaboration with authorities will be explored to support sustainable corridor development, for example by promoting integrated public transport nodes or green corridors in urban design processes.

These projects are considered within the CIA to reflect baseline cumulative pressure rather than concurrent construction interaction. The Northern Marmara Motorway and İstanbul Airport projects mentioned in this section have already completed construction and are currently in operation; therefore, no concurrent construction activities are anticipated, and joint mitigation measures such as coordinated schedules or shared haul corridors are not applicable at this stage. The final locations of spoil disposal and storage areas have not yet been confirmed and will be determined by the D+B Contractors during detailed design and early construction planning. Following the confirmation of these sites, a refined cumulative impact assessment—covering potential traffic, air quality, and noise interactions—will be prepared as part of the C-ESMP.

These findings will be refined after discussion on the D+B Contractor's working method and presented in the C-ESMP and revised ESIA (if required), once updated project data and design details are available.

5.2 Social Risks and Impacts

5.2.1 Expected Population Change

Since 2007, the population of İstanbul has fluctuated and has shown negative growth in recent years. However, due to the employment opportunities and supply chain-related advantages the project is expected to bring, population growth is anticipated in the project implementation areas. The negative trend observed in sub-settlements and districts may also shift in a positive direction as a result of these impacts. The population increases during this period will be limited to the construction phase, after which the population is expected to return to its usual trend in line with the general pattern of the region. Transportation projects have been implemented in the area intersecting with the AoI over the past 10 years. In locations overlapping with other projects, signs of fatigue or discouragement among local residents and business owners may be observed in relation to project activities. This situation may lead the public to develop preconceived notions or biases about the project.

5.2.2 Economy and Employment

In the region's economic structure, income from regular employment, commercial activities, and pensions stands out. During this process, interactions with business owners are expected to increase for supply chain management. The potential labor force mainly consists of blue-collar workers employed in the industrial sector. There may be challenges in meeting the demand for unskilled labor if such a need arises. In cases of local recruitment, the presence of individuals who have migrated irregularly may pose a risk for workforce management. Non-resident populations may be inclined toward informal sectors, which can create difficulties in labor management due to the risk of illegal employment.

5.2.3 Occupational Health and Safety (OHS) Risks and Impact

5.2.3.1 Construction Phase

The construction phase of the INRAIL Project involves a wide range of complex and high-risk activities including tunnel excavation, viaduct and bridge construction, earthworks, rail track installation, and electrification works. These activities inherently expose workers to various OHS risks. The following risks and impacts have been identified for this phase:

- Failure to develop a comprehensive Health and Safety Management System (HSMS) or Construction Phase Health and Safety Plan (HSP) before the commencement of site activities, as well as delays in the formation of qualified site-level HSE teams, may result in inadequate coordination, lack of preventive controls, and weak emergency preparedness at the early stages of construction. These gaps may lead to unsafe site conditions, uncontrolled risks during mobilization, ineffective contractor supervision, and higher likelihood of incidents during critical initial works.
- Inadequate development and application of construction-phase OHS documentation including Risk Assessments, Method Statements, Emergency Response Plans, Permit-to-Work systems, Accident and Incident Records, Root Cause Analyses, and monthly OHS Performance Reports may lead to gaps in safety implementation, delayed corrective actions, and regulatory non-compliance. The absence of structured monitoring and documentation systems may result in increased accident frequency, recurrence of preventable incidents, lack of accountability, and reputational and legal risks for the project.
- During Tunnel Construction (both TBM and NATM methods), workers operating in confined and enclosed spaces may be exposed to serious OHS risks such as insufficient

ventilation, low oxygen levels, accumulation of toxic gases, ground instability, tunnel collapse, fire, and explosion. These risks may result in respiratory problems, poisoning, crushing, severe injuries, or fatalities.

- Activities related to Bridge and Viaduct Construction involve working at height, which exposes workers to the risk of falling and being struck by falling objects. In the absence of sufficient edge protection, safe scaffolding systems, and fall arrest equipment, serious injuries such as fractures, head trauma, or fatalities may occur.
- During Excavation, Filling, and Earthworks, unstable soil conditions, slope failures, and loose backfill materials pose risks such as burial, suffocation, and crush injuries. The concurrent operation of heavy machinery within excavation areas further increases the risk of collision, entrapment, and serious workplace accidents.
- In Heavy Equipment Operation and Material Handling Activities, machinery such as cranes, excavators, loaders, and dump trucks may move with limited visibility, particularly during reversing maneuvers or while carrying unbalanced loads. Workers in the vicinity may suffer from crushing, collision, or entrapment injuries that could result in long-term disability or death.
- During Work on Temporary or Permanent Electrical Systems, if isolation, grounding, and lock-out/tag-out procedures are not properly implemented, workers are exposed to life-threatening risks such as electric shock, arc flash, and burns due to accidental contact with live conductors. These incidents may result in severe burns, permanent nerve damage, or fatalities.
- Mechanical Activities such as drilling, cutting, blasting, transportation, and breaking produce high levels of noise, vibration, and dust. Prolonged exposure to these factors may lead to hearing loss, respiratory illnesses (such as asthma or silicosis), headaches, and musculoskeletal disorders, especially in the absence of proper PPE.
- Jobs involving Manual Handling, Loading/Unloading, and Repetitive Physical Strain pose ergonomic risks. Inadequate working posture and lack of lifting aids may lead to lumbar disc herniation, muscle-tendon injuries, wrist disorders, and long-term functional limitations.
- In operations involving Hazardous Chemicals such as paint, solvents, adhesives, fuels, and lubricants, insufficient ventilation or inadequate PPE use may result in direct chemical exposure. This may lead to skin and eye irritation, poisoning, respiratory problems, and an increased risk of fire or explosion.
- Outdoor Activities in Extreme Weather Conditions expose workers to environmental stress. High temperatures may cause heat stroke, fainting, and dehydration, while cold environments may lead to frostbite, hypothermia, and reduced motor coordination. These conditions also increase the likelihood of secondary accidents due to loss of concentration.
- Construction activities conducted in Rural or Natural Areas may expose workers to biological hazards such as bee stings, snake bites, or insect infestations. Such incidents may lead to allergic reactions, panic-induced falls or equipment-related accidents, and situations requiring emergency medical response.
- During On-Site Vehicle and Machinery Traffic, the lack of proper signage, inadequate traffic separation, and limited visibility may result in collision, entrapment, or crushing incidents involving pedestrians. These types of accidents frequently cause severe injuries or fatalities.
- Electrification and Signaling Works involve the installation and energization of high-voltage catenary systems and the commissioning of signaling equipment. During these tasks, workers are exposed to serious risks such as electric shock, uncontrolled energization, short circuits, fire, and arc flash. In addition, functional testing of signaling systems carries the risk of technical failure, which may result in unexpected system behavior and accidents affecting technical personnel.

- Workers living or working in shared accommodation and natural areas may be exposed to infectious diseases due to poor hygiene, limited access to clean water, or insufficient preventive health services. Vector-borne diseases such as Crimean-Congo Hemorrhagic Fever (CCHF) transmitted by ticks and regionally endemic during spring and summer months pose a seasonal risk to outdoor construction workers. Outbreaks of such diseases may result in absenteeism, reduced labor productivity, increased healthcare burden, and public health concerns if not properly monitored and controlled.

These risks may result in a range of potential impacts, including temporary or permanent injury, long-term occupational illness, reduced worker productivity, and increased absenteeism. Accidents may also affect project timelines and labor relations if not adequately managed.

5.2.3.2 Operation Phase

During the operation phase, the INRAIL railway will be fully electrified and actively transporting passengers and/or freight. Though less labor-intensive than construction, the operation phase carries specific OHS risks, particularly related to the maintenance of infrastructure, operation of high-voltage systems, and safe management of rail traffic.

- Failure to develop a comprehensive Operation Phase Health and Safety Management System (HSMS), including clear procedures for routine and emergency conditions, regular reporting, and contractor performance monitoring, may result in inconsistent safety implementation. Absence of documented OHS procedures during operation may cause inadequate hazard control, uncoordinated response actions, weak regulatory compliance, and long-term safety performance issues.
- Inadequate development and use of operation-phase OHS documentation, including Risk Analyses, maintenance task, safety checklists, work permits, incident investigation reports, and monthly OHS performance indicators, may result in gaps in safety implementation and reduced responsiveness to incidents. This may lead to repetitive safety violations, unreported near misses, and occupational accidents, posing risks for the operator.
- During continuous operation and maintenance of high-voltage electrification systems such as overhead catenary lines and traction substations, workers may face significant risks such as electric shock, arc flash, and equipment-induced fire or explosion. Failure to follow lock-out/tag-out procedures and poor system isolation may lead to fatalities, infrastructure damage, and service disruption.
- Operation and inspection of signaling and control systems including ERTMS, ETCS, and ATP modules carry risks of software failure, human error during functional testing, or system overload. Such failures may result in loss of train control, unauthorized movements, and operational accidents involving both personnel and passengers.
- Routine inspection and maintenance of rail tracks, switches, bridges, tunnels, and technical buildings expose workers to hazards related to working near railway lines. These include being struck by moving trains, slipping on tracks, or falling from structures, particularly in poor weather or low visibility conditions.
- During tunnel and enclosed structure inspections, workers may face exposure to poor ventilation, gas accumulation, and limited escape routes. Without adequate lighting, oxygen level monitoring, or confined space entry procedures, these tasks may result in respiratory problems, collapse, or fatal entrapment incidents.
- Operation and handling of hazardous materials such as fuels, degreasers, paints, and cleaning agents without proper ventilation and PPE may expose workers to chemical burns, respiratory hazards, and increased fire risk. Spills and leakages may also cause environmental contamination and public health concerns.
- Long-term exposure to noise and vibration from operational trains and maintenance activities may lead to hearing damage, stress-related disorders, and reduced

concentration levels among workers, particularly those stationed along high-frequency corridors.

- Increased passenger traffic and pedestrian movement in and around stations and railway crossings may pose collision and fall risks. Overcrowded areas, lack of clear signage, or panic during emergencies may result in injuries, especially for vulnerable groups such as elderly or disabled passengers.
- Emergency scenarios such as train derailments, onboard fires, technical breakdowns, or sabotage may cause major disruptions if response teams are untrained or equipment is insufficient. Delayed intervention or lack of coordination with local emergency services may increase the severity of injuries and infrastructure damage.
- Lone workers operating in remote or sparsely monitored areas such as track sections far from urban centers face increased risks in case of accidents, health emergencies, or acts of aggression. Delayed emergency detection or response may result in avoidable injury severity or death.
- The operation of freight trains carrying dangerous goods such as flammable, explosive, toxic, or corrosive substances through stations and lines that are also used by passenger trains poses elevated health and safety risks. In the event of derailment, leakage, fire, or accidental release, these materials may endanger not only railway staff but also passengers, station personnel, and nearby communities. The absence of dedicated hazardous material handling protocols, real-time risk communication systems, and emergency isolation procedures increases the likelihood and severity of impacts. Mixed-use of stations and tracks without proper segregation or scheduling controls further raises the risk of exposure, evacuation challenges, and cascading disruptions in case of an incident.

These risks may lead to occupational injuries or illnesses, particularly if standard safety protocols are not strictly enforced. Such incidents may also disrupt operational continuity and public trust in the safety of the railway system.

5.2.4 Impacts on Communities Health and Safety

The INRAIL Project has the potential to affect community health and safety primarily during the construction phase, and to a lesser extent during operation. These impacts stem from increased vehicle movements, construction site hazards, temporary access restrictions, and interactions between construction workers and local populations. The Project will comply with WB-ESS4 requirements, which aim to protect communities from risks associated with project activities.

In accordance with WB ESS4, security personnel may be employed around construction sites to manage access, ensure the safety of workers and the public, and prevent unauthorized entry. All security personnel will be properly trained and qualified, with competencies including: site-specific safety procedures, emergency response, crowd management, conflict de-escalation, non-discrimination, and adherence to human rights standards. In addition, reasonable background checks will be conducted to verify that security personnel, whether directly employed or contracted, are not implicated in past abuses, in line with ESS4 requirements. They will receive periodic refresher training and clear guidance on the appropriate use of force, communication protocols, and coordination with local authorities to ensure that their presence maintains community safety without causing negative impacts on surrounding populations. A Security Management Plan will be implemented to ensure that any security personnel engaged for the Project operate in line with ESS4 principles, including respect for human rights, proportional use of force, and effective grievance mechanisms for affected communities.

5.2.4.1 Construction Phase

During the construction phase, the most significant risks to community health and safety include:

- Increased traffic volume on public roads due to the movement of heavy machinery, trucks transporting construction materials, and worker transportation. This may result in higher risks of road accidents, particularly in rural or residential areas with limited road infrastructure.
- Noise, dust, and vibration emissions from excavation, blasting (if used), and heavy machinery operations, potentially affecting the well-being of nearby residents and sensitive receptors such as schools or hospitals.
- OHS with potential spillover, such as improper handling of fuel, chemicals, or wastewater that could pose risks to adjacent communities if containment measures fail.
- Restricted access or temporary disruption to public roads, agricultural lands, or utility services in some locations, especially during tunnel and viaduct construction.
- Interaction between workers and local residents, which may lead to risks related to communicable diseases, GBV, or social tension if not properly managed.

Construction-related traffic and transportation impacts have been further assessed in the Supplementary Traffic Impact Assessment provided in Appendix 13. The assessment further evaluates construction traffic generation, haulage routes, road network interactions and community health and safety risks, and provides additional inputs for traffic management measures to be implemented through the relevant Project E&S instruments and Contractor management plans.

To address these risks, the D+B Contractor will develop and implement a Community Health and Safety Plan, including:

- Traffic Management Plan (TMP),
- Public signage and road safety measures near construction zones,
- Dust and noise control measures (e.g., water spraying, noise barriers),
- Emergency preparedness and response procedures,
- Stakeholder communication and GRM,
- Workforce CoC, including provisions for GBV/SEA prevention.

5.2.4.2 Operation Phase

Once operational, the Project is not expected to pose significant risks to community health and safety. On the contrary, the shift from road to rail transport is expected to enhance safety by reducing traffic congestion and accident risks on major road corridors.

Potential residual risks include:

- Railway crossing safety, especially where at-grade crossings exist (though most are planned to be grade-separated).
- Electrification hazards, related to overhead catenary systems, which will be mitigated through fencing, signage, and education campaigns.
- Noise and vibration from rail operations in urban areas, to be managed through engineering controls and buffer zones where needed.

Overall, the Project will apply GIIP to minimize community exposure to health and safety risks, while improving regional transport efficiency in the long term.

5.2.5 Land Acquisition Impacts and Risks

The exact number of affected persons and scope of land acquisition will be clarified during the detailed design stage. Based on current preliminary estimates, approximately 441,200 m² will be required for bridges and viaducts, and around 2,495,555 m² for cut-and-fill areas, including tunnel entrances, exits, and shaft locations. In total, the land area to be used for the Project is estimated at approximately 296 hectares. These figures are provided at this stage solely to give an indicative understanding of the potential land requirements and may be subject to change as the design

progresses. The estimated area currently comprises treasury lands, forest areas, pasturelands, areas under the control and disposal of state institutions, lands expropriated within existing road boundaries, and privately owned parcels.

Although final alignment of the route, the expropriation corridor, and the location and dimensions of auxiliary facilities have not yet been finalized, it is estimated that around 100 agricultural fields, 10 commercial businesses and 10 houses will be affected from expropriation. Therefore, the number of affected households is estimated around 120.

The primary concerns regarding the residential areas intersecting with the AoI relate to the potential damage to housing. Some homeowners may have expectations such as the appreciation of the value of their land and houses.

Concerns related to agricultural lands are largely influenced by experiences from previous projects. Sensitivities are higher among households whose sole source of livelihood is agriculture and related activities.

Views regarding the project's impact on livestock and grazing areas are not clear. However, there are informal users in the common use areas, although their numbers are unknown. Migrant individuals involved as labor in these activities are also considered a vulnerable group.

The most prominent concerns regarding the intersection with commercial activity areas relate to potential access restrictions for businesses. In addition, concerns have also emerged regarding income loss due to job losses among the existing workforce concentrated in the limited commercial and industrial areas.

Negative experiences related to land acquisition during past project phases in settlements intersecting with the AoI have led to increased concerns regarding land acquisition, including expropriation. Sensitivities are particularly high regarding avoidance of residential areas.

On the other hand, ongoing zoning and construction bans in certain areas are among the most fundamental problems faced by local settlements. Therefore, zoning and housing issues are expected to pose significant challenges for this project as well.

5.2.6 Impacts on Cultural Heritage

This section describes the impact associated with cultural heritage. CHIA team is actively engaged in the research of potential archaeological sites, which may partially fall within the project boundary. A baseline study is planned to explore these areas, and the findings were incorporated into the ESIA to ensure the preservation and inclusion of cultural heritage in the Project. Impact assessment studies for cultural heritagewas carried out in accordance with ICOMOS's the Guidance and Toolset for Impact Assessment in the Context of World Heritage ICOMOS (2022) documents, considering national legislation and international standards. Following the finalization of the alignment, site-specific field surveys will be conducted in any newly affected areas. Findings from these surveys will be used to develop site-specific mitigation measures for each identified cultural heritage site, in line with requirements issued by the relevant Regional Directorate of Culture. These measures will be detailed in the updated final ESIA report to be finalized by AYGM, and incorporated into the C-ESMP prepared by the D+B Contractor.

5.2.6.1 Construction Phase

The walkover survey method was carried out within the Project route to understand whether any tangible cultural heritage assets existed on 22/ 25 May 2025. 50 registered and unregistered cultural heritage site/ asset have been encountered during the walkover survey studies for the Project route and 400 m. impact corridor. The registered and unregistered cultural heritage sites, along with its classifications, features and location, is shown in Table 4-71 and Figure 4-47.

Elements that might have an impact on cultural heritage during land preparation and construction phase of the Project are provided in Table 5-1.

Table 5-1 Project-Based Potential Impact Elements for the Land Preparation and Construction Phase

Factors affecting Tangible Cultural Heritage	Factors affecting Intangible Cultural Heritage
• Topsoil stripping • Cutting • Excavation and Filling • Blasting • Construction traffic movement • Siting of construction sites and other Project/associated facilities • Piling • Landscaping/ earth-mounding • Waste disposal including excess excavated materials • Structures, installation features (fencing, cables etc.) • Presence of workforce • Leaks and spills	• Human Movements • Traffic Movements (vehicles and staff)

Minimizing or eliminating the negative effects that may occur on cultural heritage assets during the land preparation and construction phase can only be achieved by implementing the defined specific measures for each cultural heritage asset. The table above (Table 5-1) defines the sources of negative impacts that may occur on cultural heritage assets (tangible and intangible) during the project construction phase. The negative impact on cultural heritage can be reduced to acceptable levels after the measures are to be taken and systematic observations.

The activities to be conducted during all Project phases may cause direct potential impacts on the cultural heritage receptors, if not properly managed. Potential impacts are direct damage or disturbance to cultural heritage assets, including:

- Physical damage due to land preparation activities including topsoil stripping, excavation, filling, and blasting,
- Physical damage due to construction and mining activities, including noise, vibration, dust, equipment and heavy vehicles, spills and leaks,
- Noise and visual intrusion on people's appreciation of cultural heritage,
- Disruption of access to cultural heritage sites,
- Enhanced access to cultural heritage sites allowing increased opportunity to outside parties for collection of artefacts or damage to resources,
- Loss or change of identity or significance of the intangible cultural heritage,
- Effects of noise and visual intrusion on the ability of communities to appreciate and use their intangible cultural heritage,
- Disruption or diminution of cultural ecosystem services including customary ways of understanding the wider world and for maintaining social relations and group identity.

In addition to direct impacts, damage due to looting and interference may occur. Site may suffer inadvertent damage or interference. There may be piecemeal illicit removal of portable antiquities from the archaeological site within the Project.

Baseline information on the internationally recognised cultural heritage areas has been provided in Section 4.3.16.1 Given the distances of the sites under the World Heritage List, it is assessed that the Project will not have an adverse physical or setting impact on them nor will it induce any significant changes to visitor numbers, site access and conservation. The closest site under the World Heritage Tentative List of UNESCO is located at a distance of 3 km to the south of the Project route (Yoros Fortress in İstanbul- Beykoz). It is assessed that the Project will not have an impact on this site.

In line with Law on Preservation of Cultural and Natural Assets" (no: 2863), AYGM will notify the responsible official organizations (İstanbul 1, İstanbul 3, İstanbul 5, İstanbul 6 and Kocaeli Regional Council for the Conservation of Cultural Property) about the tangible cultural heritage sites identified within the study area, as given in this ESIA Report. To this end, the information collected through field surveys (such as site-specific photos, site survey forms, site coordinates,

digital data, expert notes, etc.) will be delivered to this institution in order to initiate official decision processes relevant to the site. The ESMP will include Chance Find Procedures, which the D+B Contractor will follow during Project implementation.

The negative impacts can be minimized or eliminated with appropriate management and planning. A Cultural Heritage Management Plan and a Chance Find Procedure for the project specific were prepared by CHIA Team. These documents are included in the ESMP and bidding documents, and the D+B contractor is required to comply with them during the construction and operation phases, taking into account the CHIA study results. during the construction and operation phases, taking into account the CHIA study results.

