# Environmental and Social Impact Assessment for the Eurasia Tunnel Project Istanbul, Turkey

Volume II
**Main Report**
Final Report

September 2011

ERM Group, Germany and UK
ELC-Group, Istanbul

*Delivering sustainable solutions in a more competitive world*

FINAL REPORT

Avrasya Tüneli İşletme İnşaat ve Yatırım A.Ş. (ATAŞ - the Eurasia Tunnel Operation, Construction and Investment Inc. Co.)

# Eurasia Tunnel Environmental and Social Impact Assessment

Volume II

## Main Report

September 2011

For and on behalf of
Environmental Resources Management

Approved by: ______________ Karen Raymond

Signed:

Position: ______________ Principal Partner

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## *LIST OF ABBREVIATIONS*

| | |
|---|---|
| AASHTO | American Association of State Highway and Transportation Officials |
| AD | Latin abbreviation for Anno Domini, referencing to the traditionally reckoned year of the birth of Jesus, with AD denoting years after the start of this epoch. |
| AIDS | Acquired immune deficiency syndrome |
| asl | Above Sea Level |
| ATAŞ | Avrasya Tüneli İşletme İnşaat ve Yatırım A.Ş. (the Eurasia Tunnel Operation, Construction and Investment Inc. Co.) |
| bgl | Below Ground Level |
| BOT | Build, Operate and Transfer |
| BP | Before present |
| BS | British Standard |
| BSTDB | Black Sea Trade and Development Bank |
| CCTV | Closed-circuit television |
| Cd | Caddesi (eg Kennedy Cd – Kennedy Caddesi) also Cad = Caddesi (Namik Kemal Cad) |
| CEO | Chief Executive Officer |
| $CO_2$ | Carbon dioxide |
| CR | Critically Endangered |
| dB(A) | Decibel, A-weighted; unit of noise levels |
| Dia | Diameter |
| DLH | Turkish Ministry of Transport, General Directorate of Railways, Seaports and Airport Construction (Türkiye Cumhuriyeti Ulaştırma Bakanlığı'na bağlı Demiryollar Limanlar ve Havameydanları İnşaatı Genel Müdürlüğü) |
| eg or e.g. | abbreviation of Latin 'exempli gratia', for example |
| EBRD | European Bank for Reconstruction and Development |
| EHS | Environment, Health and Safety |
| EIA | Environmental Impact Assessment |
| EIB | European Investment Bank |
| ELC | ELC Consulting and Engineering Group Ltd |
| EN | Endangered |
| EPC | Engineering, Procurement and Construction |
| ER | Employers Requirements |
| ERM | Environmental Resources Management |
| ESIA | Environmental & Social Impact Assessment |
| ESMP | Environmental and Social Management Plan |
| ESMS | Environmental and Social Management System |
| Et al. | Et alli (and other) |
| EU | European Union |
| EUR | Euro |
| FEE | Functional Evaluation Earthquake |
| FWHA | American Federal Highways Agency |
| GDP | Gross domestic product |
| GPS | Geographic Positioning System |
| H&S | Health & Safety |
| HIV | Human immunodeficiency virus |
| HSE | Health, Safety and Environment |
| Hz | Hertz |

| | |
|---|---|
| IBA | Important Bird Area |
| ie or i.e. | that is (*id est*) |
| IEC | International Electro-technical Commission |
| IETT | Istanbul Elektrik, Tramvay ve Tünel İşletmeleri Genel Müdürlüğü -General Directorate of Istanbul Electricity, Tram and Tunnel Facilities |
| IFC | International Finance Corporation |
| ILO | International Labour Organisation |
| IMM | Istanbul Greater Metropolitan Municipality (İstanbul Büyükşehir Belediyesi) |
| IRF | International Road Federation |
| ISO | International Organization for Standardisation |
| ISO 14001 | International Organization for Standardisation standard for Environmental Management Systems |
| ITMP | Istanbul Transportation Master Plan |
| ITS | Intelligent Transport System |
| IUCN | International Union for Conservation of Nature |
| JICA | Japan International Cooperation Agency |
| JSCE | Japan Society of Civil Engineers |
| JV | Joint Venture |
| K | Kelvin |
| Kat | Category |
| kA | Kilo Ampere |
| KBA | Key Biodiversity Area |
| KGS | Kartii Geçiç Sistemi - card passing system |
| km | Kilometre |
| km/h | Kilometre per hour |
| KS A | Type of certification Chapter 15 ??? |
| kV | Kilo Volt |
| L | Length |
| LC | Least Concern |
| LTA | Lenders Technical Advisor |
| M | Magnitude |
| m | Meter |
| $m^2$ | Square metre |
| $m^3$ | Cubic metre |
| $Mm^3$ | Million cubic metre |
| m/sec | Meter per second |
| mg/l | Milligram/litre |
| mg*l-1 | Milligram/litre ??? |
| mm | Millimetre |
| MOEF | Ministry of Environment and Forests (MOEF - Çevre ve Orman Bakanlığı) |
| MS | Management System |
| Mw | Moment magnitude |
| MWPS | Ministry of Public Works and Settlement |
| NAF | North Anatolian Fault |
| NATM | New Austrian Tunnelling Method |
| NFPA | United States National Fire Protection Association |
| No | Number |
| NT | Near Threatened |
| OECD | Organization for Economic Co-operation and Development |

| | |
|---|---|
| OGS | Otomatik Geçiç Sistemi - automatic passing system |
| PA | Paving Team A |
| PAH | Polycyclic aromatic hydrocarbons |
| PB | Paving Team B |
| PC | Paving Team C |
| PIARC | World Road Association |
| PID | Project Information Document |
| PO | Petrol Ofisi, a national Turkish company |
| PR | Public relations |
| PS | Performance Standard |
| PVC | Polyvinyl chloride |
| SA | Structure Team A |
| SB | Structure Team B (Europe) |
| SC | Structure Team C (Asia) |
| SEE | Safety Evaluation Earthquake |
| Sk | Souk (lane),- small road |
| spp | Species (plural) |
| SPV | Special Purpose Vehicle |
| t | ton |
| TBM | Tunnel Boring Machine |
| TCDD | Turkish State Railways |
| TL | Turkish Lira |
| TOKI | Başbakanlık Toplu Konut Dairesi Başkanlığı - Prime Ministry Directorate of Housing Department |
| TSS | Total suspended solids |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| US | United States |
| USD | United States Dollar |
| V | Volt |
| VAT | Value-added tax |
| VDS | Vehicle Detecting System |
| VMS | Variable Message Signs |
| vs | versus |
| VU | Vulnerable |
| WCs | Water closets |
| WGK | Wassergefaehrdungsklasse - WGK is a German classification of the physical, chemical and biological characteristics of chemicals according to their hazard to water |
| Y/N | Yes / No |
| Yrs | Years |

# 1 INTRODUCTION

## 1.1 THE EURASIA TUNNEL PROJECT ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT

This document is the Final Report of the Environmental and Social Impact Assessment (ESIA) Report for a new road tunnel proposed to be constructed in the Istanbul Metropolis, Turkey. It is being published for comment as part of the process of finalising and gaining approval for financing of the Project.