As the result of desktop studies and field works, any harm to intangible cultural heritage patterns because of the Project activities is not foreseen for all settlements in the CHIA study area. The Project does not propose to use the cultural heritage, including knowledge, innovations, or practices of local communities for commercial purposes (examples include, but are not limited to, commercialization of traditional medicinal knowledge or other sacred or traditional technique for processing plants, fibres, or metals). Assessment of the impact of the project on intangible cultural heritage has been conducted in the Project route and its vicinity in compliance with international standards and local legislation. Findings of the intangible cultural heritage studies conducted within the project were presented previous sections.

5.2.6.2 Operation Phase

As the result of desk studies and field works, any harm to cultural heritage patterns because of the Project Operation Phase activities is not foreseen for cultural heritage in and around the study area. However, provided that the impact-mitigation measures are taken during the construction phase there will be no element (human movements etc.) that may have an impact on cultural heritage during the operating phase and there will be no related impact.

5.2.7 Labor Management

Labor management practices under the INRAIL Project are governed by the LMP prepared in alignment with Turkish legislation and the WB's ESS2 on Labor and Working Conditions. The LMP provides a comprehensive framework for the recruitment, management, and protection of workers throughout the construction and operation phases of the Project.The Project workforce comprises direct workers (employed by AYGM), contracted workers (engaged through D+B contractors and CSC), and primary supply workers (employees of suppliers providing essential goods and materials). No community workers are anticipated.

Given the large scale of construction activities and reliance on subcontracted and migrant workforce, potential labor management risks include:

- OHS incidents arising from high-risk construction activities.
- Excessive working hours and wage-related grievances, particularly among subcontracted workers.
- Labour relations issues, such as strikes or collective disputes, which may affect project timelines and stability.
- Worker accommodation and living conditions that may fall short of international standards, leading to health or hygiene concerns.
- Tensions with local communities due to labor influx, increased demand on housing and local services.
- Risks of discrimination, harassment, and gender-based violence, including SEA/SH.
- Gaps in subcontractor compliance with labor standards, increasing risks of child labor, forced labor, or informal employment.

These risks have been identified as inherent to projects of this magnitude and are addressed through the LMP, which establishes preventive and corrective measures in compliance with

national legislation, ESS2, and international good practice.

The LMP outlines measures to mitigate key labor risks such as OHS, excessive working hours, child and forced labor, labor influx-related pressures, and risks associated with sexual exploitation and abuse (SEA) and sexual harassment (SH). These risks are particularly relevant due to the scale of construction activities, use of subcontractors, and potential presence of migrant workers. The Project ensures adherence to national labor laws, including Law No. 4857 (Labor Law) and Law No. 6331 (OHS Law), and applies international good practices. Contractors will be required to prepare site-specific Labor Management Plans (LM Plans) and OHS Plans in line with the LMP and the ESMP.

The GRM tailored for workers has been established to allow confidential and effective reporting of concerns, including SEA/SH incidents. All workers are trained in the CoC, which explicitly prohibits any form of harassment or abuse. Special attention is given to the working and living conditions of workers. If camps are provided, they will meet the minimum standards set out in the IFC/EBRD guidance note on worker accommodations. Regular monitoring will be conducted by the CSC and the PIU to ensure compliance with labor and OHS standards. The implementation of the LMP, including updates by AYGM, will be implemented by the D+B Contractor and continuously monitored by the PIU and the CSC, with corrective actions taken as necessary.

5.2.8 Gender and Vulnerability Assessment

The INRAIL Project recognizes the importance of identifying and addressing the needs and concerns of vulnerable groups and ensuring gender-sensitive planning throughout its lifecycle. Vulnerable individuals or groups—including but not limited to women (especially female-headed households), children, the elderly, people with disabilities, migrants, and economically marginalized populations—may face challenges in accessing information, engaging in consultation, or benefiting from project-related opportunities.

5.2.8.1 Gender Equality and Women's Participation

Baseline demographic data, both from TurkStat and the Household Survey conducted in 2025, show that women represent approximately 51% of the total population within the AoI. However, women remain underrepresented in public spaces and local governance structures. For instance, the proportion of female mukhtars in rural areas remains below 1%. Furthermore, employment rates among women, particularly widowed or divorced women, are significantly lower than those of men, which places female-headed households in a more vulnerable socio-economic position.

The Project's stakeholder engagement strategy includes provisions to ensure women's meaningful participation, especially in decision-making processes and consultations. Special attention is paid to ensuring that women who are landowners or heads of households are not excluded from land acquisition consultations or compensation processes.

5.2.8.2 Risks of Gender-Based Violence and Sexual Exploitation and Abuse

The influx of an estimated number of construction workers (anticipated to reach up to approximately 2,000 personnel at peak construction) and the potential establishment of temporary labour camps in semi-rural areas present a range of social risks that extend beyond SEA/SH concerns. A Management Plan will be prepared for these labor camps to mitigate risks related to labor influx in host communities. Large-scale labour influx may place pressure on local housing, basic services, and infrastructure; create tensions between host communities and incoming workers; and generate health and hygiene risks associated with high-density accommodation facilities. Such conditions, combined with pre-existing power asymmetries and weak institutional mechanisms in rural settings, can heighten vulnerabilities of women, girls, and other at-risk groups.

Within this context, the Project is considered to have a moderata risk of SEA/SH. The fact that the labor accommodation sites are located away from densely populated residential areas

reduces the SEA/SH risk to a moderate level. A Project-specific SEA/SH Action Plan and Accountability Response Framework is prepared by AYGM PIU, informed by the SEA/SH risk assessment and consultation findings, and will set out proportionate prevention and response measures in accordance with World Bank guidance. In response, the LMP and associated E&S instruments establish a multi-layered risk management framework. Key measures include:

- Adoption of a mandatory CoC by all workers, explicitly prohibiting GBV/SEA/SH and outlining behavioural expectations.
- Establishment of comprehensive worker training programs and awareness-raising activities addressing gender equality, SEA/SH prevention, and respectful community interactions.
- Integration of SEA/SH prevention and response protocols into the worker-specific GRM, ensuring confidential and survivor-centred reporting channels.
- Implementation of a Labour Influx Management Plan (LIMP) requiring contractors to regulate worker–community interactions, manage recruitment and accommodation, and apply disciplinary measures for non-compliance.
- Compliance with IFC/EBRD worker accommodation standards, ensuring adequate living space, sanitation, health care access, and camp security.
- Regular monitoring of worker accommodation and contractor performance by the PIU and CSC, complemented by third-party audits where necessary.
- Targeted engagement with host communities, particularly women and youth groups, to address concerns, prevent tensions, and foster positive socio-economic linkages.

In addition, the Project will identify and establish GBVH survivor referral pathways in collaboration with local institutions and relevant service providers in the project area, ensuring that survivors have access to confidential, survivor-centred medical, psychosocial, and legal support services.

Through these measures, the Project seeks not only to mitigate SEA/SH risks but also to manage broader labour influx and camp-related impacts in line with ESS2, ESS4, and international best practice.

5.2.8.3 Vulnerable Groups

The Project identifies several groups as vulnerable based on socio-demographic, economic, or physical characteristics. These include:

- Gender aspect: Women who are heads of households on their own;
- Age aspect: Individuals in the older age group (including those living alone);
- Economic aspect: Households facing economic difficulties;
- Health aspect: Persons with disabilities;
- Education aspect: Illiterate adults;
- Cultural aspect: Non-Turkish speaker

The DVIG groups listed here include individuals who may experience increased vulnerability due to project impacts as well as those who may face disadvantages in participating in stakeholder activities. The involuntary physical and economic resettlement effects associated with land acquisition can increase pressure on these vulnerable groups. In addition to the groups listed here, informal user(s) may also be considered part of the vulnerable groups. However, no direct work has been conducted for this PAP group at this time.

5.2.8.4 Alignment with International Standards

The gender and vulnerability assessment is aligned with the WB's ESF, particularly:

- ESS1: Inclusive identification of social risks;
- ESS2: Ensuring equal opportunity and non-discrimination in employment;
- ESS4: Addressing community health and safety, including GBV risks;

- ESS10: Stakeholder Engagement, with a focus on vulnerable populations.

6 ANALYSIS OF ALTERNATIVES

This section presents a systematic comparison of feasible alternatives to the proposed INRAIL Project—including site selection, alignment, design, and operational options—as well as the “no-project” scenario. The goal is to inform decision-making by evaluating how different options vary in terms of environmental and social risks and impacts, the feasibility of mitigation, and alignment with Türkiye’s broader strategic goals, particularly in multimodal transport and low-carbon development.

6.1 No-Project Alternative

The "no-project" scenario was considered as a baseline. Under this alternative, freight and passenger trains would continue to rely on the Marmaray tunnel as the only Bosphorus rail crossing. This would maintain current operational limitations, including:

- Severe restrictions on freight movement due to limited night-time access,
- Reduced tunnel availability for maintenance, risking long-term infrastructure sustainability,
- Continued reliance on inefficient and polluting rail-to-truck transshipment for freight,
- Persisting urban congestion and high road maintenance costs in İstanbul,
- Missed opportunities for multimodal logistics and improved air-to-rail connectivity.

Given these constraints, the no-project alternative would undermine Türkiye’s ambitions to enhance rail-based freight and passenger transport and its role as a logistics hub within the Middle Corridor. As such, this alternative is not realistic and wil be discarded by the Government.

6.2 Route Alignment and Station Alternatives

As part of the alignment planning process, several key route options were explored to optimize the operational, economic, and environmental efficiency of the proposed railway bypass. In particular, the placement of station nodes near İstanbul’s two major airports-Sabiha Gökçen and İstanbul Airport—was analyzed in depth.

a) Sabiha Gökçen Airport Station Alternatives

Three alternatives were considered for the Sabiha Gökçen Airport connection:

Alternative 1: Construction of a station near Viaport Shopping Mall, with passenger transfers to the airport via dedicated road-based shuttle services.
Alternative 2: Construction of a station near Viaport Shopping Mall, with an additional metro line providing a direct rail link between the station and Sabiha Gökçen Airport.
Alternative 3: Direct integration of the INRAIL alignment with Sabiha Gökçen Airport, by routing the railway beneath the terminal and establishing a station within the airport complex.

Following a comprehensive technical and strategic assessment ofthe following multi-criteria factors, Alternative 3 has been selected as the definitive solution. Alternative 3 has been selected as the definitive solution.

i. The station at Sabiha Gökçen Airport strengthens Türkiye’s position as a regional transport hub by ensuring seamless integration between rail and air systems. It supports the national agenda for low-carbon mobility, contributes to the reduction of road congestion, and enhances Türkiye’s competitiveness in both passenger and freight transport in the long run.
ii. Although the initial construction cost of an underground station is higher than surface-based alternatives, the long-term operational savings and reduced need for secondary infrastructure (e.g., shuttles, additional metro lines) make it more efficient across the lifecycle of the project. This option avoids fragmented

investments and ensures sustained economic benefits.

iii. As İstanbul's second-largest airport and a rapidly growing international hub, Sabiha Gökçen requires direct and reliable passenger connections. Alternative 3 eliminates the need for intermediate transfers and provides passengers with a direct rail-to-terminal experience, minimizing travel time, enhancing comfort, and ensuring that the airport can accommodate increasing passenger volumes with efficiency.

iv. Direct integration at Sabiha Gökçen facilitates smoother inter-airport connectivity when combined with future INRAIL connections to İstanbul Airport. Passengers, including international transfer travelers, will benefit from an efficient rail link between the two airports, reducing dependency on road transport and significantly cutting transfer times.

Direct integration of the INRAIL alignment with Sabiha Gökçen Airport reduces ecological disturbance, and limits disruption to surrounding communities. The direct underground connection reduces private car usage, lowers carbon emissions, and improves local air quality, making it the most sustainable choice from both an environmental and social standpoint.

Table 6-1 Multi-Criteria Analysis – Sabiha Gökçen Airport Station Alternatives

Criteria	Alt. 1 – Viaport + Shuttle	Alt. 2 – Viaport + Metro Link	Alt. 3 – Direct Underground Station
Long-term contribution to Türkiye's transport and logistics vision	2 – Limited, relies on road transfers and does not strengthen intermodal capacity	3 – Some contribution via metro, but still indirect and fragmented	5 – Strong contribution; establishes Türkiye as regional hub with direct intermodal integration
Cost-effectiveness and lifecycle efficiency	4 – Low initial cost, but high O&M for shuttles and congestion issues over time	3 – High cost for metro extension, moderate lifecycle benefits	4 – Higher upfront cost, but strong long-term efficiency and operational savings
Easy passenger transportation to Sabiha Gökçen (second biggest airport)	2 – Requires shuttle transfer, increases travel time and inconvenience	3 – Metro reduces time, but still indirect and less attractive for passengers	5 – Direct terminal access, fastest and most convenient passenger experience
Seamless transfer between İstanbul's two airports	2 – Weak; shuttle dependency undermines reliable inter-airport transfer	3 – Metro helps, but still fragmented	5 – Direct integration enables fast and seamless inter-airport connectivity
Land take and land acquisition	2 – Requires surface-level road use and ancillary facilities, increasing land take pressure	3 – Metro extension requires permanent right-of-way and construction footprints	5 – Fully underground solution minimises land take and avoids permanent surface acquisition
Community impacts (noise, air quality, traffic, livelihoods)	2 – Increased road traffic, noise and air emissions affecting nearby communities and livelihoods	3 – Construction-phase disturbances, but reduced long-term traffic-related impacts	5 – Limited surface disturbance; lowest long-term noise, air quality and traffic impacts
Impacts on sensitive environmental receptors (forests, biodiversity, habitats)	2 – Indirect pressure due to road traffic, emissions and potential urban sprawl	3 – Localised construction impacts along metro corridor	5 – Avoids sensitive surface habitats through underground alignment
Water resources and hydrogeological sensitivity	3 – Limited direct interaction, but increased runoff and pollution risk from roads	3 – Potential localised impacts during construction	4 – Temporary construction-related risks, manageable with standard mitigation measures

Weighted Total Score (out of 25)

- Alternative 1 (Viaport + Shuttle): 12/25

Indicatively, this option would require approximately 200,000 m² of additional land to construct

the transfer station and associated shuttle facilities at Viaport.

- Alternative 2 (Viaport + Metro Link): 15/25

This alternative would also require approximately 200,000 m² of land for a transfer station and the related metro extension facilities connecting Viaport and Sabiha Gökçen Airport.

- Alternative 3 (Direct Underground Station): 24/25

Unlike the other two options, this alternative would not require any additional surface land, as the station would be integrated within the existing airport terminal structure.

This Table 6-1 clearly shows Alternative 3 is the strongest, especially in terms of long-term strategic contribution, passenger convenience, and inter-airport transfer efficiency. By selecting the direct underground connection alternative for the Sabiha Gökçen Airport link, the Project avoids the use of approximately 200,000 m² of additional surface land that would have been required under the other options.

The other two alternatives —Viaport Mall-based road transfer and the metro connection— have been excluded from further consideration. The direct rail link to Sabiha Gökçen Airport has been deemed most suitable to meet the project's intermodal, operational, and long-term sustainability goals.

b) İstanbul Airport Station Alternatives (Freight and Passenger Services)

Similarly, two alternatives were evaluated for the İstanbul Airport segment:

Alternative 1 – Combined Airport Station for Freight and Passenger Services: This alternative involves the construction of a single rail alignment and a shared station within the İstanbul Airport area, designed to serve both freight and passenger trains. Unlike the separate station approach, this option consolidates operations into one corridor to reduce land use and lower construction costs. However, combining freight and passenger services-particularly when hazardous materials are transported by freight trains-can significantly increase safety risks. The lack of physical separation raises the potential for accidents or incidents that could impact both transport modes. Therefore, careful planning and the implementation of robust safety measures will be essential.

Alternative 2 – Separate Airport Stations for Freight and Passenger Services: This alternative involves the construction of two separate rail alignments and two corresponding stations within the İstanbul Airport area—one dedicated to freight trains and the other to passenger trains. One of the primary reasons for separating freight and passenger train operations in this alternative is the need to address safety concerns related to the transportation of hazardous materials. Freight trains often carry substances that pose significant risks in the event of an accident or spill. By establishing separate rail alignments and stations for freight and passenger services, the design effectively minimizes the potential for interaction between these two modes, thereby reducing the likelihood of safety incidents. This separation not only enhances operational safety but also ensures compliance with international standards for hazardous materials transport within mixed-use infrastructure systems. By separating freight and passenger operations, this option enables more efficient and safer traffic management. It also ensures both transport modes are effectively integrated with the airport, enhancing overall network efficiency. The specific mitigation measures to be taken in this regard will be detailed in the ESIA Report.

c) İstanbul Airport Station Alternatives (Rail Connection to the Cargo Terminal)

Two alternatives were evaluated for the İstanbul Airport – cargo terminal segment:

Alternative 1 – Adding Rail Connection to the Cargo Terminal: This alternative includes the construction of open-ended short branch lines/spurs from the INRAIL alignment directly to the cargo terminal of İstanbul Airport. Supporting multimodal freight operations, this

option aligns with Türkiye's objective to become a regional logistics hub. Although it requires additional investment and close coordination with airport operations, it enables seamless air-to-rail logistics transfers and offers long-term advantages in terms of efficiency and competitiveness in freight transport.

Alternative 2 – Excluding Rail Connection to the Cargo Terminal: This alternative considers the option of not extending a rail spur from the INRAIL alignment to the cargo terminal of İstanbul Airport. Under this scenario, rail access would be limited to passenger services and freight transport to and from the airport would continue to rely on existing road-based logistics infrastructure. While this option avoids the need for additional investment and mitigates the complexity of coordinating with airport authorities during construction and operation, it also forgoes the opportunity to integrate air and rail freight systems. As a result, it may limit the project's contribution to Türkiye's broader strategic objective of enhancing its multimodal transport capabilities and positioning itself as a regional logistics hub. In the long term, the absence of a direct rail link to the cargo terminal could result in operational inefficiencies and reduce the competitiveness of rail freight services associated with the airport.

d) Considerations:

The evaluation of these alignment alternatives considered multiple criteria, including technical feasibility, cost, travel time, multimodal integration, land use impacts, and future scalability. Direct airport access alternatives for both Sabiha Gökçen and İstanbul Airport were ultimately favored in preliminary assessments due to their strategic alignment with national logistics goals, potential to enhance user experience, and support for low-emission transport systems.

The evaluation of the proposed alternatives for İstanbul Airport—both in terms of passenger/freight station arrangements (Section b) and the potential rail connection to the cargo terminal (Section c)—is still ongoing. A final decision has not yet been made. However, the assessment is guided by a set of comparative criteria, including:

- Technical feasibility and constructability,
- Safety considerations, particularly regarding the transport of hazardous materials,
- Cost-effectiveness and land use efficiency,
- Operational flexibility and traffic management,
- Level of integration with existing airport infrastructure,
- Impact on multimodal transport potential,
- Compliance with international standards, and
- Alignment with Türkiye's national logistics and low-carbon transport goals.

For Section b, the key comparison revolves around the balance between cost savings through a combined station and the safety and operational benefits of separating freight and passenger services. Safety concerns, especially related to hazardous freight transport, are a significant factor in this evaluation.

For Section c, the alternatives are being assessed based on the long-term benefits of direct cargo terminal access versus the simplicity and reduced cost of avoiding such integration. While direct connection supports enhanced multimodal logistics, it also entails more complex construction and coordination.

The final selection for both configurations will be based on a holistic review of the above factors, with the aim of ensuring that the chosen design maximizes safety, operational efficiency, and alignment with the project's strategic objectives.

6.3 Comparison of Alternatives and Preferred Option

The alternatives considered for the INRAIL Project—particularly those related to the Sabiha Gökçen and İstanbul Airport station configurations—have been evaluated based on a set of

environmental and social criteria. These include potential impacts on land use, community safety, emissions, multimodal connectivity, and long-term sustainability.

Sabiha Gökçen Airport Station Alternatives

Among the three alternatives evaluated, **Alternative 3** (direct connection beneath the terminal) was selected as the preferred option. This alternative:

- Minimizes additional land take and avoids additional surface infrastructure, thus reducing ecological disturbance and land use conflicts.
- Provides a fully integrated rail-air transfer system, encouraging public transport use and reducing reliance on private vehicles, thereby lowering carbon emissions and local air pollution.
- Eliminates the need for shuttle or metro construction, which would have required additional right-of-way and caused greater short-term construction impacts.

. As described in Section 6.2, each alternative's indicative land requirement was assessed to enable a direct comparison of the land take implications.

In contrast, Alternatives 1 and 2 would have introduced additional road traffic or required new infrastructure, increasing land acquisition needs, energy consumption, and potential community disruption.

İstanbul Airport Freight and Passenger Station Alternatives

The evaluation is still ongoing between **Alternative 1** (combined station) and **Alternative 2** (separate stations). However, preliminary assessments suggest that:

- **Alternative 2** is more favorable from a **community health and safety** perspective due to physical separation between passenger and freight operations—particularly where hazardous materials are involved.
- While **Alternative 1** may be more cost-effective and land-efficient, it presents greater safety risks and potential regulatory challenges due to mixed-use infrastructure.

Environmental impacts such as noise, vibration, and emissions during operations are also likely to be better managed under Alternative 2, where freight operations can be confined to more isolated alignments.