The Eurasia Tunnel Project comprises a 5.4 km road tunnel beneath the Bosphorus Strait, between the European and Asian shores of Istanbul, together with the widening of a total of 9.2 km of existing roads on both sides to form the approaches to the tunnel. The Project location is shown in Figure 1-1. Further details of the Project and the background to its development from the 1997 Transportation Master Plan for the city are provided in Chapter 2.

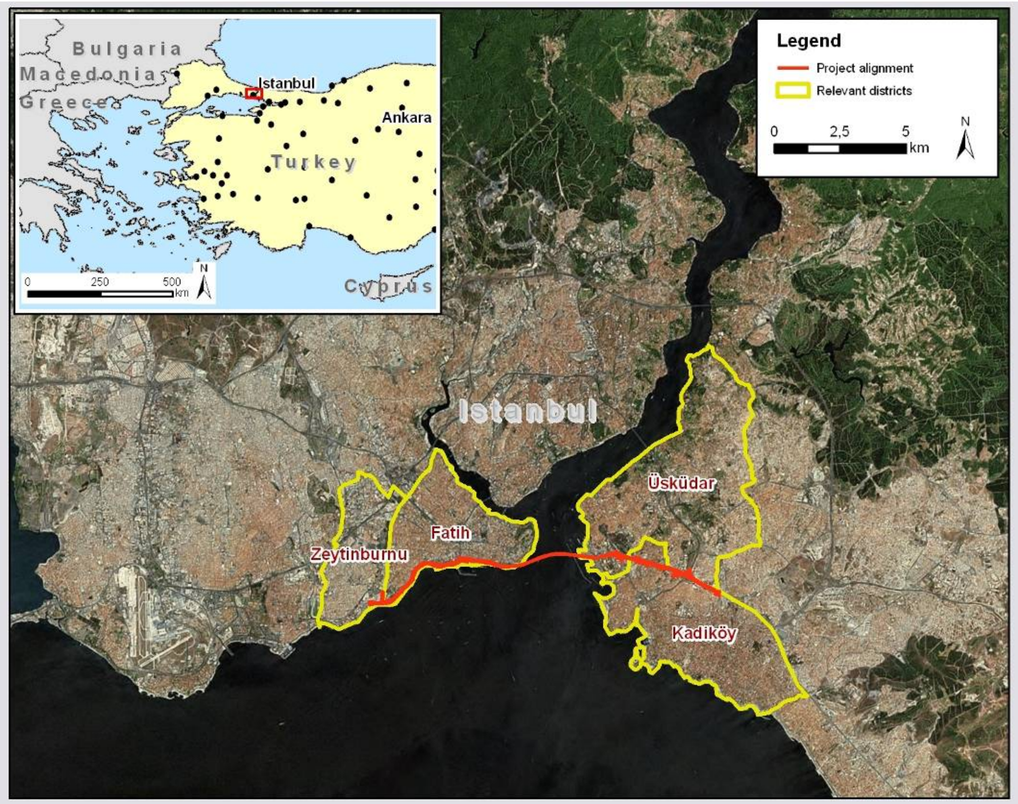


*Figure 1-1 Project Location*

The ESIA is a study into the effects of construction and operation of the Project on the physical, natural, cultural, social and socio-economic environment. The ESIA Report describes the Project and the impacts it is predicted to have on environmental and social conditions and explains how the Project has been designed and how it will be implemented in order to minimise its adverse impacts and maximise its benefits. The ESIA has been commissioned by Avrasya Tüneli İşletme İnşaat ve Yatırım A.Ş. (ATAŞ - the Eurasia Tunnel Operation, Construction and Investment Inc. Co.) and undertaken by Environmental Resources Management (ERM) and ELC Consulting and Engineering Group Ltd (ELC). The membership of the ESIA Team is presented in Annex A.

ATAŞ is a consortium of Turkish and Korean companies (1) who have been awarded a contract by the Turkish Ministry of Transport, General Directorate for the Construction of Railways, Harbours and Airports (DLH - Türkiye Cumhuriyeti Ulaştırma Bakanlığı'na bağlı Demiryollar, Limanlar ve Havameydanları İnşaatı Genel Müdürlüğü), to Build, Operate and Transfer (BOT) the Eurasia Tunnel Project. Under the terms of the BOT Contract, ATAŞ will appoint an EPC Contractor to undertake the detailed design and construction of the Project. The consortium will then be responsible for operation and maintenance of the tunnel for a period of 25 years, 11 months and 9 days, after which time it will be transferred to DLH. The responsibility for operation and maintenance of the approach roads will be transferred to the Istanbul Greater Metropolitan Municipality (IMM - İstanbul Büyükşehir Belediyesi) as soon as their construction is complete. The cost of the Project will be financed by debt and equity under a project finance structure. The cash flow for the repayment of debt and distribution of dividends to equity shareholders will be generated by tolls levied on vehicles using the tunnel.

## *1.2 THE REQUIREMENT FOR ESIA*

The requirement for Impact Assessment of major projects can arise for various reasons: typically either a local, in-country legal requirement for Environmental Impact Assessment (EIA) associated with permitting, or procedures associated with approval of project finance by international institutions.

The current relevant legislation in Turkey is the Environmental Impact Assessment Regulation 2008 (2). In 2007 a Project Information Document (1)

(1) ATAS is a joint venture of Yapi Merkezi Insaat ve Sanayi A. Ş. of Istanbul and four Korean companies SK E & C; Samwhan Corporation; Kukdong Engineering & Construction; and Hanshin Engineering & Construction), all located in Seoul

(2) Environmental Impact Assessment Regulation of 17.07.2008 Official Gazette No. 26939

was prepared by DLH in accordance with the requirements of the 2003 Turkish EIA Regulation applying at the time (2) and was submitted to the Ministry of Environment and Forests (MOEF - Çevre ve Orman Bakanlığı). On the basis of this submission MOEF concluded that the proposed project was not within the scope of the 2003 EIA Regulation and that EIA was not therefore required. A copy of MOEF's decision (with translation) is presented in Annex B.