İstanbul Airport Cargo Terminal Connection Alternatives

Similarly, both alternatives remain under review. However, from an environmental and social standpoint:

- **Alternative 1**, which proposes a direct spur to the cargo terminal, aligns with national low-carbon logistics goals. It facilitates rail-based freight transfers, reducing truck traffic and associated emissions.
- **Alternative 2**, which omits the rail connection, may lower construction impacts but misses the opportunity to support multimodal transport and reduce long-term environmental burdens associated with road logistics.

Overall Assessment

From an environmental and social risk management perspective, the **preferred alternatives (e.g., direct connection at Sabiha Gökçen)** demonstrate clear advantages in terms of:

- Minimizing land and resource use,
- Enhancing safety and efficiency,
- Supporting sustainable mobility,
- Reducing long-term environmental footprints.

The selection of final alternatives for İstanbul Airport will continue to consider these criteria in the

forthcoming ESIA phase, and will be supported by further stakeholder consultations, quantitative impact assessments, and cost-benefit analyses, and will be finalized in the ESIA with proper and comprehensive information on social impacts, including but not limited to land acquisition/land take, livelihood impacts, and resettlement considerations.

During the early planning stage, at least two to three broad corridor alternatives were considered prior to the selection of the preferred route. These alternatives were assessed at a strategic level, taking into account ES constraints in addition to technical and economic considerations.

The comparative assessment focused on key ES factors, including proximity to settlements and sensitive receptors, potential land acquisition and resettlement requirements, impacts on biodiversity and habitat connectivity, interactions with surface water and groundwater resources, and cumulative social effects.

While technical feasibility and cost efficiency were primary drivers in the final route selection, the preferred corridor was also found to offer relative ES advantages compared to other alternatives, including reduced interaction with densely populated areas, lower risk to sensitive ecological receptors, and improved opportunities for impact avoidance and mitigation. On this basis, the selected route represents a balanced option from both technical and environmental and social risk management perspectives.

7 MITIGATION MEASURES

This section outlines the mitigation measures proposed to prevent, reduce, or otherwise manage the potential adverse environmental and social impacts of the Project. It also identifies any significant residual negative impacts that cannot be fully mitigated, and—where possible—assesses the acceptability of such residual impacts.

Differentiated measures are incorporated to ensure that adverse impacts do not disproportionately affect disadvantaged or vulnerable groups. Furthermore, this section specifies issues that require no further action, with a clear rationale for such determinations.

The content also provides guidance for the preparation of specific sub-plans aimed at managing impacts on various valued environmental and social components. The detailed mitigation measures are presented in the accompanying mitigation tables within this section (The tables, including magnitude and receptor sensitivity matrices, are provided in full in the ESMP document).

7.1 Mitigation Measures for Construction Phase

Table 7-1 Mitigation Measures for Construction Period

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
Environmental and Social Management System	Lack of E&S Management System Failure to coordinate environmental and social mitigation measures; non-compliance with ESSs	Wide	Medium-term reversible	Medium-term	Continuous/ Recurrent	Moderate	Medium	High	Major	- Development and implementation of C-ESMP with all sub-management plans - Deployment of qualified E&S staff within PIU and CSC - Regular audits, monitoring and reporting mechanisms	Negligible	AYGM PIU (overall ESMP framework) D+B Contractor (site-specific sub-plans, C-ESMP)	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Environmental and Social Management System	Lack of continuous environmental and social monitoring may lead to unidentified non-compliance.	Wide	Medium-term reversible	Medium-term	Continuous/ Recurrent	Moderate	Medium	High	Major	- Implement the monitoring plan (air, noise, vibration, water, biodiversity, social etc.) as defined in ESMP. - Apply KPI thresholds defined ib the ESMP(aligned with WB standards). - Regular reporting by the D+B Contractor to the CSC/Engineer, verification and consolidation through the CSC and PMC, and reporting to AYGM and the World Bank in accordance with the Project reporting arrangements, together with corrective action plans for exceedances.	Negligible	AYGM PIU (monitoring framework, KPIs) D+B Contractor (detailed site monitoring plan)	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Seismicity	Risks to human safety, infrastructure, and the environment from earthquakes or earthquake-induced events, including building collapse, landslides, soil liquefaction, and disruption of services, potentially affecting workers, communities, and ecosystems.	Wide	Medium-term reversible	Long-term	Intermittent	Moderate	Medium	Medium	Major	- All engineering structure and superstructures (fill, cut) in the project closure will be designed and constructed taking into account the earthquake resistant design parameters and criteria. - The structures planned for construction within the project will strictly comply with regulations outlined in two official publications. These include the “Regulation Regarding Buildings to be Constructed in Disaster Zones” issued by the Emergency Management Presidency of Türkiye published in the Official Gazette dated 18.03.2018, and the “Earthquake Building Regulation” of the Ministry of Public Works and Settlement, published in the Official Gazette dated 14.07.2007. - All engineering designs will be implemented in full compliance with the Turkish Seismic Code, AFAD regulations, and other relevant national standards. In addition, system-level seismic performance objectives and post-event operational criteria will be further defined within the Employer’s Requirements and the detailed design documentation.	Minor	AYGM PIU (design standards, regulatory compliance)	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Surface Water Quality	Pollution of surface water due to sediment runoff, concrete washout, spills, or wastewater discharge	Wide	Medium-term reversible	Long-term	Intermittent	Significant	High	High	Moderate	- Implement erosion and sediment controls (silt fences, traps, buffer zones) near water bodies. - Use silt fences, sediment traps, and buffer zones to reduce sediment runoff. - Designate washing/maintenance areas away from streams with oil-water separators. - Prohibit direct discharge of untreated wastewater; maintain continuous flow via proper diversion methods. - Ensure continuous water flow through proper diversion methods; do not allow stream interruption. - Construct upstream and downstream cofferdams based on highest expected flow; design diversion channels with adequate slope to minimize erosion. - Use subsoil excavated from diversion channel areas for cofferdam construction. - Upon completion of stream crossing works, remove cofferdams and backfill diversion channels using excavated native soil. - Reestablish the natural watercourse by removing the downstream cofferdam first, followed by the upstream one, ensuring uninterrupted flow. - Establish buffer zones around sensitive areas; use temporary bridges/culverts for safe crossings. - Construct temporary bridges or culverts to allow safe vehicle and equipment crossing over the riverbed.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- Carry out excavations in a controlled manner to prevent abrupt changes in riverbed levels. - Prevent oil/fuel leaks with spill barriers; maintain safe machinery distances near water. - Establish safe working distances for machinery near water bodies; install physical barriers to prevent accidental falls into streams. - Prepare emergency response plans for flood or high-flow events and provide training to site workers accordingly. - Implement strategic land use plans to minimize impacts on agricultural areas and natural habitats. - Monitor and regulate water consumption to prevent over-extraction and contamination of local water resources. In addition, as committed under Section 5.1.4.1 of this ESIA, the D+B Contractors will prepare and implement a **Reservoir Protection Protocol** as an annex to the C-ESMP. The Protocol will define zone-specific method statements, secondary containment for fuels and chemicals, hot-work permit procedures, designated concrete washout areas, real-time turbidity monitoring at sentinel points with stop-work thresholds, immediate notification to İSKİ/DSİ, and a pre-works emergency drill with the managing utility. The Protocol will be approved by the Employer prior to mobilization and subject to weekly inspections during works adjacent to reservoir protection zones.			
Groundwater	Interference with groundwater flows due to tunneling, deep excavation, or dewatering activities; contamination risk from fuel, wastewater, and construction chemicals	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Major	- Conduct hydrogeological surveys prior to deep excavation or tunneling activities - Identify potential aquifer intersections and determine required dewatering measures - Use closed-loop or lined dewatering systems to prevent uncontrolled discharge - Store fuel, chemicals, and construction materials on impermeable surfaces with secondary containment - Install groundwater monitoring wells around sensitive zones - Prohibit direct discharge of contaminated water into soil or karstic areas - Train workers on good groundwater protection practices and emergency spill response	Moderate	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Wastewater	Pollution of soil and water bodies due to improper discharge of domestic and process wastewater (e.g., from worker camps, concrete batching, and vehicle washing areas)	Local	Medium-term reversible	Medium-term	Continuous/ Recurrent	Moderate	Medium	High	Moderate	- Install mobile or modular treatment units or holding tanks at worker camps and regularly dispose of domestic wastewater through licensed service providers - Design concrete batching and equipment washing areas with impermeable flooring and wastewater collection systems - Install oil-water separators at vehicle and machinery washing zones - Prohibit direct discharge of untreated wastewater into surface waters or the ground - Ensure compliance with the Turkish Water Pollution Control Regulation and integrate measures into CESMP	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Air Quality	Emission of dust (PM_{10}, $PM_{2.5}$) and exhaust gases from excavation, earthmoving, and vehicle operations; potential exceedance of WHO air quality standards near sensitive receptors	Wide	Medium-term reversible	Long-term	Intermittent	Moderate	Medium	High	Major	- Apply frequent water spraying on unpaved roads, stockpiles, and active work zones, especially during dry and windy conditions - Cover trucks transporting loose materials and install wheel-washing stations at site exits - Use dust-binding agents (e.g., polymers) on large earth surfaces and stockpiles - Minimize simultaneous operation of heavy equipment near sensitive receptors - Restrict construction activities to daytime hours only (typically 07:00–19:00) - Establish vegetative buffer zones or temporary	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										physical dust barriers near settlements and schools - Conduct continuous PM_{10} and $PM_{2.5}$ monitoring near the most vulnerable locations - Maintain construction equipment regularly to minimize emissions			
Climate Change	- During construction and operation phases, greenhouse gas (GHG) emissions will occur mainly from diesel-powered machinery, transportation vehicles, energy consumption, and material production (e.g., steel, concrete). - Indirect impacts include land clearing (loss of carbon sinks) and soil carbon loss due to excavation and grading. - Increased GHG emissions may contribute to climate change and potentially affect Turkey's national emission targets (2053 net-zero goal).	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Major	- Adopt low-carbon design principles: select construction materials with recycled content and lower embodied carbon. - Optimize rail alignment to minimize land take and forest clearance. - Integrate energy efficiency criteria into equipment procurement and facility design. - Use modern, fuel-efficient, and well-maintained machinery to reduce fuel consumption. - Promote renewable energy sources (e.g., grid electricity, hybrid equipment) where feasible at camps and worksites. - Implement anti-idling policies and schedule works to minimize machinery run time. - Develop a GHG inventory and monitoring system for major emission sources (fuel logs, energy meters). - Provide training for contractors on energy efficiency and carbon footprint reduction.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Waste Management	Improper waste handling, storage, or disposal leading to soil, water, and air pollution	Restricted	Irreversible/ Long-term reversible	Short-term	One-off/rare	Moderate	Low	High	Moderate	- Minimize waste through personnel training and adherence to the waste hierarchy (prevent, reduce, reuse, recycle, recover, dispose). - Implement prevention, recycling, reuse, and recovery strategies to reduce waste; dispose of remaining waste with measures to protect health and the environment. - Classify waste as recyclable, hazardous, or non-hazardous; separate mineral construction waste from other waste types through on-site sorting. - Collect non-hazardous, inert, biodegradable, and recyclable waste separately, ensuring no mixing with hazardous waste. - Establish a temporary waste storage area with impermeable ground, roof, drainage, spill kits, and firefighting equipment; store waste in labeled compartments by type. - Limit hazardous waste storage (except medical waste) to 6 months and non-hazardous to 1 year; obtain a storage permit if hazardous waste exceeds 1,000 kg/month. - Keep detailed records of waste generation, storage, and disposal; complete a Waste Registry Information Form and submit an annual waste declaration to MoEUCC via the Integrated Environmental Information System. - Report all waste management agreements and protocols, including recycling and disposal, to the relevant authority.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Waste Oils	Improper storage or disposal of waste oil can cause soil and water contamination, leading to environmental damage and toxic exposure risks. Its flammable nature also poses fire hazards. Additionally, it presents health and safety risks to workers.	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Moderate	- All maintenance-related waste, including used oil, oil filters, and oily rags, will be collected and disposed of properly. Waste oils will never be discharged onto the ground or into any water bodies. - If different categories of waste oils are generated at the construction site, they will be stored separately to prevent cross-contamination. - Waste oil storage containers will be kept sealed at all times to prevent rainwater infiltration and ensure safe containment. - Waste oils will be transported using licensed vehicles and disposed of at authorized recycling or disposal facilities in compliance with the Waste Oil Management Regulation.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Topsoil Management	Loss, degradation or contamination of topsoil due to improper handling, storage, or mixing with subsoil,	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Moderate	- Topsoil will be stored adjacent to its removal area, preferably on flat land with a maximum slope of 5%.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:**

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
	potentially resulting in reduced land productivity, erosion, and hindered site restoration.									Pile height will not exceed 2 m, and side slopes will be limited to 45°. - The pile surface will be lightly compacted to allow rainfall infiltration and prevent anaerobic conditions. - Topsoil will be kept separate from subsoil, with measures such as geotextile covers or silt fences to avoid mixing. - Piles will be positioned to allow free drainage, with surrounding drainage channels connected to natural drains or surface water flow points. - Part of the topsoil from surface facilities will be used for landscaping after construction, with the remainder applied to offset potential losses in nearby areas; any excess may be made available to the local community upon request. - Topsoil from temporary areas will be reapplied to the site during restoration works. - Topsoil will not be used as padding, pipe bedding, or backfill material.			Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Excavation Material Management	Uncontrolled or non-compliant handling, storage, or disposal of excavated materials may lead to land degradation, obstruction of natural drainage patterns, contamination of ecologically or culturally sensitive areas, and violation of legal requirements under national waste regulations.	Restricted	Medium-term reversible	Short-term	One-off/rare	Significant	Low	Medium	Moderate	- The subsoil to be formed will be stored in excavation soil storage areas to be approved by the relevant municipalities within the framework of the provisions of “Regulation on the Control of Excavation Soil, Construction, and Debris Wastes” published in the Official Gazette numbered 25406 and dated 18.03.2004. - Existing possible material disposal sites include: Istanbul Leather Organised Industrial Zone; İSTAÇ – İmrahor Excavation Material Storage Area; İSTAÇ – Atalaylar Excavation Material Storage Area; İSTAÇ – Çiftalan Excavation Material Storage Area; and İSTAÇ – Büyükkılıçlı Excavation Material Storage Area. Further details, including capacities, are provided in the ESIA Baseline (see Section 4.2.6.2 and Annex EK-11). If a new excavation storage area is requested by the contractor, approval will be obtained from the relevant municipality within the framework of the provisions of RCESCDW. - The subsoil to be formed should be temporarily stored on a flat ground next to the construction area at a height of maximum 3 m and with a slope of maximum 450. - The unauthorized storage or disposal of subsoil on agricultural lands, pastures, meadows, or private properties will be strictly prohibited under the relevant regulations. - Excavated soil shall in no way be disposed of in riverbeds, dam lakes, or stream beds, regardless of whether they are seasonal or permanent, nor in areas protected for biological, ecological, or cultural reasons - The Contractor will prepare a high-level Excavated Material & land Management Plan within the C-ESMPto define overarching principles and coordination mechanisms for spoil handling, transport, reuse, and disposal.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Chemicals and Hazardous Materials Management	- Risk of soil and groundwater contamination due to leaks or spills of hazardous materials - Fire and explosion hazards, especially during transportation and storage of fuels and solvents - Adverse health impacts on workers and surrounding communities - Improper waste management leading to environmental pollution - Lack of emergency preparedness for chemical accidents	Restricted	Short-term reversible	Long-term	Intermittent	Moderate	Low	Medium	Minor	- SDSs shall be available for all hazardous materials and personnel shall be informed accordingly - Chemicals shall be stored in sealed, clearly labeled containers and in designated storage areas with appropriate containment systems - Storage facilities shall be protected against external factors such as flooding or rainwater infiltration - Fuel and chemical refueling operations shall be conducted in designated areas by trained personnel - Spill response kits (absorbents, fire extinguishers, etc.) shall be kept available on site at all times - Hazardous wastes shall be stored in designated temporary storage areas until transferred to licensed	Negligible	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										facilities, and all handling shall avoid spill risks outside the AoI. - Regular training shall be provided to workers on safe chemical handling and emergency response procedures - Waste management practices shall comply with national regulations such as the Regulation on Control of Hazardous Waste and Waste Oil Management Regulation, as well as IFC/EBRD standards			
Noise and Vibration Management	- Disturbance to nearby sensitive receptors such as residential areas, schools, and hospitals due to elevated noise levels - Health impacts such as stress, sleep disturbance, and hearing loss among workers and communities - Potential structural damage to nearby buildings due to vibration from heavy equipment or tunneling activities	Wide	Medium-term reversible	Medium-term	Continuous/ Recurrent	Moderate	Medium	Medium	Minor	- Conduct baseline noise monitoring at key sensitive receptor points prior to construction - Schedule high-noise activities (e.g. pile driving, heavy excavation) during daytime hours only - Maintain equipment to minimize noise (e.g. mufflers, silencers) - Use low-noise machinery and acoustic barriers near sensitive areas when necessary - Implement vibration monitoring in areas where underground or structural risks exist - Inform nearby communities in advance of planned noisy activities - Provide workers with hearing protection equipment and conduct regular OHS trainings related to noise exposure	Negligible	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Biodiversity	Population of endemic and rare species decrease	Wide	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Moderate	Several plant species with restricted or critical distribution have been recorded within the project area, including Centaurea hermannii, Cirsium polycephalum, Ferulago confusa, Symphytum tuberosum subsp. nodosum, Leucojum aestivum, and Lilium martagon. In order to ensure the protection and long-term conservation of these species and their habitats, the following measures should be implemented: • Seeds of the aforementioned species should be collected during the appropriate phenological period and submitted to the Turkish Seed Gene Bank for ex-situ conservation. • As the habitat in which these species occur is ecologically sensitive, topsoil storage and management must be conducted in accordance with best practice guidelines to prevent degradation. • Introduction and spread of invasive plant species within this habitat must be strictly prevented through regular monitoring and control measures. • For populations of critically distributed species that would be directly impacted by the project activities, translocation to ecologically suitable habitats should be carried out under the supervision of a qualified botanist or plant ecologist. • Centaurea hermannii seed collection in July • Cirsium polycephalum seed collection in August • Ferulago confusa seed collection in July • Symphytum tuberosum subsp. nodosum seed collection in June • Lilium martagon bulb collection in July • Leucojum aestivum bulb collection in July	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Biodiversity	Habitat loss and endemic\rare species population decrease Trend and population decrease of threatened species	Wide	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	High	Moderate	In-situ conservation measures should also be implemented for regionally endemic and/or non-endemic but locally rare plant species. Specifically, for populations that are likely to be adversely affected by the project activities, translocation efforts should be carried out to ecologically suitable and protected habitats based on lot-specific survey results, recipient-site suitability and competent-authority requirements. - Centaurea hermannii seed re-location in October-November - Cirsium polycephalum seed re-location in October-November - Ferulago confusa seed re-location in October-	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										November - Symphytum tuberosum subsp. nodosum seed re-location in October-November - Lilium martagon bulb re-location in October-November - Leucojum aestivum bulb re-location in October-November - Replacement planting will be carried out as follows: for trees from natural forests, 2 new trees will be planted for each tree removed; for trees from slopes next to the motorway, 1 new tree will be planted for each tree removed.			
Biodiversity	Threat to species Miss of identification of geophytes	Wide	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Major	Since the field surveys along the project corridor were conducted in June, some early spring geophyte species could not be detected. Therefore, lot-specific surveys shall be conducted during the appropriate species-specific detection periods before vegetation clearance including Ornithogalum pascheanum, Galanthus plicatus subsp. byzantinus and Crocus pestalozzae.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Biodiversity	Habitat loss Trend and population decrease of threatened species	Local	Irreversible/ Long-term reversible	Medium-term	Intermittent	Significant	Medium	Medium	Moderate	In order to assess whether plant species with critical distribution (including regionally endemic or non-endemic but locally rare species) continue to persist along the project corridor and to determine the extent of potential impacts from the project activities, regular monitoring should be conducted. Specifically, monitoring should take place at least twice per year during the construction phase. If necessary, urgent conservation measures must be implemented based on the monitoring results. The following measures will be implemented to prevent habitat loss during the construction phase of the Project: - Drainage and hydrological design should avoid or minimise changes to natural flow regimes, wetland hydrology, and aquatic or riparian habitat function - Any micro-realignments should be informed by updated biodiversity mapping, including the location of sensitive habitats, critical habitat features, Priority Biodiversity Features, watercourses, wetlands, breeding areas, roosting features, and key wildlife movement corridors. - Micro-realignment decisions shall take into account the presence of fauna movement routes and ecological connectivity features, with the aim of avoiding severance of known or potential wildlife corridors. - The location and design of associated infrastructure, including access roads, laydown areas, drainage structures, culverts, retaining walls, and temporary construction compounds, should be optimised to avoid additional biodiversity disturbance and habitat fragmentation. - Detailed design shall include reinstatement and habitat restoration requirements for temporarily disturbed areas, using native and locally appropriate species. - Permanent and temporary land take shall be limited to the minimum area required for safe construction. - Clearly defined construction boundaries shall be established prior to works to prevent unnecessary encroachment into adjacent habitats. - Vegetation clearance shall be restricted to essential areas only. - Topsoil from suitable areas shall be stripped, stored appropriately, and reused during reinstatement. - Temporary working areas shall be rehabilitated as soon as practicable following completion of construction activities.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- Hydrobiological monitoring will be conducted before, during, and after construction, and nearby watercourses will be clearly marked and, where necessary, protected with fencing to prevent disturbance. - Bank vegetation clearance shall be restricted to the minimum necessary, and disturbed riparian areas shall be reinstated as soon as practicable. In addition, to ensure continuity of wildlife movement at the ecological crossing location near km 2 (Cut & Cover-7, aligned with the North Marmara Motorway Ecological Bridge), the following measures will be implemented: - A temporary wildlife passage will be established during construction to maintain crossing functionality. - The reinstated surface over the covered railway will be designed in line with ecological overpass best practice (minimum effective width, substrate continuity, native vegetation cover, perimeter fencing, noise and light minimization, post-construction monitoring). - Coordination with the motorway operator and relevant authorities will be undertaken regarding timing, fencing tie-ins, and maintenance responsibilities. - Adaptive measures (e.g., widening of vegetated platform, enhancement of guide fencing) will be introduced if monitoring indicates residual barrier effects. - Upon completion of the cut-and-cover works and reinstatement of the surface, the land bridge function will be preserved and the wildlife movement corridor will be restored. - If required at detailed design stage, the effective width of the ecological crossing will be extended over the railway section to maintain or enhance habitat connectivity. In addition, the following biodiversity protection measures will be integrated into the lot specific Biodiversity Management Plan (BMP): - Seasonal timing windows will be applied for vegetation clearance and high-noise activities to avoid breeding, nesting, and migration periods for fauna species recorded during baseline surveys. - Dark-sky compliant lighting (e.g., downward-directed, low-intensity fixtures) will be adopted at all work sites and approaches to minimize light disturbance to nocturnal fauna. - Invasive-species hygiene protocols will be implemented, including equipment wash-down before site entry and exit, to prevent the spread of invasive alien plant species. - Immediate stop-work and ecologist inspection procedures will be triggered if any active nest, roost, or breeding site of a protected species is discovered during construction. -Post-construction monitoring shall continue for the period defined in the lot-specific BMP/BAP and shall be extended until the applicable habitat-recovery and crossing-functionality criteria are achieved. - Adaptive management actions will be implemented if post-construction monitoring identifies residual barrier or habitat degradation effects. - Special attention will be given to the Bosphorus raptor flyway and other ecologically sensitive crossings, ensuring that mitigation and monitoring cover potential disturbance and collision risks. -Lot- and receptor-specific indicators, baselines, success criteria and action thresholds shall be used to assess effectiveness.			