Since then ATAŞ has been discussing the Project with a range of prospective lenders including multilateral institutions, export credit agencies and Equator Principles Financial Institutions. All these institutions operate strict procedures for environmental and social due diligence which require the preparation and public disclosure of an ESIA Report and an accompanying Environmental and Social Management Plan (ESMP), prior to the decision to approve finance for projects. The requirement for this ESIA has thus arisen as a result of ATAŞ seeking finance from international lenders to support the development of the Project.

These lenders will require the Project to comply with various international performance standards for environmental and social sustainability including:

- The European Bank for Reconstruction and Development (EBRD) Performance Requirements on Environmental and Social standards (3) ;
- European Investment Bank Statement of Environmental and Social Principles and Standards (4) .
- the International Finance Corporation (IFC) Performance Standards on Social and Environmental Sustainability (5);

(1) Ministry of Transportation General, Directorate of Railroads, Ports and Airports Constructions; Bosphorus Crossing Motorway Tunnel Project; *Project Introduction File*; November 2007

(2) At that time the current regulation was the EIA Regulation of 16.12.2003 Official Gazette No. 25318

(3) http://www.ebrd.com/pages/about/principles/sustainability/standards.shtml

(4) European Investment Bank 2009; The EIB Statement of Environmental and Social Principles and Standards.

(5) International Finance Corporation; *Performance Standards on Social & Environmental Sustainability*; April 2006. http://www.ifc.org/ifcext/sustainability.nsf/Content/PerformanceStandards

- the IFC General Environmental, Health and Safety Guidelines(1);
- the IFC specific Environmental, Health and Safety Guideline for Toll Roads (2);
- the Equator Principles (3);
- the OECD Common Approaches (4).

The project must also comply with Turkish environmental and social legislation and, as a result of involvement of EBRD and EIB and because Turkey is a candidate for accession to the European Union, to comply with EU Directives on protection of the environment and the community. An overview of applicable laws and standards is provided in Annex C, including national legislation regarding expropriation of land and property and international conventions which have been ratified by Turkey.

These laws and standards are referred to later in this report where they are relevant to the assessment and mitigation of impacts. Together, they set strict requirements for the conduct of the ESIA and the content of the ESIA Report and ESMP, and for the environmental and social performance of the Project in its design, construction and operation.

## 1.3 APPROACH TO THE ASSESSMENT

### 1.3.1 *Overview and Programme*

The assessment for the Eurasia Tunnel Project has been undertaken in accordance with the guidelines and procedures noted above. It has followed a systematic process of predicting and evaluating the impacts the Project is expected to have on the physical, natural, cultural, social and socio-economic environment, and identifying measures that the developer is able take to avoid, reduce, remedy, offset or compensate for adverse impacts, and to provide benefits.

(1) International Finance Corporation; Environmental, Health and Safety Guidelines; 2007 http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_GeneralEHS/$FILE/Final+-+General+EHS+Guidelines.pdf

(2) International Finance Corporation; *Environmental, Health, and Safety Guidelines for Toll Roads*; April 2007 http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/gui_EHSGuidelines2007_TollRoads/$FILE/Final+ -+Toll+Roads.pdf

(3) *The "Equator Principles": A financial industry benchmark for determining, assessing and managing social & environmental risk in project financing*; July 2006; www.equator-principles.com

(4) OECD, Trade And Agriculture Directorate, Trade Committee 2007; Revised Council Recommendation on Common Approaches on the Environment and Officially Supported Export Credits; TAD/ECG(2007)9

The overall approach followed is shown schematically in Figure 1-2 and the key steps are described in the subsequent sections.

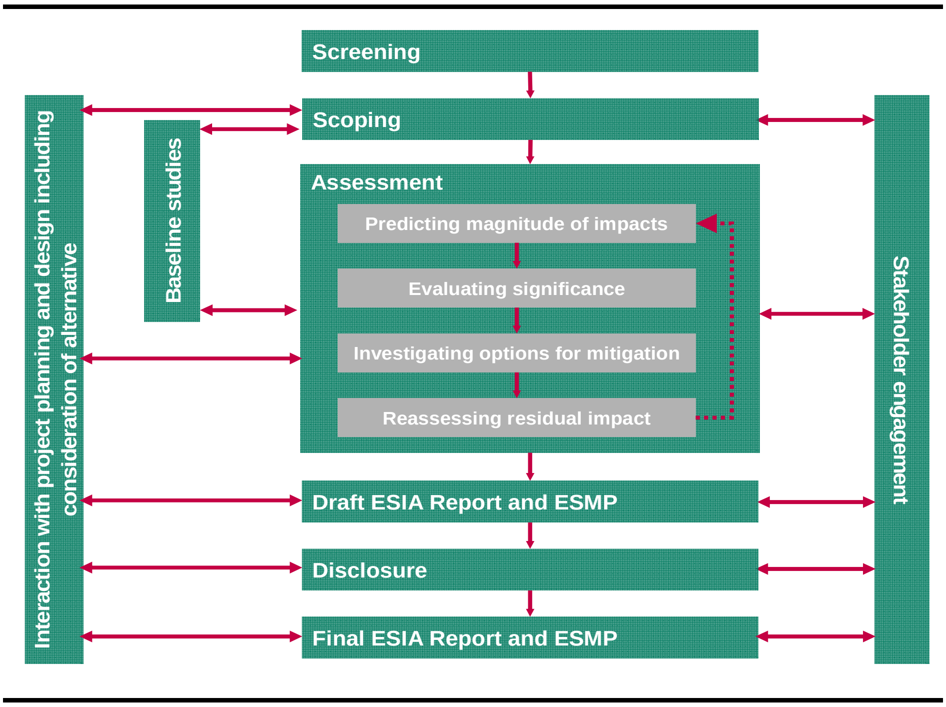


*Figure 1-2* *ESIA Approach*

Before outlining the key steps in the process it is however, important to note the timeframe within which this Final ESIA Report has been prepared. The BOT Contract process and the programme for discussions with lenders required an early draft of the ESIA Report to be completed in Spring 2010. Work commenced in September 2009 and a working draft was completed in April 2010. This meant certain aspects of the work were undertaken to an accelerated programme compared to normal practice. In the absence of finalisation of the BOT Contract and public launch of the Project, only limited external stakeholder consultation was undertaken prior to April 2010 (see Section 1.3.9). Since completion of the early draft in April 2010, additional work was undertaken over the summer of 2010 The report has been amended to address the conclusions of the 34th Meeting of the World Heritage Committee held in June 2010 regarding the Istanbul World Heritage Site (see Chapter 11). The Preservation Councils responsible for protection of the cultural heritage of Istanbul gave their approval of the Project during 2010 and their conclusions are reported in Chapter 11.

A draft of the ESIA Report was published for comment in Spring 2011 and the results of consultation are presented in a Consultation Report which is available together with this Final ESIA and accompanying Environmental and Social Management Plan. In parallel lenders undertook a formal process of due diligence, including their own public disclosure of the ESIA Report and have completed their final evaluation of the proposals.

### *1.3.2 Screening*

Screening is the first stage in impact assessment in which the need for assessment and the level of assessment required is determined for a particular project.

As noted above, the competent EIA authorities in Turkey have concluded that EIA is not required for the Eurasia Tunnel Project although it is noted that project construction and implementation will need to comply with all other environmental legislation. The developers are, however, seeking project finance from the international community and as such the Project is subject to the due diligence procedures of international lenders. Most lenders apply a process of categorising projects according to their potential for adverse impact and determine impact assessment requirements accordingly.

Lender guidance on categorisation of projects states that projects with the potential for significant adverse impacts and risks that are diverse, irreversible and unprecedented should be identified as Category A projects and should be subject to comprehensive Environmental and Social Impact Assessment (1). The ESIA Team has been advised that in the case of this Project, lenders will refer to the classification of the Project under the European Union Directive on Environmental Impact Assessment(2) to guide them in categorisation. The EU Directive requires that EIA must be undertaken for certain types of projects listed in Annex I of the Directive. It provides a second list of types of projects in Annex II, for which EIA must be undertaken only if the project is considered likely to have significant effects on the environment. The Eurasia Tunnel Project is considered to fall within Class 7(b) of Annex I; that is

(1) International Finance Corporation; *Performance Standards Guidance Note 1: Social and Environmental Assessment and Management Systems*; July 2007

(2) Council Directive 85/337 on the assessment of the effects of certain public and private projects on the environment, as amended in 1997 and 2003 (Directives 97/11 and 2003/35). It may be noted that the EU Directive requires assessment of only environmental effects whilst international lender procedures require a wider environmental **and social** impact assessment.

"*construction of motorways and express roads*" (1). It therefore falls within the list of projects for which EIA is a mandatory requirement in every case. As such it would be subject to a requirement for full EIA within the European Union.

The conclusion of screening has therefore been that a full ESIA is required for this Project and the lenders have identified the Project as falling within Category A.

### *1.3.3 Scoping*

Once the decision is made that impact assessment is required the next step is to determine the scope of the assessment: that is, to identify the likely significant impacts of the Project and to define the approach that will be taken to their assessment. Scoping involves systematic examination of the potential for interaction between activities involved in developing the Project and aspects of the physical, natural, cultural, social and socio-economic environment that may result in adverse or beneficial changes in environmental or social conditions. The views of key stakeholders should also be identified and taken into account.

In order to undertake scoping effectively it is important to be clear what is included within the Project, how its area of influence is defined, and the broad types of impacts that are to be addressed in the assessment. The way these issues have been addressed in this assessment is outlined below.

***Definition of the Project and its Area of Influence***

In ESIA a **Project** should be defined so as to include all those actions and activities which are a necessary part of the development, including all related and ancillary facilities without which the project cannot proceed, and also any other developments or activities which follow as a necessary consequence of the project.

The Eurasia Tunnel Project has been defined to include:

- the tunnel itself and the widening of the approach roads to the tunnel;
- the new junctions, underpasses, U-turns, footbridges and other road-related facilities along the approach roads;
- the toll plaza;
- the operations building;
- the tunnel ventilation shafts;
- all sites and activities involved in the construction of the works;
- the traffic that will use the tunnel and the approach roads;

(1) The project will fall within the definition of an express road; that is a road which complies with the definition in the European Agreement on Main International Traffic Arteries of 15 November 1975.

- activities involved in long term operation and maintenance of the Project.

The assessment also takes account of the influence of the Project on the wider area of Istanbul including its effect on traffic flows elsewhere on the road network and on patterns of future land use and development.

Impacts have been assessed for all phases of the Project from initial site preparation and advance works, through construction, to operation of the tunnel. Decommissioning of the Project is not assessed as the tunnel is envisaged to remain in place and in operation for the foreseeable future.

Impacts have been assessed throughout the **Area of Influence** of the Project. This varies depending on the type of impact being considered, but in each case it is defined to include all that area within which it is considered that significant impacts could occur. This takes into account:

- the physical extent of the proposed works, defined by the limits of land to be acquired or used temporarily or permanently for the construction and operation of the Project;
- the nature of the baseline environment, the source of impact and the manner in which the impact is likely to be propagated beyond the Project boundary.

For example, if there are effects on buried archaeological features these are likely to be confined to those areas physically disturbed by construction works, whilst the effects of noise could be experienced at some distance, and air pollution may be dispersed over long distances or even have regional or global effects. The area for each type of impact is defined in the later chapters of this report where each type of impact is assessed.

In the case of this Project it is not expected that any impacts will extend across national boundaries and the assessment does not therefore address trans-boundary effects.

***Types of Impact***

The assessment has considered both **Positive** and **Negative** impacts on all aspects of the **Physical**, **Natural**, **Cultural**, **Social** and **Socio-Economic** environment.

**Positive** or **beneficial** impacts are those which are considered to present an improvement upon the situation without the Project (the baseline) or to introduce a new desirable factor. **Negative** or **adverse** impacts are the reverse.

Aspects of the environment include:

- the **physical** environment including:
  - geology and soils;
  - land and topography;
  - hydrology and hydrogeology;
  - surface and ground water resources;
  - air;
  - noise, vibration, light and other forms of radiation;
- the **biological** or **natural** environment including:
  - aquatic and terrestrial habitats and ecosystems;
  - flora and fauna;
  - protected areas;
- the **cultural environment** including:
  - tangible and intangible sites and features of archaeological, historic, traditional, cultural, aesthetic or landscape interest;

  - cultural traditions, practices and events;
- the **social and socioeconomic environment** including:
  - people and their homes, lands and other resources and assets;
  - the characteristics and structures of communities;
  - population and demographics:
  - human health, welfare, amenity, safety and security;
  - lifestyles including employment and incomes;
  - economic activities including industry and commerce, tourism, fisheries, agriculture and forestry;
  - community facilities such as schools, hospitals, leisure facilities;
  - utilities and infrastructure (power, water, sewerage, waste disposal, transport);
  - services such as health care, education and access to goods;
  - local, regional and national economies.