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
Biodiversity	Insufficient wildlife connectivity / lack of fauna crossings	Local	Irreversible/ Long-term reversible	Medium-term	Intermittent	Significant	Medium	Medium	Moderate	- Incorporation of additional underground passages for small animals as a separate biodiversity mitigation measure. - The number, location, spacing and design of fauna passages shall be determined through the lot-specific ecological-connectivity assessment and final design, considering target species, habitat continuity, topography, drainage structures and adjacent infrastructure. - Routine inspection and maintenance to ensure passages remain functional and unobstructed. - For reptiles and amphibians, open trenches, pits, and other excavations shall be covered when unattended or provided with escape ramps to prevent entrapment; construction materials, pipes, rubble, and spoil shall be stored to avoid creating hazards; any rocks, logs, debris, or other refugia removed during construction shall, where feasible, be relocated to safe adjacent areas under Biodiversity & Ecology Specialist supervision; works shall cease in the immediate area if herpetofauna are encountered; and erosion and sediment control measures shall be implemented prior to works and maintained throughout the construction period. - Train staff to recognize and protect important habitats and nests, avoiding disturbance without expert input. - Any required lighting shall be directional, shielded, and of the lowest intensity necessary for safety. - Light spill into adjacent habitats shall be minimized. - Noise- and vibration-generating activities shall be reduced through proper equipment maintenance and the use of low-noise methods where practicable. - Operational lighting at stations, depots, and maintenance areas shall be designed to minimize glare, spill, and skyglow. - Trackside and drainage infrastructure shall be designed, where feasible, to avoid creating inescapable confined spaces for small fauna. - Escape ramps, ledges, roughened surfaces, or other fauna-friendly escape features shall be incorporated where entrapment risk is identified. . In addition, temporary escape provisions shall be implemented for construction-phase features such as open excavations, trenches and pits where relevant. This risk may occur along the entire alignment but is most pronounced in at-grade sections (i.e. where the railway is not in tunnels or on viaducts), where rail infrastructure and adjacent elements may create confined spaces and limit escape opportunities for small fauna. - Culverts, channels, sumps, and similar structures shall be reviewed for fauna access and escape potential during design. - Temporary excavations and trenches shall be covered, fenced, or fitted with escape provisions when left unattended. - Escape features shall be maintained in functional condition and kept free of blockage. - Appropriate fauna crossing structures shall be incorporated into the design, including underpasses, oversized culverts, bridges, ledges, or dedicated wildlife passages. - Embankments, cuttings, and retaining structures shall be designed to avoid unnecessarily steep or inaccessible profiles where feasible. - Habitat on both sides of crossing points shall be managed to encourage wildlife use.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- The spacing and number of crossing structures shall take account of train frequency, traffic intensity, and the movement ecology of target species.			
Biodiversity	Cumulative habitat connectivity loss	Local	Irreversible/ Long-term reversible	Medium-term	Intermittent	Significant	Medium	Medium	Moderate	- Conduct pre-construction ecological connectivity assessment. - Integrate fauna crossings (culverts, underpasses) into detailed design. - Restore disturbed areas with native vegetation after construction. - If required, extend ecological crossing width in detailed design stage. - Workforce access to sensitive habitats shall be controlled. - To maintain ecological connectivity, specific mitigation measures are applied for species associated with riparian corridors, including Eurasian otter (Lutra lutra), through the completion of pre-construction and pre-clearance surveys by a Biodiversity & Ecology Specialist across all suitable aquatic and riparian habitats within the Project AoI to identify active holts and signs of use; establishment of species-specific buffer zones (minimum 30–50 m, subject to refinement) where no construction activities are permitted; adjustment of project to avoid disturbance where feasible; scheduling of works to avoid sensitive periods such as breeding. Ongoing monitoring by a Biodiversity & Ecology Specialist during construction in areas of confirmed otter presence. Subject to the expertise, seniority level, and workload of the appointed Biodiversity & Ecology Specialist; a detailed inspection shall be carried out by a mammal specialist as an additional consultancy support.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Biodiversity	Blasting impacts on fauna and soil	Local	Irreversible/ Long-term reversible	Medium-term	Intermittent	Significant	Medium	Medium	Moderate	- Prepare and implement Blasting Management Plan. - Restrict blasting to 08:00–18:00 hours, avoid during breeding/migration periods identified through the lot-specific seasonal restriction schedule. - Use blasting mats and controlled blasting methods. - Post-blast: stabilize slopes and revegetate disturbed surfaces. - Blasting activity will be conducted based on constraint periods for the species which are given in the BMP. - If any of the active nests are located less than 500 meters away where the blasting will be, no blasting activity will be conducted until after the animals leave the nest permanently.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Biodiversity	Spread of Invasive Alien Species (IAS)	Local	Irreversible/ Long-term reversible	Short-term	Intermittent	Significant	Medium	Low	Minor	- Clean machinery before site entry. - Inspect fill and plant material sources. - Minimise traffic and the distance it has travelled, - Source goods/materials locally where possible. - Train and raise awareness of all site personnel regarding invasive alien species. - Conduct risk-based and seasonally appropriate IAS inspections and maintain records.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Biodiversity	Disturbance to breeding bird species	Local	Irreversible/ Long-term reversible	Medium-term	Intermittent	Significant	Medium	Medium	Moderate	- Conduct **pre-construction nest survey** before vegetation clearance. - If active nests are found, establish **200–500 m buffer zones** based on species sensitivity. - Resume works only after ornithologist approval. - Pre-construction and pre-clearance surveys will be undertaken by Biodiversity & Ecology Specialist to identify nests at suitable habitats and natural and artificial structures during breeding season (from early breeding in mid-February to late breeding end of May), at most 1 week leading up to the construction works in the surrounding area. If nests are identified, they will be marked off and left undisturbed, if feasible. If not	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										feasible, they will be relocated to the nearest suitable and secure habitat appropriate to the species - All bird nests shall be protected until they are no longer in use, with the implementation of a minimum 30 m buffer zone. This buffer shall be increased where required based on species sensitivity, in accordance with NatureScot or other recognised guidance.			
Cultural Heritage	- Construction works may cause physical damage to military bunkers, aqueducts, slope settlements, Roman water structures, historical cemeteries, and other cultural sites. - Vibration, excavation, and access road construction pose risks to unregistered archaeological remains. - Lack of awareness among workers may lead to accidental destruction of heritage assets. - Risk of failing to identify and protect chance finds during excavation activities.	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Moderate	- Conduct pre-construction surveys and GIS-based mapping for all known cultural assets, in accordance with the Cultural Heritage Management Plan. - Apply buffer zones and fencing to protect known sites, as identified in ESIA. - Limit access and use manual techniques near sensitive structures. - Implement the Chance Find Procedure prepared by AYGM, including immediate work stoppage, notification to authorities, and archaeological evaluation. - Provide cultural heritage awareness training for all site personnel. - Ensure continuous monitoring near heritage structures during construction. - Immediate notification to the Istanbul Regional Directorate of Cultural Heritage and Tourism and relevant Conservation Board in case of chance finds or impacts to registered sites. - Establish vibration limits for construction activities in proximity to historical masonry and heritage buildings, based on international standards (e.g., DIN 4150-3 or BS 7385). Continuous vibration monitoring shall be undertaken to ensure compliance. - Define restrictions on night-time construction works, especially near sensitive receptors such as schools, hospitals, and heritage buildings, to minimize noise and vibration disturbance. - Integrate these criteria and working-hour limitations into the C-ESMP.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Expected population change	Construction-related employment opportunities and temporary economic activity may lead to short-term population influx in certain sub-settlements, potentially placing additional pressure on local services (housing, infrastructure, and social cohesion). Previous experience with overlapping transport projects indicates that such influx may also lead to 'project fatigue' among local residents and business owners.	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Moderate	- AYGM-PIU, in cooperation with district municipalities, will identify settlements most likely to attract temporary workers and monitor population dynamics during construction. - To minimize unplanned in-migration, worker accommodations will be established and managed by the Contractor outside of sensitive settlements, under the supervision and approval of AYGM. - PIU will coordinate with local service providers (schools, healthcare centers, waste management units) to anticipate and address potential increases in demand. - Awareness-raising meetings will be held with local communities to explain workforce management measures, expected duration of construction-related influx, and grievance channels. - Lessons learned from previous projects in the AoI will be integrated into the Stakeholder Engagement Plan (SEP), with a focus on reducing "project fatigue." - PIU will establish a monitoring mechanism (quarterly reports) on in-migration trends, housing rental price fluctuations, and community concerns.	Minor	AYGM PIU	**Implementing:** AYGM PIU **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Stakeholder Engagement Economy and Employment	There is a potential risk of labor management challenges during the construction phase, including shortage of unskilled labor, reliance on informal or irregular migrant workers, and risks of non-compliance with labor laws. These risks may lead to workforce instability,	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Moderate	- AYGM/PIU will coordinate with local employment agencies and municipalities to assess labor availability and ensure transparent recruitment channels. - The Contractor will prepare and implement a Labor Management Plan (LMP) consistent with national labor	Minor	AYGM PIU (overall labor policy, coordination with state agencies) + D+B Contractor (site-specific Labor Management Plan)	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:**