When discussing different aspects of the environment we use the term **resources** to describe features of the environment such as soils, water resources, habitats, species, etc which are valued by society for their intrinsic worth and/or their social or economic contribution. The term **receptors** is used to define people and communities who may be affected by the Project.

***Timeframe***

The assessment has addressed impacts with different temporal characteristics:

- **permanent** impacts that will arise from **irreversible** changes in conditions such as the removal of features;
- **temporary impacts** that will arise during **short term** activities such as construction; and
- **long term impacts** that will arise over the **operation** of the Project.

Short term, temporary impacts will cease on completion of the relevant activities although there may be a period before the environment returns to its previous condition. Long term impacts will continue over the life of the project and may vary during this period, but will ultimately cease when the Project ceases to operate. Again the environment may take some time to recover. In the case of this Project, long term impacts are assumed to continue indefinitely because decommissioning of the tunnel is not envisaged to occur in the foreseeable future, but they are expected to change over time as traffic volumes change and as patterns of land use, population and economic activity evolve. These factors are taken into account in the assessment in so far as is possible with available information.

Other temporal characteristics of impacts such as whether they are **continuous** or **intermittent, one-off** or **recurrent**, and their **frequency** and **timing** (e.g. seasonality) are also taken into account.

***Routine and Non-Routine Impacts***

Development of a road tunnel raises the potential for impacts to arise from both planned and unplanned events. The ESIA has therefore assessed both:

- **routine** impacts resulting from planned activities within the Project; and
- **non-routine** impacts arising from:
  - **unplanned** or accidental events within the Project such as fire in the tunnel;
  - **external events** affecting the Project such as seismic activity and flooding.

The impact of non-routine events is assessed in terms of the Risk *ie* taking into account both the consequence of the event and the probability of occurrence (Risk = probability x consequence).

***Direct, Indirect and Induced Impacts***

Impacts can also be characterised according to whether they are **direct (primary)** impacts arising from activities associated with the Project or **indirect** (**secondary and higher order) impacts** that follow on as a consequence of these. So for example construction can lead to emissions of dust with a direct effect on air quality. High levels of dust can then cause reductions in visibility with knock-on effects on visual amenity and, possibly, increased risk of road accidents. They can also result in soiling of buildings and materials with effects on amenity for users and added costs for maintenance.

Projects can also have **induced** impacts by stimulating other developments to take place which are not directly within the scope of, or essential to, the development of the Project. So for example, road improvements may encourage people or businesses to move into an area, and as a result lead to building of new homes and other facilities which will have their own impacts. Whilst these possible developments are not part of the Project, they are caused at least in part by the Project and they are therefore considered in the assessment.

***Cumulative Impacts***

The potential for this Project to have **cumulative** impacts with other known or committed developments taking place in the area at the same time has been taken into account by incorporating them into the future baseline for the Project (*ie* the No Project situation against which the impacts of the Project are assessed).

The scoping process followed for the Project and the results of this are presented in Chapter 3. The consultations that have been undertaken during the assessment are discussed in Section 1.3.9.

### *1.3.4 Baseline Studies*

To provide a baseline against which the impacts of the Project can be assessed, an important part of the study has been to establish the conditions that would prevail in the absence of the project – the so-called Baseline. Baseline studies commenced in parallel with scoping and initial information was used to inform the scoping process. They then continued alongside the impact assessment providing information to allow description and, where possible, quantification of impacts and to inform judgments about their significance (see Section 1.3.5).

Baseline information has been collected from various sources:

- from existing sources including government agencies, research organisations, publications and maps;
- by review of aerial photographs of the route and its surrounding area; and

- through field studies designed to fill gaps in the data where this is needed to enable assessment of impacts.

Existing information has been obtained from searches of publications and databases and from requests to external stakeholders during the ESIA consultations as discussed in Section 1.3.9. The details of sources and survey methods are described as relevant in later chapters of the report.

When assessing the impacts of projects such as new roads, it is important to recognise that the baseline is likely to change significantly from the current situation, as a result of changes in population, land use and economic activity, and through other transport developments and traffic growth independent of the project. The baseline for this Project has therefore been defined by considering how current conditions will develop in the future without the Project (the "No Project" scenario). A separate Transport Assessment has been carried out in parallel with the ESIA and the results of this have been used to inform the future No Project baseline. Impacts are assessed for the year 2023 (the Istanbul master plan planning horizon) 9 years after the planned tunnel opening in 2015, by comparing forecast circumstances with and without the Project at these dates. In addition the scenarios have been compared against the present situation (based on traffic in 2009).

### *1.3.5 Assessment of Impacts*

#### *1.3.5.1 Introduction*

The assessment of impacts has proceeded through an iterative process considering four questions:

1. Prediction - What will happen to the environment and social and community conditions as a consequence of this Project?
2. Evaluation - Does this impact matter? How important or significant is it?
3. Mitigation – If it is significant can anything be done to avoid or reduce adverse effects or enhance benefits?
4. Residual Impact – Is the impact still significant after mitigation?

#### *1.3.5.2 Predicting the Magnitude of Impacts*

The impact assessment has set out to describe what will happen to the environment and society by predicting the magnitude of impacts and quantifying this to the extent practicable. The term "magnitude" is used here as shorthand to encompass various possible dimensions of the predicted impact including:

- the nature of the change (what is affected and how);
- its size, scale or intensity;
- its geographical extent and distribution;
- its duration, frequency, reversibility, *etc*; and
- where relevant, the probability of the impact occurring as a result of accidental or unplanned events.

It also includes any uncertainty about the occurrence or scale of the impact(1).

Magnitude therefore describes the actual change that is predicted occur in a resource or receptor (*eg* the area and duration over which air or water become polluted and the increase in concentration of the pollutant; the degree and probability of impact on the health or livelihood of a local community; the probability of injuries or deaths as the result of an accident).