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
	illegal employment, and associated social tensions if not properly managed									law and WB ESS2, including provisions against child and forced labor. - NGOs and local organizations may be engaged by AYGM to support inclusion of vulnerable groups, particularly migrants, under a regulated framework. - Monitoring of illegal or informal employment risks will be jointly carried out by AYGM PIU and Contractor, with corrective actions defined under the LMP.			AYGM and 3rd Party E&S Consultant
Stakeholder Engagement Housing and residences	Potential housing pressure in the AoI may occur due to temporary population influx during the construction phase. This may lead to insufficient social housing supply and increased demand on existing housing stock, with possible impacts on affordability and land values. These risks are primarily linked to regional planning and fall under the responsibility of governmental housing and urban planning institutions (e.g., TOKİ, municipalities, provincial administrations).	Local	Irreversible/ Long-term reversible	Long-term	Continuous/ Recurrent	Significant	High	High	Moderate	- Further analysis will be conducted to assess potential housing demand pressures during construction, - AYGM will engage with TOKİ, municipalities, and provincial administrations to address risks of housing supply shortages and price speculation. - The construction workforce will be primarily accommodated within designated labour camps established and managed by the Contractor, in accordance with the approved Labor Management Plan. A limited number of specialized and managerial personnel will be housed in nearby settlements as part of the overall workforce accommodation strategy. Final ratios and specific accommodation arrangements will be defined during the detailed design and workforce planning phase, in coordination with AYGM and relevant local authorities. -These issues fall outside the scope of Contractor responsibilities and will require inter-agency cooperation.	Minor	AYGM (in cooperation with TOKİ, municipalities, provincial administrations, NGOs)	**Implementing:** AYGM **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Stakeholder Engagement Land acquisition-Residential areas	There are areas with high housing density within the zones intersecting the AoI. In predominantly privately owned housing areas, homeowners and users (tenants) may face involuntary physical and economic resettlement due to the project's land acquisition impacts. Efforts will be made to avoid this impact as much as possible. Involuntary physical resettlement caused by other projects overlapping with the AoI may exacerbate the overall effect.	Local	Medium-term reversible	Long-term	Continuous/ Recurrent	Significant	High	High	Major	- Involuntary physical resettlement impacts will be avoided. - In cases where avoidance is not possible, a RP will be prepared for the affected areas in line with the RF. - No access to affected land, site clearance or physical works will commence in the relevant section until the applicable RP/LRP compensation, assistance and livelihood-restoration measures have been fully implemented, the Sectional RP Completion Report has been approved, the required World Bank No-Objection has been obtained and formal land-access clearance has been issued in accordance with the Employer's Requirements.. - During the implementation of the RP, special attention will be given to disadvantaged groups such as those facing economic hardship, individuals with physical disabilities, people living alone, female-headed households, and migrants, and additional mitigation measures will be applied for these groups. - Special attention will be given to individuals who do not own another residence or are unlikely to have access to alternative housing. - Communication must be established with all homeowners and tenants. - During the communication process, the needs of disadvantaged groups should be identified. - The Contractor will coordinate work schedules with AYGM to ensure compliance with the No-Works Clause and will only mobilize in areas formally cleared by AYGM/PIU.	Moderate	AYGM PIU	**Implementing:** AYGM **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Stakeholder Engagement Land acquisition-Commercial areas	The areas intersecting with the AoI include zones with a high concentration of commercial activities. In predominantly privately owned commercial areas, business owners, users (tenants), and employees may face involuntary physical and economic resettlement due to the land acquisition impacts of the project. This impact will be avoided as much as	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	High	Major	- Involuntary physical and economic resettlement impacts will be avoided. - A Resettlement Plan (RP) will be prepared an applicable lot- or section-specific RP and, where required, LRP will be prepared by AYGM for the affected areas in line with the RF. No access to affected land, site clearance or physical works will commence in the relevant section until the applicable RP/LRP compensation, assistance and livelihood-	Moderate	AYGM PIU	**Implementing:** AYGM **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
	possible. Involuntary physical and economic resettlement caused by other projects overlapping with the AoI may further intensify the overall effect.									restoration measures have been fully implemented and formal land-access clearance has been issued in accordance with the Employer's Requirements. - During the implementation of the RP, special attention will be given to disadvantaged groups such as those facing economic hardship, individuals with physical disabilities, people living alone, female-headed households, and migrants, and additional mitigation measures will be applied for these groups. - Special attention will be given to individuals whose sole source of livelihood is the affected business. - Specific mitigation measures will be implemented for individuals employed in the affected facilities. To this end, it is essential to establish cooperation with industrial zones such as Organized Industrial Zones (OIZs) and local employment agencies. - Communication must be established with all business-owners and tenants. - During the communication process, the needs of disadvantaged groups should be identified.			
Stakeholder Engagement Land acquisition-Agricultural areas	There are agricultural activity areas—albeit to a limited extent—within the zones intersecting the AoI, some of which operate as agricultural enterprises. While many agricultural lands are privately owned, agricultural activities are also carried out on common lands. Landowners, as well as formal and informal users, may be subject to involuntary physical and economic resettlement due to the land acquisition impacts of the project. This impact should be avoided as much as possible. Involuntary physical and economic resettlement caused by other projects intersecting with the AoI may further intensify the impact. In particular, settlements that held village status prior to 2013 tend to show heightened sensitivity on this issue.	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	High	Major	- Involuntary physical and economic resettlement impacts will be avoided. - A Resettlement Plan (RP) will be prepared an applicable lot- or section-specific RP and, where required, LRP will be prepared by AYGM for the affected areas in line with the RF. No access to affected land, site clearance or physical works will commence in the relevant section until the applicable RP/LRP compensation, assistance and livelihood-restoration measures have been fully implemented and formal land-access clearance has been issued in accordance with the Employer's Requirements. - During the implementation of the RP, special attention will be given to disadvantaged groups such as those facing economic hardship, individuals with physical disabilities, people living alone, female-headed households, and migrants, and additional mitigation measures will be applied for these groups. - Special attention will be given to individuals whose sole source of livelihood is the affected agricultural area. - Communication must be established with all landowners, formal and/or informal users, and tenants. - During the communication process, the needs of disadvantaged groups will be identified.	Moderate	AYGM PIU	**Implementing:** AYGM **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Stakeholder Engagement Land acquisition-Livestock areas	There are livestock activity areas within the zones intersecting the AoI, some of which may include livestock-related enterprises. These areas are mostly privately owned and may be located in shared spaces together with residential properties. Both structures used for livestock activities—such as barns—and livestock enterprises themselves may be subject to involuntary physical and economic resettlement due to the project's land acquisition impacts. This impact should be avoided as much as possible. Involuntary physical and economic resettlement resulting from other projects intersecting with the AoI may further intensify this effect. Views regarding the project's impact on livestock is not clear. Migrant individuals involved as labor in these activities are also considered a vulnerable group.	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	High	Major	- Involuntary physical and economic resettlement impacts will be avoided. - A Resettlement Plan (RP) will be prepared an applicable lot- or section-specific RP and, where required, LRP will be prepared by AYGM for the affected areas in line with the RF. No access to affected land, site clearance or physical works will commence in the relevant section until the applicable RP/LRP compensation, assistance and livelihood-restoration measures have been fully implemented and formal land-access clearance has been issued in accordance with the Employer's Requirements. - During the implementation of the RP, special attention will be given to disadvantaged groups such as those facing economic hardship, individuals with physical disabilities, people living alone, female-headed households, and migrants, and additional mitigation measures will be applied for these groups. - Special attention will be given to individuals whose sole source of livelihood is the affected husbandry area. - If applicable, individuals working informally as shepherds will also be duly considered.	Moderate	AYGM PIU	**Implementing:** AYGM **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- In cases involving livestock enterprises, special attention should also be given to individuals employed in these businesses. - Communication must be established with all owners, users, and workforce (formal /informal). - During the communication process, the needs of disadvantaged groups will be identified.			
Stakeholder Engagement Land acquisition-Grazing areas	There are grazing areas within the zones intersecting the AoI, the ownership of which is mostly under public/common property or the treasury. Both formal and informal users of these areas may face involuntary physical and economic resettlement due to the project's land acquisition impacts. This impact will be avoided as much as possible. Involuntary resettlement caused by other projects overlapping with the AoI may further intensify this effect. Views regarding the project's impact on grazing areas are not clear. Migrant individuals involved as labor in these activities are also considered a vulnerable group.	Local	Medium-term reversible	Long-term	Continuous/ Recurrent	Moderate	Medium	High	Major	- Involuntary physical and economic resettlement impacts will be avoided. - A Resettlement Plan (RP) will be prepared an applicable lot- or section-specific RP and, where required, LRP will be prepared by AYGM for the affected areas in line with the RF. No access to affected land, site clearance or physical works will commence in the relevant section until the applicable RP/LRP compensation, assistance and livelihood-restoration measures have been fully implemented and formal land-access clearance has been issued in accordance with the Employer's Requirements. - During the implementation of the RP, special attention will be given to disadvantaged groups such as those facing economic hardship, individuals with physical disabilities, people living alone, female-headed households, and migrants, and additional mitigation measures will be applied for these groups. - Special attention will be given to individuals whose sole source of livelihood is the affected grazing / pasture area. - If applicable, individuals working informally as shepherds will also be duly considered - Communication must be established with all users - During the communication process, the needs of disadvantaged groups will be identified.	Moderate	AYGM PIU	**Implementing:** AYGM **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Labor Management	Inadequate labor management can lead to risks such as labor rights violations, unsafe working conditions, labor disputes, and exploitation. Poor management may cause accidents, reduced workforce morale, and non-compliance with local labor laws and international standards, including risks related to labor relations such as restrictions on freedom of association, lack of effective grievance mechanisms, or failure to respect collective bargaining rights.	Local	Short-term reversible	Medium-term	Intermittent	Moderate	Low	High	Major	- Ensure full compliance with Turkish Labor Law No. 4857, OHS Law No. 6331, and WB ESS2. - Align labor management practices with international good practices and the LMP. All workers to receive written contracts detailing labour conditions, working hours, wages, rights and dutiies code of Conduct (CoC) etc - Implement transparent and non-discriminatory recruitment processes for direct, contracted, and primary supply workers, In line with ESS2, conduct due diligence on labor practices of primary suppliers to ensure compliance with labor laws, prevention of child and forced labor, and take corrective measures where non-compliance is identified. - Require contractors to develop site-specific Labor Management Plans (LM Plans) and OHS Plans in accordance with Project standards. - Enforce strict prohibition of child labor and forced labor through regular monitoring and audits. - OHS-related measures (training, PPE, right to refuse unsafe work) are detailed under Occupational Health and Safety risks. - Monitor and regulate working hours to prevent excessive overtime and worker fatigue, in line with applicable legislation. - Implement zero-tolerance policies on SEA/SH with mandatory CoC training. - Establish confidential and accessible GRM specifically for SEA/SH complaints. - Ensure worker camps meet IFC/EBRD minimum standards regarding hygiene, sanitation, water supply, and adequate living conditions - Deliver periodic training on LMP provisions, workers' rights, Coc, and grievance procedures to all workforce categories.	Minor	AYGM PIU (based on ESIA/ESMP and LMP)	**Implementing:** D+B Contractor (to develop Labour Management Plan on the basis of project LMP and apply it on site) **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- Maintain effective, confidential, and accessible grievance channels for workers, with defined response and resolution protocols. - Conduct ongoing monitoring and supervision by the PIU and CSC. - Prepare regular compliance reports and implement timely corrective actions when deviations are identified.			
Gender and Vulnerable Groups (Women, children, elderly, migrants, disabled)	- Risk of gender-based violence (GBV) and harassment related to labor influx. - Limited access of vulnerable groups to grievance mechanisms. - Unequal impact of construction-related nuisances (noise, dust, restricted access) on vulnerable households. - Exclusion of women and vulnerable groups from stakeholder engagement.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Moderate	- Implement a GBV Action Plan (training, awareness campaigns, CoC for workers, service provider mapping) developed by AYGM. - Ensure accessible GRM (multiple channels, anonymity, gender-sensitive handling). - Prioritize inclusive stakeholder consultations (separate sessions for women, translation if needed). - Conduct awareness-raising on workers' behavior and community interactions.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	The failure to develop a comprehensive Occupational Health and Safety Management System or a Construction Phase OHS Plan prior to construction, along with the delayed establishment of qualified site OHS teams, may lead to unsafe conditions such as lack of coordination during mobilization, inadequate emergency preparedness, and an increased risk of workplace accidents.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- A full H&S Management System and Construction Phase H&S Plan will be developed and approved prior to site mobilization. - Full compliance will be ensured with the Turkish Law No. 6331 on Occupational Health and Safety, in addition to international standards (IFC/EBRD). - A qualified and adequate OHS team will be mobilized before the start of any construction activities. - Clear roles, responsibilities, and communication channels for OHS will be defined for all contractors and subcontractors. - A mobilization-specific risk assessment and control plan will be prepared. - Emergency preparedness and response plans will be tested and validated through drills before site works commence. - OHS induction and training for all site personnel will be completed prior to mobilization. - Daily coordination and supervision mechanisms between employer and contractor OHS teams will be established. - Conduct mandatory OHS training for all workers and ensure continuous awareness. - Provide adequate PPE and implement safety protocols to minimize accidents and occupational diseases. - Every worker has the right to refuse unsafe work and report it immediately. No disciplinary action shall be taken for exercising this right	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	Inadequate development and implementation of construction-phase OHS documentation such as Risk Assessments, Emergency Response Plans, Permit-to-Work systems, Accident/Incident Records, Root Cause Analyses, Monthly OHS Performance Reports, and OHS Training Records may result in incomplete safety measures, delayed corrective actions, and non-compliance with regulations. The absence of proper monitoring and documentation systems may lead to an increased number of accidents, recurrence of preventable incidents, risks for the project	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B Contractor and all subcontractors will be required to establish and implement a comprehensive set of OHS documents (e.g., risk assessments, emergency response plans, permit-to-work systems etc,, as required under Turkish law, ESIA and ESMP) prior to commencement of works. - Permit-to-Work systems will be applied to all critical and high-risk activities and will be monitored by both the main contractor and subcontractors. - A standardized system for recording accidents and incidents will be implemented, and root cause analyses will be conducted following each case. - The D+B Contractor shall immediately notify the CSC/Engineer of any E&S or OHS incident and, in all cases, no later than 24 hours after becoming aware of the incident. The Contractor shall submit a detailed incident investigation report, including root cause analysis and a corrective action plan, within 10 days following the initial notification, unless otherwise agreed in writing by the Engineer and the Employer. - Monthly OHS performance reports will be prepared by the D+B contractor and subcontractors and shared regularly with the project management.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- All workers will be required to complete mandatory OHS trainings before beginning work on site. - OHS training participation and completion records will be maintained and monitored for both main and subcontractor personnel. - No worker (including subcontractor personnel) will be allowed to operate on-site without up-to-date OHS training certification. - Training programs (content, frequency, delivery methods) will be regularly reviewed and updated as necessary. - Responsible personnel for preparing, reviewing, and updating OHS documentation will be designated by each contractor. - Periodic internal audits will be conducted by D+B Contrutor. to verify the consistency and field-level application of OHS documentation across all contractors.			
Occupational Health and Safety	During tunnel construction, workers operating in confined and enclosed spaces may be exposed to serious occupational health and safety risks such as insufficient ventilation, low oxygen levels, accumulation of toxic gases, ground instability, tunnel collapse, fire, and explosion. These risks may lead to respiratory problems, poisoning, crushing, severe injuries, or fatalities.	Local	Irreversible/ Long-term reversible	Short-term	One-off/rare	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to develop and implement specific OHS procedures for confined space works prior to tunnel construction activities. - Continuous gas detection and air quality monitoring systems will be installed and operated within the tunnel environment. - All workers will receive specialized training on confined space safety, oxygen deficiency, toxic gases, and emergency evacuation before entering tunnel works. - Ventilation systems will be installed at tunnel entrances to ensure constant air circulation. - A Permit-to-Work system will be applied to regulate access to confined areas, allowing entry only to authorized and trained personnel. - Gas detectors and oxygen sensors will be carried by workers or installed at fixed locations inside the tunnel. - Gas testing must be conducted before entry. - Fire detection and suppression equipment will be available and regularly maintained within the tunnel. - Geotechnical assessments will be conducted to evaluate ground stability continuously during tunnel excavation and support works. - Emergency evacuation plans for events such as tunnel collapse or fire will be developed and tested through regular drills. - Rescue teams trained in emergency response will be present and ready during each shift. - Scenario-based emergency planning will include TBM rescue procedures, refuge chamber provisions, maximum cross-passage spacing (≤350 m), and redundant power and ventilation systems to ensure safe egress during power loss or fire events. - Design will account for smoke ventilation and foam/fire suppressant system compatibility to prevent secondary hazards. - Coordination protocols with municipal fire, rescue, and medical services will be established, including joint emergency response simulations during commissioning. - Seismic risk mitigation will include tunnel stability assessments, refuge area integrity checks, and emergency response plans adapted to potential earthquake events. - The D+B Contractor shall comply with international best practices and ensure that emergency infrastructure (refuge chambers, fire suppression, egress signage) is included in the final design and verified prior to construction.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- Where hyperbaric (pressurized) tunnelling is applied, specific SOPs for decompression, medical monitoring, and emergency evacuation will be developed and approved prior to works. - No TBM launch shall occur until the Emergency Response Plan is approved by relevant authorities and a multi-agency mass-casualty drill is completed. - Confined-space and evacuation drills will be conducted quarterly, and competency/training records for all tunnel personnel will be maintained and periodically reviewed.			
Occupational Health and Safety	Bridge and viaduct construction activities involve working at height, which exposes workers to the risk of falling and being struck by falling objects. In the absence of sufficient edge protection, safe scaffolding systems, and fall arrest equipment, serious injuries such as fractures, head trauma, or fatalities may occur.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to prepare and implement a detailed OHS procedure specific to working at height. - Edge protection systems (e.g., guardrails, barriers) will be installed and secured in all elevated work areas. - Safe scaffolding systems will be installed by authorized personnel and will be inspected regularly. - All workers will receive certified working-at-height training, and training records will be maintained. - Workers performing elevated tasks will be provided with and required to use appropriate PPE (e.g., harnesses, lanyards, anchor points). - Protection against falling objects (e.g., overhead netting, covered platforms) will be implemented where necessary. - During lifting operations or material movement, access under elevated areas will be restricted and safety perimeters will be established. - Lifting operations require a lifting plan and weather condition checks. - Access to elevated work areas will be limited to trained and authorized personnel only. - All height-related equipment will undergo regular inspections, and findings will be documented. - Rescue procedures for working at height emergencies will be established, and appropriate rescue equipment will be maintained on site.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	During excavation, filling, and earthworks, unstable soil conditions, slope failures, and loose backfill materials pose serious risks such as burial, suffocation, and crush injuries. The concurrent operation of heavy machinery within excavation zones further increases the likelihood of collisions, entrapment, and major workplace accidents.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to develop safe working procedures for excavation and earthworks based on geotechnical assessments. - Slope stability will be continuously monitored, and appropriate measures such as benching, sloping, or shoring systems will be implemented when necessary. Trenches deeper than 1.2 meters must be sloped, shored, or shielded. - Access to excavation zones will be restricted and controlled using physical barriers to prevent unauthorized entry. - Workers operating in excavation areas will receive specialized training on soil-related risks, collapse prevention, machinery traffic, and emergency escape procedures. - Loose backfill materials will be compacted or stabilized and will not be stockpiled near excavation edges. - All workers within excavation zones will wear high-visibility personal protective equipment (PPE), especially reflective vests. - Designated traffic routes and blind spot warning systems will be implemented for the operation of heavy machinery. - Separate work zones will be defined to minimize interaction between machinery and workers. - Spotters will be assigned for heavy equipment operations, and radio communication systems will be used to enhance coordination.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- Excavation areas will be equipped with emergency escape routes, alert systems, and first response equipment.			
Occupational Health and Safety	In heavy equipment operation and material handling activities, machinery such as cranes, excavators, loaders, and dump trucks often operate with limited visibility especially during reversing maneuvers or when carrying unbalanced loads. Workers in the vicinity may suffer from crushing, collision, or entrapment injuries, which could lead to long-term disability or fatalities.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to develop and implement detailed safe work procedures for heavy equipment operations. - All heavy equipment operators will be licensed and properly trained before being assigned to machinery operation. - During reversing, turning, or load-carrying operations, cameras, proximity sensors, and audible alarms (e.g., reverse beepers) will be activated. - A spotter will be assigned during reversing and blind maneuvers, maintaining continuous communication with the operator via radio or hand signals. - Only trained and licensed operators are permitted to use heavy machinery. - All site personnel will receive training on maintaining safe distance from heavy equipment, understanding blind spots, and adhering to communication protocols. - Operational zones for heavy equipment will be clearly demarcated with visible signs and physical barriers to restrict pedestrian access. - Loads being transported will be properly balanced, secured, or supported to prevent tipping or loss of control. - Daily pre-shift inspections and maintenance checks will be conducted on all equipment, including brakes, steering, and warning systems. - Site layout will separate vehicle and pedestrian pathways, and one-way traffic flow and visual signage will be established. - Emergency response protocols and equipment specific to collision, overturning, and entrapment incidents will be available on site.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	During work on temporary or permanent electrical systems, if isolation, grounding, and lock-out/tag-out (LOTO) procedures are not properly implemented, workers are exposed to life-threatening hazards such as electric shock, arc flash, and burns due to accidental contact with live conductors. These incidents may result in severe burns, permanent nerve damage, or fatalities.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to develop and implement detailed electrical safety procedures for all activities involving temporary or permanent electrical systems. - LOTO procedures will be clearly defined in writing, implemented on all relevant electrical equipment, and communicated to workers. - Prior to any electrical work, proper isolation and grounding will be carried out, and the work area will be tested to ensure de-energization. - Only authorized and trained personnel will be permitted to perform tasks involving electrical systems. - Workers will receive specialized training on electrical hazards, arc flash risks, safe working distances, and correct use of PPE. - Electrical panels, temporary lines, and work zones will be marked with warning signs, and unauthorized access will be restricted. - Arc-rated PPE (including protective clothing, gloves, face shields, etc.) will be provided and used during all electrical work. - Prior to critical tasks, energy isolation plans and risk assessments will be prepared and approved. - Emergency response plans specific to electrical incidents will be established, and first aid equipment suitable for electrical injuries will be maintained on site.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	Mechanical activities such as drilling, cutting, blasting, transportation, and breaking generate high levels of noise, vibration, and dust. In the absence of proper PPE, prolonged exposure to these hazards may lead to hearing loss,	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to develop and implement OHS procedures specifically addressing noise, vibration, and dust control in mechanical operations. - Dust suppression systems (e.g., water spraying, local exhaust ventilation) will be installed and maintained in active work areas.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:**

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
	respiratory illnesses, headaches, and musculoskeletal disorders.									- Workers exposed to high noise levels will be provided with hearing protection (e.g., earplugs, earmuffs), and their use will be mandatory. - Respiratory protective equipment (e.g., P2/P3-rated masks) will be supplied to all workers exposed to airborne particulates. - For vibration-related tasks, anti-vibration tools and ergonomic work plans will be adopted. - PPE requirements will be determined based on task-specific risk assessments and reinforced through training and regular supervision. - Noise, dust, and vibration levels will be regularly monitored, and records will be maintained. - Where exposure limits are exceeded, work durations will be restricted and rest periods will be implemented. - All PPE will undergo routine maintenance, and worn or unsuitable equipment will be replaced immediately. - Workers will undergo regular health screenings, including respiratory function and hearing tests, and results will be tracked over time.			AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	Jobs involving manual handling, loading/unloading, and repetitive physical strain pose ergonomic risks. Inadequate working posture and lack of lifting aids may lead to lumbar disc herniation, muscle-tendon injuries, wrist disorders, and long-term functional limitations.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to conduct ergonomic risk assessments for tasks involving manual handling and physical strain, and define control measures accordingly. - Workers will receive practical training on correct lifting techniques, body mechanics, and safe material handling. - Mechanical aids such as pallet jacks, forklifts, hoists, and lifting straps will be provided and promoted for use in lifting and transporting heavy items. - Weight limits per worker will be defined, and the maximum allowable load for manual handling tasks will be communicated. - For repetitive tasks, job rotation strategies will be implemented to avoid overuse of the same muscle groups. - Rest breaks will be scheduled for high-strain physical activities, and working durations will be limited accordingly. - Workstations will be designed or adjusted to fit ergonomic principles regarding height, reach, and layout. - Periodic medical screenings will be conducted to monitor musculoskeletal health and detect early signs of strain. - Ergonomic support gear (e.g., back support belts, knee pads, wrist braces) will be made available for high-risk activities.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	In operations involving hazardous chemicals such as paint, solvents, adhesives, fuels, and lubricants, insufficient ventilation or inadequate use of PPE may result in direct chemical exposure. This may lead to skin and eye irritation, poisoning, respiratory problems, and an increased risk of fire or explosion.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to establish and implement chemical management procedures for all activities involving hazardous substances. - Hazardous chemicals will only be handled by authorized and trained personnel, and workers will receive training on hazardous materials. - All chemicals will be stored and used with corresponding SDSs readily available on site. - Work areas involving chemical use will be equipped with adequate natural or mechanical ventilation, including local exhaust systems in enclosed spaces. - To prevent exposure, appropriate PPE (e.g., safety goggles, respirators, gloves, protective suits) will be provided and required. - Chemicals will be stored in their original, clearly labeled containers, and improper or mixed storage will be strictly prohibited. - To mitigate fire and explosion risks, flammable substances will be stored away from ignition sources,	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										and only flame-proof equipment will be used; fire extinguishers will be readily available. - Spill response kits will be made available on site, and workers will be trained in spill management procedures. - During transport, secondary containment or sealed transport boxes will be used to prevent leakage. - Hazardous chemical waste will be segregated, labeled, and disposed of in accordance with applicable regulations.			
Occupational Health and Safety	Outdoor activities in extreme weather conditions expose workers to environmental stress. High temperatures may cause heat stroke, fainting, and dehydration, while cold environments may lead to frostbite, hypothermia, and reduced motor coordination. These conditions also increase the likelihood of secondary accidents due to loss of concentration.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to develop and implement specific work plans for extreme weather conditions. - In hot weather, working hours will be adjusted to cooler times of the day, and shaded rest areas and sufficient drinking water will be provided. - In cold weather, heated shelters, insulated layered clothing, and warm beverages will be made available. - Workers will receive training on recognizing symptoms and first aid for heat stress, hypothermia, and related conditions. - Work durations will be limited, and scheduled rest breaks will be implemented under extreme conditions. - Weather forecasts will be monitored daily, and work will be suspended when hazardous conditions are expected. - The health status of personnel working outdoors will be monitored, and medical support will be arranged as necessary. - A buddy system will be established for outdoor teams to ensure early detection of heat exhaustion or cold-related issues. - In cold environments, non-slip footwear and de-icing materials will be used to reduce slip and fall risks. - Emergency response plans will include specific scenarios for environmental exposures (e.g., response to heat stroke) and will be supported by practical drills.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	Construction activities conducted in rural or natural areas may expose workers to biological hazards such as bee stings, snake bites, or insect infestations. Such incidents may lead to allergic reactions, panic-induced falls or equipment-related accidents, and situations requiring emergency medical response.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to conduct a risk assessment specific to biological hazards associated with construction in rural or natural environments. - Preventive measures will be taken against common regional biological threats (e.g., pest control, physical barriers against insects and snakes). - All workers will receive training on biological hazards, recognizing symptoms of allergic reactions, snakebite response, and first aid. - Personnel operating in high-risk areas will be equipped with appropriate PPE, such as high-ankle boots, gloves, and protective clothing. - In the event of discovering bee colonies or infestations, professional pest control teams will be contacted, and workers will be evacuated from the area. - Additional safety measures will be implemented in areas involving work at height or with heavy equipment to prevent accidents triggered by panic reactions. - A communication and coordination plan with the nearest medical facility will be established, and transport arrangements will be made available. - Prior to each shift, the area will be scanned for potential biological threats, which will be marked or isolated. - A reporting and incident analysis system will be implemented for all biological hazard-related events to prevent recurrence.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
Occupational Health and Safety	During on-site vehicle and machinery traffic, the lack of proper signage, inadequate traffic separation, and limited visibility may result in collision, entrapment, or crushing incidents involving pedestrians. These types of accidents frequently cause severe injuries or fatalities.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to develop and implement a detailed site traffic management plan. - Vehicle and pedestrian routes will be physically separated, using barriers where necessary to prevent interaction. - Clear and internationally recognizable traffic signage will be installed throughout the site. - Mirrors, warning lights, and slowdown signage will be placed at intersections, blind spots, and high-traffic zones. - Both vehicle operators and site personnel will receive regular training on site traffic rules and pedestrian safety. - In pedestrian-heavy areas, vehicle speed limits will be enforced, and speed restriction signs will be clearly posted. - A spotter will be assigned during reversing maneuvers, and radio communication will be maintained. - The traffic management plan will define one-way routes, designated parking areas, and emergency access paths. - Vehicle and machinery movement will be restricted outside of working hours or controlled via a permitting system. - In case of accidents, first aid kits, warning lights, and incident reporting procedures will be made readily available.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	Electrification and signaling works involve the installation and energization of high-voltage catenary systems and the commissioning of signaling equipment. During these tasks, workers are exposed to serious risks such as electric shock, uncontrolled energization, short circuits, fire, and arc flash. In addition, functional testing of signaling systems carries the risk of technical failure, which may result in unexpected system behavior and accidents affecting technical personnel.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- The D+B contractor and all subcontractors will be required to develop and implement specialized safety procedures for high-voltage and signaling works. - Only authorized, trained, and certified personnel will be permitted to perform tasks related to the installation and testing of high-voltage systems. - Isolation, grounding, and lock-out/tag-out procedures will be fully applied before energizing the catenary system. - All workers will receive training on high-voltage safety, short circuit risks, arc flash protection, and fire prevention measures. - During the commissioning of signaling systems, controlled testing protocols will be implemented, and tests will be conducted step by step. - Functional tests will be carried out in safe modes, and test zones will be physically isolated to prevent unintended exposure. - Appropriate PPE including arc-rated clothing, insulated gloves, and face shields will be provided and used by all responsible personnel. - All temporary and permanent electrical panels will be clearly marked with warning signs and physically restricted from unauthorized access. - Emergency response plans for system failures, short circuits, and uncontrolled signaling will be established and tested. - A permit-to-work system will be applied to all electrical and signaling test operations, requiring prior approval before commencement. - Temporary power systems must include Residual Current Device protection and proper grounding.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	Workers living or working in shared accommodation and natural areas may be exposed to infectious diseases due to poor hygiene, limited access to clean water, or insufficient preventive health services. Vector-borne diseases such as Crimean-Congo Hemorrhagic Fever	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- Ensure worker camps meet IFC/EBRD minimum standards regarding hygiene, sanitation, water supply, and adequate living conditions - The D+B contractor and all subcontractors will be required to develop and implement health and hygiene management plans tailored to local infectious disease risks.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:**