Magnitude has been predicted using a range of different methods depending on the nature of the impact: so for example, noise and air quality impacts from traffic are predicted using standard mathematical models developed for calculating the effects of traffic on noise levels and concentrations of air pollution; impacts on views of the city are predicted using visualisations; and some impacts which are less amenable to mathematical or physical representation are predicted using the professional knowledge and experience of experts in areas such as ecology and archaeology.

To assist in the next step of evaluating significance (see below), the magnitude of certain impacts has been graded taking into account all the various dimensions to determine whether an impact is of small, medium or large magnitude. This scale is defined differently according to the type of impact and a more or less detailed scale may be used for particular impacts depending on the circumstances. For quantifiable impacts such as noise, numerical values are used whilst for other topics a more qualitative classification is necessary.

(1) A distinction is made here between the **probability** of impact arising from a non-routine event such as a seismic event or fire, and the **uncertainty** about predicted impact. For example it may not be certain that health will be affected by air emissions or that jobs will be obtained by local people. This different from estimating the probability of an unplanned event occurring. Uncertainty can be expressed by describing the predicted outcome using a range rather than a single value, by placing confidence limits around the prediction, or by estimating the likelihood of the prediction being correct.

The details of how magnitude is predicted and described for each impact are presented in the relevant later chapters of the report.

#### 1.3.5.3 *Evaluation of Significance*

The next step in the assessment is to take the information on the magnitude of impacts, and explain what this means in terms of their importance to society and the environment, so that decision-makers and stakeholders understand how much weight to give to the issue in deciding on their view of the Project. This is referred to as Evaluation of Significance.

There is no statutory or agreed definition of significance; however, for the purposes of this assessment, the following practical definition is used:

> *An impact is significant if, in isolation or in combination with other impacts, it should, in the judgement of the ESIA team, be reported in the ESIA Report so that it can be taken into account in the decision on whether or not the Project should proceed and if so under what conditions.*

This recognises that evaluation requires an exercise of judgement and that judgements may vary between parties involved in the process (including regulators, funders, assessors, affected people and the general public). The evaluation of impacts that is presented in this report is based on the judgement of the ESIA Team, informed by reference to legal and international standards and policy, current good practice and the views of stakeholders as expressed through the consultation process.

Criteria for assessing the significance of impacts are clearly defined for each type of impact taking into account whether the Project will:

- cause legal or accepted environmental standards to be exceeded – *eg* air, water or soil quality, noise levels – or make a substantial contribution to the likelihood of standards being exceeded;

or:

- adversely affect protected areas or features or valuable resources – these include protected nature conservation areas, rare or protected species, historic features, important sources of water supply;

or:

- conflict with established government or international policy *eg* to reduce $CO_2$ emissions, recycle waste, improve health, protect human rights.

Where standards are not available or provide insufficient information on their own to allow evaluation of impacts, significance has been evaluated taking into account the magnitude of the impact and the value or sensitivity of the affected resource or receptor. Magnitude is defined across the various dimensions described in the previous section. The value of a resource is judged taking into account its quality and its importance as represented, for example, by local, regional, national or international designation, its importance to the local or wider community, or its economic value. The sensitivity of receptors, for example a household, community or wider social group, will take into account their likely response to the change and their ability to adapt to and manage the effects of the impact.

Magnitude and value/sensitivity are looked at in combination to evaluate whether an impact is significant and if so its degree of significance. The principle is illustrated in Table 1.1. The grades apply to both positive and negative impacts.

***Table 1.1 Evaluation of Significance***

| **Sensitivity/Value of Resource/Receptor** | **Magnitude of Impact** | | |
|---|---|---|---|
| | **Small** | **Medium** | **Large** |
| **Low** | Not significant | Minor | Moderate |
| **Medium** | Minor | Moderate | Major |
| **High** | Moderate | Major | Critical |

The specific criteria used to evaluate significance for each type of impact are defined in the impact assessment chapters. The distinctions between grades cannot be considered as clear cut and judgements as to magnitude, value or sensitivity, and significance involve careful weighing up of a range of factors by the ESIA Team.

### *1.3.5.4 Mitigation*

Impact assessment is designed to ensure that decisions on Projects are made in full knowledge of their likely impacts on the environment and society, but a vital step within the process is the identification of measures that can be taken to ensure impacts are as low as technically and financially feasible.

This has been done by identifying where significant impacts could occur and then working with the Project team to identify practical and affordable ways of mitigating those impacts as far as possible. These measures have been agreed with ATAŞ and integrated into the Project proposals.

Where a significant impact was identified, a hierarchy of options for mitigation was considered to identify the preferred approach:

- Avoid at source – remove the source of the impact, for example by relocating a component of the Project to avoid a sensitive site;
- Abate at source – reduce the source of the impact, for example by controlling the emission of dust or noise;
- Attenuate – reduce the impact between the source and the receptor, for example by installing a noise barrier between the road and neighbouring houses;
- Abate at the receptor – reduce the impact at the receptor, for example by providing noise insulation in nearby buildings;
- Remedy – repair the damage after it has occurred, for example by cleaning up accidental spills during construction;
- Compensate / Offset – replace a lost or damaged resource with a similar or a different resource of equal value, for example by resettling displaced businesses into new premises, or providing monetary compensation for loss of business.

Mitigation can also include measures to provide or enhance positive benefits from the Project, so for example a construction project can create employment opportunities, and the chances of these being available to local people may be improved by setting up training in the required skills.

Mitigation can be achieved by various means including:

- changes in the design of the Project, for example relocating structures, incorporating noise barriers into the design, and designing structures to minimise their visual impact;
- selection of particular approaches and methods for construction, for example using bored rather than driven piling or electrical rather than diesel powered equipment;
- adoption of measures to control impacts during construction and operation, such as covering of dusty materials, installation of oil interceptors, adoption of emergency spill plans, and traffic management.

All these types of measures have been considered in the assessment and proposals have been discussed and agreed with ATAŞ. Agreed measures are presented in the Environmental and Social Management Plan (ESMP) for the Project presented in Annex D (see Section 1.3.7).Implementation of the measures identified in the ESMP will be monitored and ATAŞ will provide regular reports for external stakeholders as part of the Environmental and Social Management System for the Project (see Chapter 15).

#### 1.3.5.5 *Assessing Residual Impacts*

Following agreement on feasible mitigation the ESIA Team have re-assessed the impacts taking into account the mitigation now integrated into the Project. Where significant residual impacts remained after mitigation further options were examined and impacts re-assessed, in consultation with the developer and the design team, until they were considered to be are as low as is technically and financially feasible for the Project. The significant residual impacts remaining at the end of this process are described in this report with commentary on the proposed mitigation. The degree of significance attributed to residual impacts is related to the weight the ESIA Team considers should be given to them in reaching decisions on the Project.