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
	(CCHF), transmitted by ticks and regionally endemic during spring and summer months, pose a seasonal risk to outdoor construction workers. If not properly monitored and controlled, outbreaks of such diseases may result in absenteeism, reduced labor productivity, increased healthcare burden, and public health concerns.									- Cleaning and sanitation standards will be established in shared living spaces, with regular inspections and disinfection carried out. - All workers will be provided with clean drinking water, sufficient restroom/shower facilities, and proper waste management services. - Training will be delivered to workers on symptoms and prevention of infectious diseases, including risks such as tick bites. - During spring and summer months, tick control programs (e.g., area spraying, personal tick checks) will be implemented and monitored. - Outdoor workers will be equipped with protective clothing (e.g., long-sleeved garments, light-colored uniforms) and tick repellents. - Isolation protocols, on-site health monitoring, and emergency medical response procedures will be established in case of potential outbreaks. - Regular health screenings will be conducted to detect and contain infectious cases early. - Medical staff and basic emergency medical equipment will be made available on-site or at nearby facilities.			AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	If OHS performance is not systematically monitored, the root causes of incidents may not be identified, risk trends may go unnoticed, and necessary preventive measures may not be implemented.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	- Indicators such as TRIR (Total Recordable Incident Rate), LTIFR (Lost Time Injury Frequency Rate), and the number of near-misses will be periodically monitored and reported. -These indicators will be mandatory for both contractors and subcontractors and will be regularly submitted to project management. - Weekly and monthly OHS inspections will be undertaken, and compliance records/reports will be prepared and regularly submitted by CSC to project management. - Any identified non-compliances will be corrected immediately; if not resolved, related works will be suspended until compliance is ensured.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	Occupational accidents and health issues may arise due to subcontractors insufficient OHS capacity, lack of documented systems, and low compliance with applicable legislation and standards. Implementation gaps may lead to additional risks concerning worker safety.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	-An OHS competence assessment will be conducted during the selection of subcontractors. -OHS compliance obligations and associated sanctions in case of non-compliance will be incorporated into the contracts signed with subcontractors. -Subcontractor performance will be monitored through periodic audits, and evaluation scores will be assigned accordingly.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	Factors such as long working shifts, excessive workload, poor management practices, and social isolation may lead to work-related stress, burnout, low motivation, and psychological disorders among employees.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	-Awareness-raising trainings on psychosocial risks will be organized, and confidential employee support hotlines will be established. -Employee satisfaction surveys and grievance mechanisms will be actively implemented. -Workload levels, shift durations, and task distribution will be regularly reviewed.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Occupational Health and Safety	Workers residing in on-site camps or off-site accommodations may face increased health, hygiene, and safety risks in the event that living conditions do not meet required standards.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	-Worker accommodation areas will be designed and monitored in accordance with the IFC's Worker Accommodation: Processes and Standards guidance note. -Access to clean water, adequate ventilation, waste management, fire safety, hygiene standards, and personal privacy will be ensured. -Accommodation facilities will be subject to periodic inspections by independent experts, including aspects related to emergency preparedness and response. -A Workers' Camp Management Plan (WCMP) will be developed and implemented, defining minimum space and WASH standards, visitor management, and transport arrangements. -The WCMP will also include provisions for Code of Conduct adherence, SEA/SH prevention training, and	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										safe access to the Workers' GM with non-retaliation measures			
Occupational Health and Safety	In the absence of an effective and confidential grievance mechanism through which workers can report their concerns, systematic OHS violations may be overlooked and workers' rights may be infringed.	Restricted	Irreversible/ Long-term reversible	Short-term	Continuous/ Recurrent	Significant	Medium	High	Major	-An independent and confidential worker grievance mechanism will be established and introduced to all employees. -The tracking of complaints, response times, and resolution processes will be formalized through defined procedures. - Immediate notification of all OHS incidents will be ensured, followed by the preparation and implementation of Corrective Action Plans (CAP) as required. - Incident reporting and CAP follow-up will be carried out in line with the procedures specified in the Environmental and Social Incident Reporting Tool (ESIRT).	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant
Community Health and Safety (CHS) including risks of Sexual Exploitation and Abuse / Sexual Harassment (SEA/SH)	- Increased risk of traffic accidents, accidents related to the worksites due to movement of construction machinery and heavy vehicles near settlements- Unauthorized access to construction sites, posing safety risks to the public - Exposure of communities to dust, noise, and visual disturbances, which may disproportionately affect vulnerable groups and individuals such as persons with disabilities and the elderly during construction activities. - Risk of communicable disease transmission (e.g. through labor influx) - Anxiety or psychological stress among local residents due to construction nuisances - Risks of SEA/SH resulting from interactions between workers, third-party security personnel, and community members, particularly affecting women, girls and vulnerable groups. - Security personnel may use excessive force or act without proper guidance while maintaining site security, potentially causing physical or psychological harm to workers or community members, - Lack of communication or understanding between security personnel and local communities/workers may lead to misunderstandings, tension, or negative perceptions of the security presence, - Unauthorized persons entering the site or failure to implement security procedures may increase risks of injury, theft, or other security incidents for workers and visitors.	Restricted	Medium-term reversible	Short-term	Intermittent	Moderate	Low	High	Moderate	- Prepare and implement a site-specific Construction Traffic Management Plan for each active workfront, with safety measures especially near schools and residential zones, - Each Construction Traffic Management Plan will define approved haul routes and operating hours, pedestrian detours, safety signage, and temporary access arrangements for emergency services. - No lane closures or night works will be permitted until the relevant Construction Traffic Management Plan is approved by AYGM/PIU and disclosed to local stakeholders at least 14 days in advance, in line with the SEP. - Weekly haulage and routing maps will be requested from Contractors and published through local communication channels. - Special attention will be given to ensuring pedestrian and community safety near schools, clinics, and densely populated areas. - Install fencing, barriers, and warning signs around active construction zones to prevent unauthorized entry - Regularly water exposed surfaces and unpaved roads to control dust emissions near communities - Limit construction work to daytime hours to reduce disturbance - Provide regular updates to the community regarding construction schedules and any disruptions - Implement communicable disease prevention measures (e.g., hygiene protocols, awareness campaigns) if needed - A unified Project Grievance Mechanism (GM), managed by the PIU, will be established and operated in coordination with the SEP. This mechanism will integrate all grievance channels, including contractor-level hotlines and CİMER/YİMER , ensuring accessible, confidential, and transparent resolution of community concerns. - Implement a Code of Conduct for all workers and security personnel covering SEA/SH, respectful behaviour and zero tolerance of GBV/SEA/SH incidents; ensure all workers receive mandatory induction and refresher training, in line with the SEA/SH Action Plan and Accountability Response Framework and the Security Management Plan. - Mandatory training on human rights, ethical conduct, and proportionate use of force for all security personnel. - Clear written procedures and limits for use of force. - Incident reporting and regular audits to prevent inappropriate behavior.	Minor	AYGM PIU	**Implementing:** D+B Contractor **Supervising:** Supervision Consultant **Monitoring:** AYGM and 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- Training on conflict resolution, crowd management, and effective communication. - Regular community engagement meetings and open communication channels, including SEA/SH-related awareness-raising for communities (if appropriate). - Coordination mechanisms with local authorities and community representatives. - Implement access control measures, ID verification, and regular security patrols. - Train all workers and security personnel on emergency procedures. - Conduct regular drills and inspections to ensure security measures are effective. - A Security Management Plan will be implemented to ensure that any security personnel engaged for the Project operate in line with ESS4 principles, including respect for human rights, proportional use of force, and effective grievance mechanisms for affected communities.			

7.2 Mitigation Measures for Operation Phase

Table 7-2 Mitigation Measures for Operation Phase

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
Surface Water Quality	- Surface water contamination risk due to accidental spills, runoff from maintenance yards, and drainage discharges. - Increased sedimentation and turbidity in streams near bridges and culverts.	Local	Medium-term reversible	Medium-term	One-off/rare	Moderate	Low	Medium	Minor	- Install and maintain oil-water separators in drainage systems. - Implement regular water quality monitoring upstream and downstream of discharge points. - Develop Spill Prevention and Response Plan for operational facilities. - Ensure proper stormwater management and sediment control measures.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Groundwater	- Risk of contamination from fuel or chemical leaks at maintenance depots. - Potential impact on groundwater-dependent ecosystems due to long-term dewatering (if applicable).	Local	Medium-term reversible	Short-term	Intermittent	Moderate	Low	Medium	Minor	- Provide secondary containment for underground fuel/chemical tanks. - Conduct periodic groundwater quality monitoring near sensitive receptors and wells. - Ensure proper sealing and lining of wastewater and stormwater channels to prevent infiltration.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Wastewater	- Generation of wastewater from stations, cleaning operations, and maintenance facilities. - Risk of untreated wastewater discharge into nearby surface or groundwater.	Local	Medium-term reversible	Short-term	Intermittent	Moderate	Low	Medium	Minor	- Connect station and maintenance facilities to municipal wastewater treatment systems where available. - Where not available, construct onsite treatment (e.g., package WWTP) compliant with WB/IFC standards and Turkish Regulation. - Conduct regular inspections and maintenance of wastewater treatment systems. - Monitor effluent quality to ensure compliance with discharge limits.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Air Quality	- Emissions from maintenance vehicles and auxiliary equipment. - Dust generation from maintenance works (e.g., ballast replacement). - Possible air quality deterioration around stations due to increased traffic.	Restricted	Short-term reversible	Short-term	Intermittent	Moderate	Low	Low	Minor	- Use electric or low-emission vehicles for maintenance. - Implement dust suppression measures (e.g., water spraying during maintenance). - Periodic air quality monitoring at sensitive receptors (schools, residential areas).	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Climate Change	- High GHG emissions from diesel machinery, transportation, and energy use. - Indirect emissions from land clearing (loss of carbon sinks).	Wide	Medium-term reversible	Long-term	Intermittent	Moderate	Medium	High	Major	- Use fuel-efficient and well-maintained equipment; minimize idling. - Optimize logistics to reduce transport emissions. - Integrate low-carbon materials (e.g., recycled aggregates, low clinker cement). - Establish GHG inventory and annual reporting. - Apply energy efficiency measures and renewable energy in operation.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Chemicals (Fuel, Lubricants, Cleaning Agents)	- Risk of spills during storage or handling at maintenance facilities. - Improper disposal of chemical wastes (e.g., oils, solvents) causing soil and water contamination.	Local	Irreversible/ Long-term reversible	Short-term	One-off/rare	Significant	Medium	Medium	Moderate	- Implement Hazardous Materials Management Plan (storage, labeling, spill kits). - Train staff in safe chemical handling and emergency response. - Ensure secondary containment in storage areas. - Comply with national hazardous waste regulations and WB/IFC standards for disposal.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Noise and Vibration	- Noise from train operations (wheel-rail interaction, braking). - Vibration impacts on nearby sensitive receptors (houses, schools, cultural sites).	Local	Short-term reversible	Medium-term	Intermittent	Moderate	Low	Medium	Minor	- Install noise barriers and low-noise rail technology (rail grinding, dampers). - Speed control near sensitive areas. - Regular track maintenance to minimize vibration levels. - Conduct periodic noise and vibration monitoring and adjust operations if thresholds are exceeded.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Biodiversity	Habitat loss Trend and population decrease of threatened species	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Moderate	In order to assess whether plant species with critical distribution (including regionally endemic or non-endemic but locally rare species) continue to persist along the project corridor and to determine the extent of potential impacts from the project activities, regular monitoring should be conducted. Specifically, monitoring should take place at least twice per year during the construction phase. If necessary, urgent conservation measures must be implemented based on the monitoring results.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Biodiversity	Habitat loss and degradation (existing vegetation areas)	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Moderate	- Implement vegetation maintenance protocols avoiding extensive clearing.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:**

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- Conduct maintenance works outside of breeding and flowering seasons. - Maintain native ground cover in non-critical zones to prevent erosion and maintain soil biota. - Replant disturbed strips annually using native species. - Permanent and temporary land take shall be limited to the minimum area required for safe operation. - Topsoil from suitable areas reused during reinstatement. - Temporary working areas should be rehabilitated as soon as practicable during operation activities.			Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Biodiversity	Wildlife mortality from rail collision	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Moderate	- Install and maintain wildlife fencing and underpasses to guide animal movement. - Conduct annual wildlife mortality monitoring along the corridor. - Adjust fencing and passage structures based on monitoring results. - Train drivers to report fauna collision incidents. - Temporary excavations and trenches shall be covered, fenced, or fitted with escape provisions when left unattended - Escape features shall be maintained in functional condition and kept free of blockage. - The effectiveness of these crossing structures shall be reviewed during operation, and additional adaptive measures shall be implemented where monitoring indicates that wildlife permeability is insufficient.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Biodiversity	Noise and vibration impact on fauna	Local	Short-term reversible	Medium-term	Intermittent	Moderate	Low	Medium	Minor	- Restrict use of loud warning horns near sensitive habitats. - Conduct acoustic monitoring annually during migration season. - Adjust operational schedules if significant disturbance detected. - Noise and vibration-generating activities during operation and maintenance activities shall be reduced through proper equipment maintenance and the use of low-noise methods where practicable. - Noise and vibration shall be reduced, through track and wheel maintenance, speed management, damping systems for wheels and tracks. - Noise barriers shall be implemented where high noise levels are linked to adverse biodiversity outcomes.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Biodiversity	Light pollution	Local	Short-term reversible	Medium-term	Intermittent	Moderate	Low	Medium	Minor	- Install timers and motion sensors to minimize night illumination. - Avoid floodlights in natural or wetland zones. - Monitor bat and bird behavior annually near lighted structures. - Any required lighting shall be directional, shielded, and of the lowest intensity necessary for safety. - Operational lighting at stations, depots, and maintenance areas shall be designed to minimize glare, spill, and skyglow.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Biodiversity	Invasive Alien Species (IAS) spread	Local	Short-term reversible	Medium-term	Intermittent	Moderate	Low	Medium	Minor	- Conduct risk-based and seasonally appropriate IAS inspections along right-of-way. - Remove detected species manually or by controlled treatment. - Ensure maintenance contractors clean vehicles and tools between work zones. - Minimise traffic and the distance it has travelled. - Source goods/materials locally where possible. - Keep IAS management log as part of biodiversity monitoring program.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Biodiversity	Biodiversity Monitoring of sensitive and protected species	Local	Medium-term reversible	Medium-term	Intermittent	Moderate	Medium	Medium	Moderate	- Continue Critical Habitat Monitoring Program (fauna and flora). - Conduct seasonal surveys (spring–autumn) by qualified ecologists.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										-Review and update the Biodiversity Action Plan where monitoring identifies declining trends, ineffective mitigation, unforeseen impacts or failure to achieve established biodiversity targets. - Implement adaptive management measures if population trends decline.			**Monitoring:** 3rd Party E&S Consultant
Stakeholder Engagement Expected population change	No permanent impact that could lead to population growth is expected, except for a short-term fluctuation during the operation phase.	Local	Short-term reversible	Medium-term	Intermittent	Moderate	Low	Low	Minor	- During this period, stakeholder engagement activities are expected to be carried out on an annual basis. - The GRM should remain active.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Stakeholder Engagement Economy and Employment	The blue-collar workforce potential typical of the construction phase will not be present during this period. Employment will mostly consist of skilled white-collar personnel. Therefore, no significant risks or impacts are anticipated in this regard.	Local	Short-term reversible	Medium-term	Intermittent	Moderate	Low	Low	Minor	- During this period, stakeholder engagement activities are expected to be carried out on an annual basis. - The GRM should remain active.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Stakeholder Engagement Housing and residences	No temporary or permanent accommodation areas/facilities are planned for white-collar personnel.	Local	Short-term reversible	Medium-term	Intermittent	Moderate	Low	Low	Minor	- During this period, stakeholder engagement activities are expected to be carried out on an annual basis. - The GRM should remain active.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Stakeholder Engagement Land acquisition	No land acquisition is planned for the operation phase.	Local	Short-term reversible	Medium-term	Intermittent	Moderate	Low	Low	Minor	- During this period, stakeholder engagement activities are expected to be carried out on an annual basis. - The GRM should remain active.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Labor Management	Inadequate labor management can lead to risks such as labor rights violations, unsafe working conditions, labor disputes, and exploitation. Poor management may cause accidents, reduced workforce morale, and non-compliance with local labor laws and international standards.	Restricted	Short-term reversible	Medium-term	Intermittent	Minimal	Low	Medium	Minor	- Ensure full compliance with Turkish Labor Law No. 4857, OHS Law No. 6331, and WB ESS2. - Align labor management practices with international good practices and the LMP. - Implement transparent and non-discriminatory recruitment processes for direct, contracted, and primary supply workers. - Require contractors to develop site-specific Labor Management Plans (LM Plans) and Occupational Health and Safety (OHS) Plans in accordance with Project standards. - Enforce strict prohibition of child labor and forced labor through regular monitoring and audits. - Conduct mandatory OHS training for all workers and ensure continuous awareness. - Provide adequate Personal Protective Equipment (PPE) and implement safety protocols to minimize accidents and occupational diseases. - Every worker has the right to refuse unsafe work and report it immediately. No disciplinary action shall be taken for exercising this right. - Monitor and regulate working hours to prevent excessive overtime and worker fatigue, in line with applicable legislation. - Implement zero-tolerance policies on SEA/SH with mandatory CoC training. - Establish confidential and accessible grievance mechanisms specifically for SEA/SH complaints. - Ensure worker camps meet IFC/EBRD minimum standards regarding hygiene, sanitation, water supply, and adequate living conditions. - Deliver periodic training on LMP provisions, workers' rights, CoC, and grievance procedures to all workforce categories. - Maintain effective, confidential, and accessible grievance channels for workers, with defined response and resolution protocols. - Conduct ongoing monitoring and supervision by the PIU and CSC.	Negligible	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- Prepare regular compliance reports and implement timely corrective actions when deviations are identified.			
Gender and Vulnerable Groups (Community access and mobility)	- Possible safety concerns for women at stations and in trains (lighting, security). - Unequal access to project benefits (transport affordability, station design not considering disabled).	Local	Short-term reversible	Medium-term	Intermittent	Moderate	Low	High	Moderate	- Design stations and trains to meet universal accessibility standards (ramps, lifts, signage), with due consideration to user access, circulation, lighting and SEA/SH risk prevention, as reflected in related Project documents and design contracts. - Provide adequate lighting, CCTV, and security presence to enhance safety. - Include women and vulnerable groups in monitoring and feedback processes during operation.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Occupational Health and Safety	Failure to develop a comprehensive Operation Phase Health and Safety Management System, including clear procedures for routine and emergency conditions, regular reporting, and performance monitoring, may result in inconsistent safety implementation. The absence of documented OHS procedures during the operation phase may lead to inadequate hazard control, uncoordinated response actions, weak regulatory compliance, and long-term safety performance issues.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	The operating entity will be required to develop and implement a comprehensive Health and Safety Management System specific to the operation phase. - The system will include written procedures for both routine operations and emergency conditions, and these procedures will be communicated to all personnel. - All OHS procedures will be documented and approved, in alignment with applicable legal requirements and best practices. - Regular risk assessments will be conducted, and OHS practices will be updated based on assessment findings. - A system for periodic monitoring and internal audits of OHS performance will be established, and findings will be reported to senior management. - OHS training programs will be developed for all employees, and trainings will be delivered at regular intervals and documented. - Emergency response plans will be prepared and maintained in an operational state, and their effectiveness will be tested through drills. - Clear roles and responsibilities for OHS implementation will be defined and assigned within the organizational structure. - Incident and non-compliance reporting, root cause analysis, and corrective action mechanisms will be implemented. - Key performance indicators for long-term safety performance will be defined, monitored, and used to guide preventive strategies.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Occupational Health and Safety	Inadequate development and use of operation phase OHS documentation including risk analyses, maintenance instructions, safety checklists, work permits, incident investigation reports, and monthly OHS performance indicators may result in gaps in safety implementation and reduced responsiveness to incidents. This may lead to repetitive safety violations, unreported near misses, and occupational accidents, posing risks for the operator.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	- The operating entity will be required to develop, standardize, and actively implement all operation-phase OHS documents (e.g., risk analyses, maintenance instructions, checklists). - Daily, weekly, and monthly maintenance and safety checks will be assigned with clear responsibilities and tracked using formal records. - Work permit systems will be made mandatory, especially for high-risk activities, and the validity of permits will be routinely verified. - All incidents and near misses will be reported, and root cause analyses will be conducted to initiate corrective and preventive actions. - Monthly OHS performance indicators (e.g., accident frequency rate, training completion, inspection results) will be defined, monitored, and reported to management. - All OHS documents will be reviewed regularly, with clear revision dates and responsible persons assigned. - Employees will be trained on the use of OHS documentation and reporting procedures and will be encouraged to actively participate in implementation. - A digital documentation and recordkeeping system will be used to improve traceability and enable data-	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										driven analysis. - For any gaps, incorrect entries, or audit findings, corrective action plans will be developed and their implementation will be tracked. - To ensure the effective field application of documentation, periodic audit mechanisms will be established, and results will be reported.			
Occupational Health and Safety	During continuous operation and maintenance of high-voltage electrification systems such as overhead catenary systems and traction substations workers may face significant risks including electric shock, arc flash, and equipment-induced fire or explosion. Failure to follow lock-out/tag-out procedures and poor system isolation may result in fatalities, infrastructure damage, and service disruption.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	-The operating entity will be required to develop and implement specific procedures for the safe operation and maintenance of high-voltage systems. - Lock-out/tag-out procedures will be strictly applied, and all energy sources will be fully isolated prior to intervention. - Only authorized personnel trained in high-voltage operations will be permitted to perform tasks on the system. - Arc-rated PPE including insulated gloves, face shields, and protective suits will be provided and used to prevent arc flash and electric shock injuries. - Standardized labeling and lockout points will be applied to all equipment, and these will be checked prior to each maintenance activity. - All electrical infrastructure components will be subject to periodic inspection, and maintenance records will be kept up to date. - Emergency response plans for equipment failure, short circuits, or fire will be developed and tested through drills. - Access to high-voltage areas will be physically restricted, allowing only authorized personnel to enter. - A permit-to-work system will be enforced for all maintenance and intervention activities on traction substations and catenary lines. - All workers will receive awareness training on the risks associated with re-energization after maintenance or service work.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Occupational Health and Safety	Software errors, human mistakes during testing, or system overload may lead to loss of train control, unauthorized movements, and accidents involving both personnel and passengers.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	-Standard operating and testing procedures will be implemented for signaling and control systems. - Functional tests will be performed only by authorized and trained personnel. - Software updates will be tested in offline environments before deployment. - System overloads will be monitored, and backup and fail-safe mechanisms will be ensured. - All system components will be regularly tested with version and configuration control. - Personnel will be trained on fault detection and emergency response.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Occupational Health and Safety	Routine inspection and maintenance of rail tracks, switches, bridges, tunnels, and technical buildings expose workers to hazards associated with working near railway lines. These include being struck by moving trains, slipping on tracks, or falling from structures especially in poor weather or low visibility conditions.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	-Safe work procedures for activities near railway lines will be developed and implemented for all inspection and maintenance tasks. - All works will be scheduled and coordinated based on train traffic timetables to avoid active rail operations. - Work permits will be obtained from authorized rail authorities, and coordination with signaling and control systems will be ensured before accessing the tracks. - All personnel will wear high-visibility PPE (e.g., reflective vests, illuminated helmets) and will use designated safe walkways. - A lookout person will be assigned to monitor for approaching trains and alert workers in advance. - In conditions involving wet surfaces, ice, or poor visibility, special precautions will be taken, and workers will be equipped with anti-slip footwear and headlamps.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- When working on bridges, tunnels, or elevated structures, fall protection systems (e.g., lifelines, guardrails) will be used. - Workers walking or working along the tracks will maintain situational awareness in both directions, and use of distracting devices such as headphones will be prohibited. - All field staff will receive training on railway safety, train detection, and emergency escape procedures. - Non-essential activities will be postponed during hazardous weather conditions, and emergency response protocols will be activated if needed.			
Occupational Health and Safety	During tunnel and enclosed structure inspections, workers may face exposure to poor ventilation, gas accumulation, and limited escape routes. Without adequate lighting, oxygen level monitoring, or confined space entry procedures, these tasks may result in respiratory problems, collapse, or fatal entrapment incidents.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	-The operating entity will be required to develop and implement confined space safety procedures for all tunnel and enclosed structure inspections. - Prior to any inspection, gas measurements, oxygen level checks, and ventilation assessments will be carried out. - Portable gas detectors and oxygen sensors will be used and carried by all personnel entering risk-prone areas. - A permit-to-work system will be applied to all confined space entries, and only authorized personnel will be permitted to enter. - All confined space workers will receive certified training on confined space entry and emergency response protocols. - Adequate lighting systems and backup light sources will be provided for the full duration of inspections. - A standby or watch person will remain outside the confined space at all times to maintain continuous communication. - Two-way radios, audio alarms, or signal systems will be used for communication, and emergency exits will be clearly marked. - Rescue equipment and evacuation plans will be made available and ready for immediate use in case of collapse, gas exposure, or entrapment. - Non-essential inspections in high-risk areas will be postponed based on weather conditions or technical constraints where appropriate. - Temporary power systems must include Residual Current Device protection and proper grounding.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Occupational Health and Safety	Operation and handling of hazardous materials such as fuels, degreasers, paints, and cleaning agents without proper ventilation and PPE may expose workers to chemical burns, respiratory hazards, and increased fire risk. Spills and leakages may also cause environmental contamination and public health concerns.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	-The operating entity will be required to develop and implement chemical safety procedures for the use and handling of all hazardous substances. - Hazardous chemicals will only be handled by authorized and trained personnel, and SDS will be made available and accessible. - Natural or mechanical ventilation systems will be installed in all chemical usage areas, with local exhaust ventilation for enclosed spaces. - Appropriate PPE (e.g., gloves, masks, goggles, protective suits) will be selected based on the chemical risk and its use will be mandatory. - All chemicals will be stored in original, clearly labeled containers, and improper or mixed storage will be strictly prohibited. - Spill response kits and trained personnel will be available on site to immediately respond to leaks or accidental discharges. - Flammable substances will be stored away from ignition sources, in designated safe areas, and fire extinguishers will be readily accessible. - Spilled chemicals and hazardous waste will be disposed of through licensed and authorized service providers in compliance with environmental regulations.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
										- During chemical transportation, sealed containers and secondary containment will be used to prevent leaks or spills - In long railway tunnels and enclosed infrastructure with limited evacuation options, automated fire suppression systems such as high-pressure water mist or foam-based localized extinguishing units will be installed, particularly in technical rooms, cable shafts, and equipment chambers. The design shall be based on tunnel-specific fire risk assessments and be integrated with tunnel ventilation and emergency response systems.			
Occupational Health and Safety	Long-term exposure to noise and vibration from operational trains and maintenance activities may lead to hearing damage, stress related disorders, and reduced concentration levels among workers.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	-The operating entity will be required to conduct workplace exposure assessments for noise and vibration risks and develop corresponding mitigation strategies. - Hearing protection devices (e.g., earplugs, earmuffs) will be provided to personnel at high-risk locations, and their use will be mandatory. - Vibration-dampening tools, shock-absorbing flooring, and ergonomic operator seats will be implemented where applicable. - Worker exposure durations will be limited in accordance with threshold limits, and rotational work schedules will be planned to minimize continuous exposure. - Noise and vibration levels will be measured regularly, recorded, and monitored over time. - Warning signs will be posted in high-exposure areas, and access without protective equipment will be restricted. - All personnel will receive training on noise and vibration hazards, protective measures, and correct PPE usage. - Periodic medical screenings focusing on hearing and balance health will be conducted for exposed workers. - Source-level noise reduction measures, such as sound-absorbing panels and insulation materials, will be applied where feasible.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Occupational Health and Safety	Increased passenger traffic and pedestrian movement in and around stations and railway crossings may pose collision and fall risks. Overcrowded areas, lack of clear signage, or panic during emergencies may result in injuries, especially for vulnerable groups such as elderly or disabled passengers.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	- Pedestrian and passenger safety plans will be developed and implemented for areas with high foot traffic. - Walkways, entry/exit points, and crossing areas will be clearly marked with signage, ensuring barrier-free accessibility. - Crowd control measures (e.g., barriers, directional lanes, informational boards) will be used to guide flow on platforms and other critical areas. - Emergency evacuation plans will be prepared for stations and crossings and drilled with relevant staff. - Audio and visual communication systems will be integrated to assist visually or hearing-impaired passengers. - Warning signs and safety announcements will be made available and broadcast regularly for passenger awareness. - Floor surfaces will be made slip-resistant, and stairs, ramps, and platform edges will be marked with safety indicators. - During peak hours, additional safety personnel will be deployed to monitor movement and assist in emergencies.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Occupational Health and Safety	Emergency scenarios such as train derailments, onboard fires, technical breakdowns, or sabotage may cause major disruptions if response teams are untrained or equipment is insufficient.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	- The operating entity will be required to develop and implement a comprehensive Emergency Preparedness and Response Plan (EPRP) covering all major emergency scenarios. - Response teams will receive regular training on fire	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
	Delayed intervention or lack of coordination with local emergency services may increase the severity of injuries and infrastructure damage.									response, evacuation, rescue, sabotage handling, and technical failure management. - Emergency response tools and equipment (e.g., fire extinguishers, first aid kits, rescue gear) will be made available and maintained at every station and critical point. - Clear roles and responsibilities will be assigned to all personnel involved in emergency situations and validated through practical drills. - Rapid and multi-channel communication systems will be established between stations, train crew, and control centers. - Protocols for coordination with local fire departments, medical services, and law enforcement will be pre-established and reinforced through joint drills. - A crisis communication plan will be prepared for managing information sharing, passenger evacuation, and media response during emergencies. - Monitoring systems and security partnerships will be strengthened to mitigate sabotage risks at critical infrastructure points.			
Occupational Health and Safety	Lone workers operating in remote or sparsely monitored areas such as track sections far from urban centers face increased risks in case of accidents, health emergencies, or acts of aggression. Delayed emergency detection or response may result in avoidable injury severity or death.	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	- The operating entity will be required to develop and implement a lone worker safety procedure for all relevant operations. - Workers assigned to remote areas will be equipped with wearable emergency alert devices and/or GPS tracking systems. - Scheduled check-ins or automated location updates will be made mandatory for all lone working assignments. - A risk assessment will be conducted in advance for any lone work, and tasks deemed unsafe for solo execution will be prohibited. - Mobile applications or alert systems with automatic emergency notification features will be used for lone workers. - A designated standby support team will be assigned to monitor and respond to emergencies involving lone workers. - Reliable communication infrastructure (e.g., radio, mobile phone networks) will be ensured, and alternative communication methods will be evaluated in areas with poor signal coverage. - All personnel will receive training on lone working risks, emergency protocols, and self-protection techniques. - Pre-defined response plans for incidents involving lone workers will be integrated into the central emergency system. - Records of lone worker activities, incident responses, and reports will be regularly reviewed to support continuous improvement.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Occupational Health and Safety	The operation of freight trains carrying dangerous goods such as flammable, explosive, toxic, or corrosive substances through stations and railway lines shared with passenger trains poses elevated health and safety risks. In the event of derailment, leakage, fire, or accidental release, these materials may endanger not only railway staff but also passengers, station personnel, and nearby communities. The absence of dedicated hazardous material handling protocols, real-time risk communication systems, and emergency isolation procedures	Local	Irreversible/ Long-term reversible	Medium-term	Continuous / Recurrent	Significant	High	High	Major	- In order to protect passenger trains from possible leaks, fires, or explosions involving freight trains, a durable barrier resistant to fire and blast will be installed between freight train tracks and passenger areas at shared stations. - Automatic fire suppression systems (e.g., water-based sprinkler systems) will be installed in all passenger stations, technical rooms, and critical equipment areas in accordance with national fire protection legislation and international standards. - These systems will significantly reduce the risk of fire spread, improve evacuation safety, and enhance infrastructure resilience against fire-induced operational disruptions. - The operating entity will be required to establish and	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant

Subject	E&S Risks	Magnitude						Receptor Sensitivity	Description of Risk/Expected Impact	Mitigation Measures	Final Impact Significance	Responsibility	
		Geographical extent	Reversibility	Duration	Frequency	Severity	Overall					Development / Definition	Impementation
	increases the likelihood and severity of impacts. Mixed-use of stations and tracks without proper segregation or scheduling controls further raises the risk of exposure, evacuation challenges, and cascading disruptions in case of an incident.									implement specific safety protocols, transport restrictions, and monitoring procedures for freight trains carrying hazardous materials. - The movement of such trains will be scheduled in advance and, where possible, planned for off-peak hours with low passenger traffic. - All transport units, containers, and wagons will be properly labeled in accordance with international standards, and transport documentation will be complete and accurate. - Emergency isolation plans will be developed to enable rapid containment of affected areas in case of fire, leakage, or gas release. - Real-time hazard communication systems will be implemented to alert passenger trains, station staff, and emergency response teams. - During the approach or passage of hazardous material trains through stations, personnel movement within the station will be restricted, and passenger announcements will be made. - To reduce post-incident impact, evacuation plans, quarantine zones, and alternative routing scenarios will be prepared and ready for deployment.			
Occupational Health and Safety	The absence of a confidential and accessible grievance mechanism for workers may result in unresolved complaints, increased dissatisfaction, and exposure to labor rights violations, including harassment and unsafe conditions.	Local	Irreversible/Long-term reversible	Medium-term	Continuous /Recurrent	Significant	High	High	High	- A confidential and accessible worker grievance mechanism will be established and communicated to all workers. -The mechanism will ensure anonymous submissions, protection against retaliation, and defined response times. -Grievances and resolution outcomes will be regularly monitored to identify systemic issues.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Occupational Health and Safety	Prolonged working hours, isolated worksites, monotonous tasks, or high-pressure roles may lead to psychosocial risks such as stress, fatigue, anxiety, and decreased performance.	Local	Irreversible/Long-term reversible	Medium-term	Continuous /Recurrent	Significant	High	High	High	-Psychosocial risks will be assessed through worker feedback, health checks, and supervision. -Stress management and mental health awareness training will be provided to workers. -Rest and rotation schedules will be adjusted to reduce fatigue and improve mental well-being.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Occupational Health and Safety	Inadequate monitoring of safety performance metrics may lead to missed trends, ineffective corrective actions, and reduced accountability in occupational health and safety management.	Local	Irreversible/Long-term reversible	Medium-term	Continuous /Recurrent	Significant	High	High	High	-Key indicators such as TRIR, LTIFR, incident rate, and near-miss frequency will be monitored and reported monthly. -Root cause analysis will be required for all reportable events. -Management reviews will incorporate KPI analysis to guide preventive strategies.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant
Community Health and Safety (CHS)	- Increased safety risks near stations and crossings (trespassing, accidents). - Electromagnetic field (EMF) exposure near lines.	Restricted	Irreversible/ Long-term reversible	Long-term	One-off/rare	Significant	Medium	Medium	Moderate	- Fencing and controlled access to rail corridors. - Install signage and warning systems at crossings. - Emergency preparedness drills for nearby communities.	Minor	AYGM PIU	**Implementing:** TCDD **Supervising:** Supervision Consultant **Monitoring:** 3rd Party E&S Consultant

8 DESIGN MEASURES

The INRAIL Project has been designed with integrated E&S considerations in order to minimize adverse impacts and enhance long-term sustainability. These design measures are informed by regulatory requirements, baseline environmental and social conditions, the results of the impact assessment, and GIIP, including the WB ESF. Accordingly, the design measures described in this chapter have been developed to align with the requirements and findings of the ESIA and the World Bank ESF. This chapter outlines the key environmental, social, and safety-related design decisions incorporated during the feasibility and preliminary design stages of the Project. These measures will be further developed, verified and incorporated into the final design by the D+B Contractors. The ESIA, ESMP and applicable management plans will be updated where the detailed design introduces material changes or additional environmental and social risks and impacts.

Route Selection and Corridor Optimization

To avoid ecologically and socially sensitive areas, the railway alignment was selected based on a comparative analysis of multiple route alternatives. Priority was given to:

- Minimizing the number of settlements directly affected;
- Avoiding designated conservation areas and critical habitats;
- Following existing infrastructure corridors where possible (e.g., roads, utility lines);
- Minimizing forest clearance and impact on agricultural land;
- Reducing the need for large-scale resettlement or expropriation.

This corridor-based design approach helped avoid direct impacts on nationally protected areas and reduced the Project's potential biodiversity footprint.

Tunneling and Viaduct Structures

Approximately 50% of the route is planned as tunnel, and several long-span viaducts are incorporated, particularly in topographically challenging areas. These structural solutions designed to;

- Avoid large-scale cut-and-fill operations,
- Reduce interference with surface watercourses and wetlands,
- Minimize habitat fragmentation by allowing wildlife movement beneath elevated structures,
- Limit noise and visual impacts in densely populated areas,
- Preserve forested or rugged terrain from large-scale excavation.

Tunnel construction will primarily use TBM and NATM, minimizing the need for blasting and reducing air, noise, and vibration impacts.

Environmental Safeguards Integrated into Design

A range of environmental protection measures have been embedded into the preliminary design or identified for further development during detailed design, including:

- Drainage and erosion control: Design of adequate stormwater drainage systems along the corridor to prevent waterlogging, erosion, and sedimentation;
- Slope stabilization: Engineering stabilization of embankments and cut faces using bioengineering or mechanical structures to prevent landslides;
- Soil protection: Topsoil stripping and reuse planning in construction zones;
- Water crossings: Use of culverts, box channels, and elevated structures to maintain the natural hydrological flow and minimize disruption to watercourses;
- Noise mitigation: Provision of noise barriers or other appropriate noise-control measures where required based on baseline noise assessments and predicted exceedances;

- Dust and air quality: Paving of access roads in sensitive locations and layout of construction sites to minimize dust dispersion toward settlements.
- Wildlife crossing continuity at motorway interface: At the location where the INRAIL alignment intersects the North Marmara Motorway ecological overpass, the railway will be delivered as a cut-and-cover tunnel, thereby maintaining the functionality of the ecological crossing in operation. During construction, a temporary wildlife passage will be installed to ensure uninterrupted fauna movement. The reinstated surface over the covered railway will be designed to meet ecological overpass best practice, including minimum effective width and substrate continuity, native vegetation cover, perimeter fencing to guide fauna, exclusion from construction zones, noise and light minimization, and post-construction monitoring. Coordination with the motorway operator and relevant authorities will be undertaken to align timing, fencing tie-ins, and maintenance responsibilities. If monitoring indicates residual barrier effects, adaptive measures (e.g., widening of the vegetated platform or enhancements to guide fencing) will be implemented.

Social Design Measures

To reduce adverse social impacts and promote community safety and acceptance, several socially oriented design features have been adopted into the preliminary design or identified for confirmation during detailed design:

- Grade-separated crossings to avoid road–rail conflicts and ensure traffic and pedestrian safety;
- Access roads and underpasses to prevent disruption of community connectivity and access to agricultural lands;
- Station location planning based on accessibility, integration with other modes of transport, and minimizing land acquisition impacts;
- Minimizing land take and physical displacement through optimized land footprint and infrastructure layout;
- Incorporation of gender-sensitive design elements at stations and public interfaces (e.g., lighting, signage, and safe waiting areas).

Where detailed design changes may result in additional land acquisition, access restrictions, physical displacement or economic displacement, the relevant alternatives will be reassessed and the applicable RP and, where required, LRP will be prepared or updated before access to the affected land.

Worker and Community Safety Measures

Design considerations also include the integration of occupational and public safety features such as:

- Fire suppression systems, ventilation shafts, and escape routes in tunnels;
- Safety signage and fencing along the railway corridor to prevent unauthorized access;
- Drainage systems designed to prevent ponding and reduce vector-borne disease risks;
- Platforms and crossings built in compliance with universal accessibility standards.

The D+B Contractors will undertake design-stage OHS and community-safety risk assessments, including constructability reviews, fire-life-safety assessments, emergency-access planning and safety-in-design reviews, and will demonstrate how identified risks have been eliminated or reduced through the hierarchy of controls.

Climate and Energy Efficiency Considerations

The Project supports Türkiye's 2053 net-zero emission targets through the promotion of electrified rail transport. Additional climate-smart design elements include:

- Use of electric traction via overhead catenary systems;
- Regenerative braking systems to reduce energy demand;

- Design of energy-efficient station buildings with natural lighting and ventilation;
- Potential for solar PV integration on station rooftops and depot buildings.

In addition, route alignment and structural elements were planned to reduce long-term maintenance and operational energy consumption. Climate-risk and vulnerability considerations, including extreme rainfall, flooding, heat, wildfire, landslide and seismic risks, will be incorporated into the final design and asset-resilience requirements.

Stakeholder Feedback in Design Process

Feedback from local communities, governmental agencies, and NGOs&CSOs collected during the ESIA process and earlier project development phases has been reflected in several design decisions, such as:

- Adjustments to the alignment to avoid sensitive receptors;
- Modifications to underpass designs to address community mobility needs;
- Consideration of noise control solutions and visual barriers in affected settlements.

The D+B Contractors will maintain a design-change and stakeholder-feedback register demonstrating how relevant stakeholder concerns have been considered and either incorporated into the design or addressed through documented justification and mitigation measures.