- **Critical** impacts are considered to be of such significance that they should be avoided.
- Any residual **Major** impacts, whether positive or negative, are considered to warrant substantial weight, when compared with other environmental, social or economic costs and benefits, in deciding whether or not the Project should proceed. Conditions should be imposed to ensure adverse major impacts are strictly controlled and monitored and beneficial impacts are fully delivered.
- Residual **Moderate** impacts are considered to be of reducing importance to the decision, but to still warrant careful attention to conditions regarding mitigation and monitoring, to ensure best available techniques are used to keep adverse impacts as low as reasonably practicable, and to ensure beneficial impacts are delivered.
- **Minor** impacts should be brought to the attention of the decision-maker but are identified as warranting little if any weight in the decision. Adequate mitigation should be achieved using normal good practice and monitoring should be carried out to confirm that impacts do not exceed predicted levels.

### 1.3.6 *Dealing with Uncertainty*

The ESIA for the Eurasia Tunnel Project is based on the project information presented in Chapter 2 of this report. This is based on ATAŞ's response to the tender design provided by DLH. The design is therefore still at a relatively early stage and there is some uncertainty about certain aspects of the Project that could affect its impacts. Detailed studies are still to be completed on issues such as architectural design of structures, junction layouts and emergency planning. Information on development of the Project design and on the location and operation of construction sites and other aspects of construction activity will be made available to the local community through regular newsletters, via the Project website (www.avrasyatuneli.com) and through announcements to neighbours and local community leaders of planned activities. The impacts of the Project during operation will then be crucially dependent upon traffic flows and these will depend on many different and uncertain variables, such as future population, economic growth, car ownership, availability of alternative transport modes, growth in employment and business activity around Istanbul.

Because of these uncertainties the ESIA Team have used the best information available at the current time but have had to make a number of assumptions about how the Project will be designed, built and operated in order to allow us to assess impacts. These assumptions have been made in consultation with ATAŞ, and have been selected to provide predictions of the reasonable worst case in terms of environmental and social impact. Where assumptions have been made these are identified and the nature of any resulting uncertainty is identified.

The general approach has therefore been to take a conservative and cautious view of the likely residual impacts. Where it is known that Project details may change, commitments to mitigation are expressed in terms of standards of environmental performance that will be achieved rather than as specific technical measures. Several areas of additional work that will be undertaken during detailed design are identified together with commitments to submit further information to regulators and lenders on development of mitigation to ensure performance standards are met. The ESMP identifies these additional studies, and defines monitoring plans and contingency measures that will be implemented if actual impacts turn out to be worse than predicted, and this document will be available in the public domain.

### *1.3.7 Eurasia Tunnel Environmental and Social Management Plan*

To ensure that all the mitigation identified through the ESIA is implemented all agreed measures are set out in the Environmental and Social Management Plan (ESMP) for the Project.

The ESMP is presented in Annex D. It defines for each phase of the project (detailed design, construction, operation) and for each environmental or social aspect:

- a clear statement of the measures that will be taken to mitigate adverse impacts and provide benefits;
- who will be responsible and when;
- required resources;
- how delivery of mitigation will be monitored and checked;
- what will be done if mitigation is not delivered or is not successful (contingency measures).

A Resettlement Policy Framework (RPF) describing how the Project will manage the acquisition of land and other assets required for the Project is also presented in Annex D.

Implementation and maintenance of the ESMP and RPF will be achieved through operation of a Project Environmental and Social Management System designed in accordance with the requirements of the international standard for EMS, ISO14001 (1) . The requirement for the ESMS to comply with ISO14001 is a specific requirement of the BOT Contract. Chapter 15 provides information on the ESMS and includes:

- a Project Environmental and Social Policy;
- definition of responsibilities;
- procedures for management of significant impacts;
- a Grievance Process to be followed in the event of any complaints about the Project;
- a Public Consultation and Communication Plan; and
- monitoring and audit systems.

### *1.3.8 Interface with Project Planning and Design*

#### *1.3.8.1 Consideration of Alternatives*

A key part of ESIA is the examination of feasible alternatives that could achieve the Project objectives with less impact on the environment and society. In the case of a transport infrastructure project these can, in theory, range from small scale deviations in the alignment to alternative routes and structures (*eg*

(1) International Standardisation Organisation; *Environmental Management Systems – Requirements with guidance for use*; International Standard ISO14001:2004(E).

bridges vs tunnels), development of alternative modes of transport, or even actions to reduce demand so that new infrastructure is not required.

In the case of this Project, ATAŞ's ability to consider higher level strategic alternatives is constrained by the terms of the BOT Contract which require construction of a tunnel and approach roads along the broad alignment specified in the BOT tender design prepared by DLH. Strategic alternatives were considered at an earlier stage during the various studies undertaken by the Municipality and the Government of Turkey between 1997 and 2008 and during the investigation of route alternatives by DLH. The appraisal of options and the conclusions from these studies are discussed in Section 2.2 in Chapter 2, with further details in Annex E. Section 2.2 also describes some more detailed alternatives that have been considered during the current stage in planning for the Project, as a result of the findings of the ESIA studies.

#### *1.3.8.2 Interface with the Design Team*

The ESIA Team has worked with the Project team to gather information for the assessment on the design, construction and operation of the Project. As impacts have been investigated the results have been discussed with them and feasible mitigation measures have been integrated into the Project where possible. As noted above (see Section 1.3.5.4) certain mitigation measures involving changes to the design of the Project will require the approval of DLH before they can be formally adopted, but this will be sought and all finally agreed measures will be disclosed and included in the ESMP.

The process of interaction with the design team to date has been successful in identifying a wide range of technically and financially feasible measures that can be adopted and these are taken into account in the assessment and included in the ESMP. ATAŞ is committed to continuing this process of working with environmental specialists during the detailed design and construction to keep the impacts as low as is reasonably practicable. The ESMP will be kept up to date with any additional mitigation as the Project moves forward.

### ***1.3.9 Stakeholder Engagement***

Good practice in ESIA requires active consultation with relevant regulatory bodies, experts, affected communities and other interested and affected parties. The aim is to inform them about the developing plans and give them an opportunity to express their views on the Project and its impacts, so that these can be taken into account in developing the Project proposals and in assessing and mitigating impacts. Consultation is also invaluable in identifying useful information on the baseline situation and on vulnerable resources and receptors in the study area.