REFERENCES

- *Akin, Anil & Sunar, Filiz & Berberoglu, Suha. (2015). Urban change analysis and future growth of Istanbul. Environmental monitoring and assessment. 187.4721.10.1007/s10661-015-4721-1.https://link.springer.com/article/10.1007/s10661-015-4721-1*
- *Alemdar, K.D. Seismic risk assessment of transportation networks for the impending Istanbul earthquake with GIS-based MCDM approach. Nat Hazards 121, 10085–10123 (2025). https://doi.org/10.1007/s11069-025-07199-y. https://link.springer.com/article/10.1007/s11069-025-07199-y*
- *ALO 183 Hotline Service Areas.https://alo183.aile.gov.tr/alo183pages/hizmet-alani/. Access date: December 2025*
- *Arslan, R. K. (2025). Metropolitan Municipality Elections After Law No. 6360. SSD Journal, 10(49), 277–291, https://doi.org/10.5281/zenodo.15206247, https://www.ssdjournal.org/index.php/pub/article/view/757. Access date: June 2025.*
- *Association of Housing Developers and Investors (Konutder) Istanbul Housing Demand Study Report, with the support of PwC Türkiye, 17012024. https://konutder.org.tr/files/PwC_Konutder_I%CC%87stanbul%20Konut%20I%CC%87htiyac%C4%B1%20C%CC%A7al%C4%B1s%CC%A7mas%C4%B1%20Rapor_17012024.pdf. / https://konutder.org.tr/files/konutderpwcistanbul-konut-ihtiyaci-calismasi2202504vf3-1744989716961.pdf. Access date: July 2025.*
- *Atlas of the European Dragonflies and Damselflies, Boudot and Kalkman, 2015,*
- *Canbak, Başak (2012) Female labor force participation in Turkey: the role of skill premium and gender wage gap. [Thesis]. http://192.168.1.20/record=b1505253 (Table of Contents). Access date: December 2025.*
- *Child dependency ratio: The number of persons at "0-14" age group per 100 persons at "15-64" age group. TurkStat Metadata of ABPRS. https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1#data0. Access date: July 2025.*
- *Cinsiyet Eşitliği İzleme Derneği (CEİD). (2025). Gender Equality Monitoring Report of Türkiye 2023–2024 (Annual report). CEİD. https://ceidizler.ceid.org.tr/dosya/yillik-rapor-2023-24mart6pdf.pdf. Access date: December 2025.*
- *Constitution of the Republic of Turkey (1982). https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=2709&MevzuatTur=1&MevzuatTertip=5. Access date: December 2025*
- *Convention on the Elimination of All Forms of Discrimination Against Women (CEDAW), UN Treaty Series https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-8&chapter=4&clang=_en. Access date: December 2025.*

- *Council of Europe – Istanbul Convention: Key Facts. https://www.coe.int/en/web/istanbul-convention/key-facts. Access date: December 2025*
- *Danış, D., Biehl Öztuzcu, K., & Kablan, E. (2023). Göç ve deprem III – İstanbul'a gelen depremzede mültecilere yönelik kabul ve dışlama mekanizmaları. Göç Araştırmaları Derneği. Retrieved from https://gocarastirmalaridernegi.org/tr/calismalar/arastirmalar/goc-ve-deprem-durum-tespit-raporu/322-goc-ve-deprem-durum-tespit-raporu-iii.*
- *Darülaceze Directorate. https://www.darulaceze.gov.tr/kurumsal. Access date: August 2025.*
- *Decent Work Country Diagnostics. Technical Guidelines to Draft the Diagnostic Report. Prepared by: Country Diagnosis Tool Team July, 2015. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_mas/%40program/documents/genericdocument/wcms_561044.pdf*
- *Eastern Marmara Development Agency, http://www.marka.org.tr/, Access date: June 2025.*
- *Education at a Glance: Türkiye. OECD Country Report. https://www.oecd.org/en/publications/education-at-a-glance-2025_1a3543e2-en/turkiye_9648f416-en.html. December 2025.*

- *Elderly dependency ratio: The number of persons at "65 and over" age group per 100 persons at "15-64" age group. TurkStat Metadata of ABPRS. https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1#data0. Access date: July 2025.*
- *Environmental Status Report of İstanbul – 2023, İstanbul Provincial Directorate of Environment, Urbanism and Climate Change, 2024,* https://ced.csb.gov.tr/2023-yili-il-cevre-durum-raporlari-i-112399
- *Environmental Status Report of Kocaeli – 2023, Kocaeli Provincial Directorate of Environment, Urbanism and Climate Change, 2024, https://ced.csb.gov.tr/2023-yili-il-cevre-durum-raporlari-i-112399*
- *European Commission, Eurostat. LAU - Local Administrative Units, https://ec.europa.eu/eurostat/web/nuts/local-administrative-units. Access date: July 2025*
- *European Commission, Eurostat, NUTS. https://ec.europa.eu/eurostat/web/nuts. Access date: July 2025,*
- *Final ESIA Report of the Nakkaş-Başakşehir Highway Project, ERM, August 2023, http://nakkasotoyolu.com/tr/47126*
- *Final ESIA Report of the North Marmara Motorway Project, ENCON Environmental Consultancy Co., March 2018, https://www.kuzeymarmaraotoyolu.com/en/environmental-management*
- *Gevrek, Z. E., & Gevrek, D. (2023). Social norms and the gender gap in labor force participation: Evidence from Turkey. Applied Economics Letters, 30(15), 2102–2107. https://doi.org/10.1080/13504851.2022.2094315. Access date: December 2025.*
- *IEMA, 2011; UK HA 205/08 Volume 11, Section 2; Canter, L., 1993; and other impact assessment methodology guidance/handbooks,*
- *ILO Employment and social protection in the new demographic context International Labour Office, Geneva, 2010. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_emp/%40emp_policy/documents/publication/wcms_125308.pdf. Access date: July 2025.*
- *ILO, Global Employment Trends for Youth 2017: Paths to a better working future International Labour Office – Geneva: ILO, 2017. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40dgreports/%40dcomm/%40publ/documents/publication/wcms_598669.pdf. Access date: July 2025.*
- *ILO, Global Employment Trends for Youth 2017: Paths to a better working future International Labour Office – Geneva: ILO, 2017. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40dgreports/%40dcomm/%40publ/documents/publication/wcms_598669.pdf. Access date: July 2025.*
- *ILO (2025). World Employment and Social Outlook: Trends 2025. https://www.ilo.org/sites/default/files/2025-01/WESO25_Trends_ExecSum_EN.pdf. Access date: August 2025.*
- *International Union of Railways, "Carbon Footprint of High Speed Rail"*
- *Istanbul 39: Socioeconomic Profile of the Districts. ILKE PUBLICATIONS: 249.RESEARCH REPORTS: 20. https://ilke.org.tr/files/netstk/50/web/115/4873/dosyalar/istanbul39.pdf.*

- *İstanbul Development Agency, https://www.istka.org.tr/, Access date: June 2025*
- *Istanbul Planning Agency Population Projections. https://ipa.istanbul/yayinlarimiz/50/nufus-projeksiyonlari. Access date: July 2025*
- *Istanbul Urban Regeneration Strategic Plan and Master Plan (2015-2025), İstanbul Metropolitan Municipality and İstanbul Technical University,March 2015, https://sehirplanlama.ibb.istanbul/stratejik-planlar/*
- *Kazan, A. (2017). The Effects of the Law No 6360 on the Financial Structures of Metropolitan Municipalities. Sayıştay Dergisi(104), 87-106. https://www.sayistay.gov.tr/files/4465_der104m5.pdf.*
- *Median age: The age of the person in the middle when all the persons in the population are sorted in ascending order. TurkStat Metadata of ABPRS. https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1#data0. Access date: July 2025.*
- *Ministry of Foreign Affairs Directorate for EU Affairs, NPAA, https://www.ab.gov.tr/58_en.html. Access date: July 2025,*
- *Ministry of Industry and Technology General Directorate of Development Agencies. Classification of Statistical Regional Units in Development Planning. https://ka.gov.tr/sayfalar/kalkinma-planlamasinda-istatistiki-bolge-birimleri-siniflandirmasi--24. Access date: July 2025,*
- *Ministry of Interior Inventory of Local Authority Units, https://www.e-icisleri.gov.tr/Anasayfa/MulkiIdariBolumleri.aspx. Access date: July 2025,*
- *Ministry of Family and Social Services – Legislation. https://www.aile.gov.tr/ksgm/mevzuat/. Access date: December 2025*
- *Ministry of Family and Social Services – ŞÖNİM (Violence Prevention and Monitoring Centers) Contact Information. https://www.aile.gov.tr/iletisim/bakanlik-iletisim-bilgileri/sonim/. Access date: December 2025.*
- *Ministry of Family and Social Services – Women's Empowerment Strategy Document and Action Plans. https://www.aile.gov.tr/ksgm/ulusal-eylem-planlari/kadinin-guclenmesi-strateji-belgesi-ve-eylem-planlari/. Access date: December 2025*
- *Mülteciler Derneği, 2025. Türkiye'deki Suriyeli Sayısı Mayıs 2025. https://multeciler.org.tr/turkiyedeki-suriyeli-sayisi/. Access date: July 2025.*
- *National Action Plans for Combating Violence Against Women, Ministry of Family and Social Services https://www.aile.gov.tr/ksgm/ulusal-eylem-planlari/kadina-yonelik-siddetle-mucadele-ulusal-eylem-planlari/.. Access date: December 2025*
- *OECD (2025), OECD Economic Surveys: Türkiye 2025, OECD Publishing, Paris, https://doi.org/10.1787/d01c660f-en. Access date: 2025.*
- *Office of the Ombudsman of Turkey – About the Institution. https://english.ombudsman.gov.tr/about-the-institution. Access date: December 2025*
- *Official website of the General Directorate of ISTAC (İBB's waste disposal company), https://istac.istanbul/faaliyet-alanlarimiz/atik-yonetimi,*
- *Official website of the General Directorate of the Istanbul Water and Sewerage Administration, https://www.iski.gov.tr/*
- *Official website of the General Directorate of the Kocaeli Water and Sewerage Administration, https://www.isu.gov.tr/*
- *Official website of the General Directorate of the Mineral Exploration and Research, http://yerbilimleri.mta.gov.tr,*
- *Official website of the Housing Development Administration of Türkiye (TOKİ) https://www.toki.gov.tr/*
- *Official website of the İstanbul Metropolitan Municipality, https://cevre.ibb.istanbul/wp-content/uploads/2023/04/AVRUPA-YAKASI-IZINLI-DEPOLAMA-ALANLARI.pdf*
- *Official website of the Kocaeli Metropolitan Municipality, https://www.kocaeli.bel.tr/*
- *Official website of the Kocaeli Municipality, Waste Management Company (IZAYDAŞ), https://www.izaydas.com.tr/*
- *Official website of the Refugee Association, https://multeciler.org.tr*
- *Official website of the Turkish Chamber of Engineers and Architects, https://www.tmmob.org.tr*
- *Official website of the Turkish Statistical Institute (TurkStat), https://data.tuik.gov.tr,*
- *Official website of the WBG, https://www.worldbank.org*
- *One Year After: Living and Working Conditions in Adıyaman, Hatay, Kahramanmaraş and Malatya after the February 2023 Earthquakes in Türkiye, 9789220413081 (web PDF).*

https://www.ilo.org/sites/default/files/2024-10/Household%20Survey%20Report.pdf. Access Date: July 2025.

- *Optional Protocol to the Convention on the Elimination of All Forms of Discrimination Against Women, UN Treaty Series. https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=IV-8-b&chapter=4&clang=_en. Access date: December 2025*
- *Population density: Population per one square kilometer. In the calculation of population density indicator, the land surface area excluding "inland water bodies (natural and dam lakes, rivers and continental shelves, etc.)" is used according to international definitions. TurkStat Metadata of ABPRS. https://data.tuik.gov.tr/Kategori/GetKategori?p=nufus-ve-demografi-109&dil=1#data0. Access date: June 2025.*
- *Population in largest city is the urban population living in the country's largest metropolitan area. World Urbanization Prospects 2018, UN, uri: https://population.un.org/wup/, publisher: UN Population Division, date published: 2018. Access date: July 2025.*
- *Population in urban agglomerations of more than one million is the country's population living in metropolitan areas that in 2018 had a population of more than one million people. World Urbanization Prospects 2018, UN, uri: https://population.un.org/wup/, publisher: UN Population Division, date published: 2018. Access date: July 2025.*
- *Presidency of Strategy and Budget. Twelfth Development Plan (2024-2028). https://www.sbb.gov.tr/wp-content/uploads/2025/03/Twelfth-Development-Plan_2024-2028.pdf*
- *Presidency of the Republic of Türkiye Strategy and Budget Office. Total and Female Labor Force Participation Rate, January 2017 – January 2025.https://www.sbb.gov.tr/istihdam/. Access Date: July 2025*
- *Presidency of the Republic of Türkiye. Presidency of Strategy and Budget. Eleventh Development Plan (2019-2023). https://www.sbb.gov.tr/wp-content/uploads/2022/07/Eleventh_Development_Plan_2019-2023.pdf. Access date: July 2025.*
- *Productivity Ecosystems for Decent Work. Glossary of frequently used terminology. March 2023. https://www.ilo.org/sites/default/files/wcmsp5/groups/public/%40ed_emp/%40emp_ent/documents/publication/wcms_873800.pdf. Access date: August 2025.*
- *Republic of Türkiye Ministry of Industry and Technology General Directorate of Development Agencies. Classification of Statistical Regional Units in Development Planning. https://ka.gov.tr/sayfalar/kalkinma-planlamasinda-istatistiki-bolge-birimleri-siniflandirmasi--24. Access date: July 2025.*
- *Republic of Türkiye Ministry of Interior Directorate General of Civil Society Relations. Civil Society Information System (DERBİS). https://www.siviltoplum.gov.tr/dernekler-bilgi-sistemi-derbis. Access date: August 2025.*
- *Republic of Türkiye Ministry of Interior Inventory of Local Authority Units, https://www.e-icisleri.gov.tr/Anasayfa/MulkiIdariBolumleri.aspx. Access date: July 2025.*
- *Republic of Türkiye, Ministry of Foreign Affairs Directorate for EU Affairs, NPAA, https://www.ab.gov.tr/58_en.html. Access date: July 2025.*
- *Republic of Türkiye, Ministry of Industry and Technology, Development Agencies. https://ka.gov.tr/en/development-agencies. Access date: April 2025.*
- *Sixth Five-Year Development Plan (1990–1994), Presidency of Strategy and Budget, Turkey. https://www.sbb.gov.tr/wp-content/uploads/2022/07/Altinci_Bes_Yillik_Kalkinma_Plani-1990-1994.pdf. Access date: December 2025*
- *Statement Regarding Turkey's Withdrawal from the Istanbul Convention. Presidency of Communications, Turkey https://www.iletisim.gov.tr/turkce/haberler/detay/statement-regarding-turkeys-withdrawal-from-the-istanbul-convention. Access date: December 2025*
- *Sunata, U., & Ergül, D. (2019). İstanbul İlçelerinin Nüfus Değişimi ve Kütük Bilgilerinin Analizi. Göç Dergisi, 6(1), 37-72. https://doi.org/10.33182/gd.v6i1.635. https://dergi.tplondon.com/goc/article/view/635, https://dergi.tplondon.com/goc/article/view/635/606,*
- *Tekgüç, H., Eryar, D. & Cindoğlu, D. Women's Tertiary Education Masks the Gender Wage Gap in Turkey. J Labor Res 38, 360–386 (2017). https://doi.org/10.1007/s12122-017-9243-x. Access date: December 2025*
- *The Housing Development Administration of Türkiye (TOKİ). https://www.toki.gov.tr/haber/istanbul-tuzlada-1130-sosyal-konut-teslim-ediliyor, Access date: July 2025.*

- *The Status of International Law in the Turkish Constitution, Office of the President of Turkey. https://www.anayasa.gov.tr/en/president/former-presidents-speeches/zuhtu-arslan/speeches/the-status-of-the-international-law-in-the-turkish-constitution. Access date: December 2025*
- *The WB in Türkiye. Country Overview. Economy. https://www.worldbank.org/en/country/turkey/overview, Last update: April 2024. Access date: August 2025.*
- *Toksöz, G. (2025). İşgücü piyasasının cinsiyetçi yapısı, geleceğin işleri ve kadınların önündeki engeller [Report]. TESEV – Türkiye Ekonomi Politikaları Araştırma Vakfı. https://www.tesev.org.tr/wp-content/uploads/rapor_isgucu_piyasasinin_cinsiyetci_yapisi_gelecegin_isleri_ve_kadinlarin_onundeki_engeller.pdf. Access date: December 2025.*
- *TR10 Düzey-2 Bölgesi Bölge Planı 2024-2028. İstanbul Development Agency. https://www.istka.org.tr/media/pdf/h4fuFPWyKYFCZ0RkYV9CJVbbtcZwcSKjfWZ4nBUyJuKM7M4EiDTR.pdf. Access date: July 2025.*
- *Turkish Civil Code (No. 4721). https://www.mevzuat.gov.tr/mevzuat?MevzuatNo=4721&MevzuatTur=1&MevzuatTertip=5. Access date: December 2025*
- *Turkish Statistical Institute & UN Women Turkey. (2025). Women in Türkiye: A statistical overview, 2024 (TurkStat report). https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Kadin-2024-54076. Access date: December 2025.*
- *Turkish Statistical Institute & UN Women Turkey. (2025). Women in Türkiye: A statistical overview, 2024 (TurkStat report). https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Kadin-2024-54076. Access date: December 2025.*
- *Turkish Statistical Institute (TurkStat). (2025, March 6). Statistics on women, 2024 (Press Release No. 54076). https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Kadin-2024-54076. Access date: Decenber 2025.*
- *Turkish Statistical Institute (TurkStat). (2025, March 6). Statistics on women, 2024 (Press Release No. 54076). https://data.tuik.gov.tr/Bulten/Index?p=Istatistiklerle-Kadin-2024-54076. Access date: Decenber 2025.*
- *TurkStat, Household Labour Force Survey, 2023, Access date: December 2025.*
- *TurkStat, Women in Statistics, 2024, Access date: December 2025.*
- *TurkStat, Women in Statistics, 2024, Access date: December 2025.*
- *TurkStat, Address Based Population Registration System (ABPRS) Results, 2024, https://biruni.tuik.gov.tr/medas/?kn=95&locale=en, Access date: July 2025.*
- *TurkStat, Gender Statistics, 2022, Vital and Gender Statistics Group, Publication Number 4681, Release Date March 2023., https://www.tuik.gov.tr/media/announcements/toplumsal_cinsiyet_istatistikleri.pdf, Access Date: July 2025.*
- *TurkStat Press Release dated 06.03.2025. Women in Statistics, 2024. https://data.tuik.gov.tr/Bulten/Index?p=Women-in-Statistics-2024-54076. Access Date: July 2025.*
- *TurkStat, National Education Statistics Database, 2022-2023, Table-4 Population by attained education level and sex, 2022-2023, https://data.tuik.gov.tr/Bulten/Index?p=Ulusal-Egitim-Istatistikleri-2023-53444, Access date: March 2025.*
- *TurkStat, The Results of Address Based Population Registration System, 2024. Population of province/district centers and towns/villages by province and sex, and population density, 2024. https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2024-53783. Access date: June 2025.*
- *TurkStat, The Results of Address Based Population Registration System, 2024. Median age by province and sex, 2023, 2024. https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2024-53783. Access date: July 2025.*
- *TurkStat, The Results of Address Based Population Registration System, 2024, Population and age dependency ratio by age group, 2007-2024. https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2024-53783. Access date: July 2025.*
- *TurkStat, The Results of Address Based Population Registration System, 2024. Annual growth rate of population and population density of provinces by years, 2007-2024.*

https://data.tuik.gov.tr/Bulten/Index?p=Adrese-Dayali-Nufus-Kayit-Sistemi-Sonuclari-2024-53783. Access date: July 2025.

- *TurkStat, Urban-Rural Population Statistics, 2022. Table-2 Population by urban-rural classification, sex and provinces, 2022. https://data.tuik.gov.tr/Bulten/Index?p=Urban-Rural-Population-Statistics-2022-49755. Access date: July 2025.*
- *TurkStat. Labour Force Statistics, June 2025. 30.07.2025. Number 54074. https://data.tuik.gov.tr/Bulten/Index?p=Labour-Force-Statistics-June-2025-54074. Access date: August 2025.*
- *Türkiye Halk Sağlığı Kurumu, Kronik Hastalıklar, Yaşlı Sağlığı ve Özürlüler Daire Başkanlığı. (2013). Türkiye Kronik Hastalıklar ve Risk Faktörlerinin Sıklığı Çalışması: Temel Bulgular. Ankara: T.C. Sağlık Bakanlığı Yayın No. 909. https://hsgm.saglik.gov.tr/depo/birimler/kronik-hastaliklar-ve-yasli-sagligi-db/Dokumanlar/Raporlar/KRONIK_ARASTIRMA_TEMEL_BULGULAR.pdf.*
- *UK Government GHG Conversion Factors for Company Reporting, ghg-conversion-factors-2025-full-set.xlsx*
- *UN Human Rights, Guiding Principles on Business and Human Rights, https://www.undp.org/sites/g/files/zskgke326/files/2022-09/UNGPs%20on%20B%2BHR_English.pdf.*
- *UNHCR Türkiye: Provincial Breakdown Syrian Refugees in Turkiye - September 2024. https://data.unhcr.org/en/documents/download/111466. Access date: July 2025.*
- *Urban-Rural Population Statistics, 2022, Press Release No. 49755, dated May 11, 2023. https://data.tuik.gov.tr/Bulten/Index?p=Urban-Rural-Population-Statistics-2022-49755. Access date: July 2025.*
- *WBG. Data from database: World Development Indicators. Last Updated: 07/01/2025. https://databank.worldbank.org/source/world-development-indicators/Type/TABLE/preview/on#. Access date: July 2025.*