This approach has been followed during this assessment although the scale and depth of consultations to date has been constrained by the timing of signature of the BOT Contract and public announcement of the Project (see Section 1.3.1). The following activities have been undertaken prior to and during the ESIA.

- DLH has been in regular contact with the Ministry of Culture and Tourism and supporting agencies responsible for cultural heritage interests, in particular, the Istanbul Old City UNESCO World Heritage Site, since the summer of 2008. The Project was presented to them and to the municipality and local district councils at a meeting in March 2009. A range of comments were made, in particular relating to protection of historic interests within the old city, and these have been taken into account in development of the Project and the ESIA study, including recommendations on the scope and approach to the assessment. Information has also been provided to the UNESCO Turkish National Commission for the World Heritage Site although they indicated they would not comment directly but via the Ministry of Culture and Tourism.

- A short Scoping Report was produced by the ESIA Team at the beginning of October 2009 and was provided to DLH and potential multilateral lenders for comment. This introduced the Project, provisionally identified its likely significant impacts and outlined the planned approach to the assessment. Comments were received and taken into account in conducting the work (see Chapter 3 and Annex F).
- A Project Information Document (see Annex G) was also produced and sent with a covering letter requesting views on the Project and its impacts, to national, provincial and local government authorities. The covering letter also asked for any information which the recipients considered might be relevant to the assessment as a back-up to the baseline data collection exercise already undertaken by the ESIA Team. This was sent in the second week of November 2009 and requested responses by mid December 2009, allowing time for responses to be taken into account in the final stages of the assessment. Some responses were received within the deadline but responses continued to be received up to the summer of 2010. A register of all responses received to date is presented in Annex G and these have been taken into account in conducting the assessment.
- ATAS completed direct consultations with Muhtars (politically non-aligned administrative officers elected by residents) in 25 neighbourhoods

along the Project route in December 2010 and January 2011. The main objective was to check that the ESIA had covered the main issues expected to be of concern in their neighborhoods. This was confirmed. The discussions also aimed to ensure that they were aware of the Project in advance of the formal ESIA disclosure (see Section 1.4) and to establish whether there were any vulnerable groups in the local community requiring special consideration. The Muhtars were generally supportive of the Project seeing benefits for their locality and for Istanbul due to shorter journeys across the Bosphorus. They noted a small population of homeless people in one neighbourhoods on the European Side and gave suggestions on how to communicate with them.

- On completion of the Draft ESI*A Report a 2 month consultation period was organised during which interested parties were able to comment on the Project and the findings of the ESIA. This included
    - distribution of a public information booklet to all residents and businesses within 50m of the Project and to all public buildings – such as hospitals, schools and public offices – within 100 m. Copies of the leaflet were also available at Muhtar offices, on the Project website (www.avrasyatuneli.com) and on request from ATAŞ;
    - issue of a Project briefing document to government authorities and non-governmental organisations and c to Muhtar offices; copies were also available on request from ATAŞ (www.avrasyatuneli.com, or email esia@avrasyatuneli.com, or telephone 0216 700 14 14);
    - a project information hotline (0 216 700 14 14) was available during normal business hours for further information and messages could be left outside business hours;
    - public information exhibitions were held on the European and Asian sides, details of which were advertised in the press, publicised on posters widely displayed in the vicinity of the route, and announced in all other documents (leaflets, etc) and on the website;
    - copies of the full ESIA Report and Non-Technical Summary were available for public inspection at public reading rooms on the European and Asian sides; locations and opening hours for these were publicised in the same way as the exhibitions;
    - electronic copies of all the ESIA Report and also the public consultation documents were available on the project website (www.avrasyatuneli.com);
    - copies of the full ESIA Report could be purchased on request (a charge of TL100 was made for provision of a hard copy).

The consultation documents were available for a minimum of 60 days and the closing date for comments was widely advertised.

Anyone wishing to make a comment on the Project or the ESIA findings was invited to submit these by email to esia@avrasyatuneli.com or write to the address below:

Eurasia Tunnel Project ESIA Consultation,
Kutadgu Consultancy, F. Kerim Gokay,
Caferağa Mahallesi
Safa Sokak
No:6
Kadiköy,
Istanbul

All comments and concerns raised through these activities have been recorded in a Stakeholder Register and were considered in preparing this Final ESIA Report and ESMP. A report on the consultations is available on the Project website including an up to date Stakeholder Register.

To ensure that all comments received during the consultation process were considered and addressed in a transparent manner, a Comment Management process was applied. All comments received were recorded on a Comment Form and in a Comment Log and were reviewed on a weekly basis with ATAS and an appropriate response agreed by the Project team. This included revising the ESIA text, providing further baseline or assessment data, developing additional mitigation or monitoring measures for inclusion in the ESMP, or revising the design of the Project.

Where the Project was unable to take up a suggestion, the reasons for this are explained in the Consultation Report and where appropriate a personal response was provided.

In addition if any stakeholder had a complaint about the process a separate Grievance Procedure was applied. This is described in the Stakeholder Engagement Plan which is available on the website.

Plans for longer term and continuing engagement with stakeholders are set out in the Stakeholder Engagement Plan. This is a live document and will be updated as required during the construction process. The most up to date version can be found on the Project website. Additionally, the ESMP will be a live document, updated as required and available on the website. Other Project information, notification of construction activities and reports on general progress will continue to be available throughout the construction and operation of the Project.

## 1.4 *STRUCTURE OF THE REPORT*

The remainder of this report is organised as follows:

- Chapter 2 describes the Project, including the background to its development and alternatives considered, and gives details of its design, construction and operation;
- Chapter 3 summarises the results of scoping and presents the scope of the ESIA;
- Chapters 4 to 14 then present the results of the assessment under the following impact headings:

- 4: Land Use and Property;
- 5: Resources and Waste;
- 6: Geology, Soils and Contaminated Land;
- 7: The Water Environment;
- 8: Air Quality and Climatic Factors;
- 9: Noise and Vibration;
- 10: Biodiversity and Nature Conservation;
- 11: Cultural Heritage – archaeology, built heritage and landscape;
- 12: Socio-Economic Impacts;
- 13: Community Health and Safety;
- 14: Working Conditions.

Each chapter provides:

- an introduction to the topic and to the sources and types of impact addressed in the chapter (ie the scope);
- a description of methods and sources used to characterise the baseline and to predict and evaluate impacts with a note of any difficulties or limitations;
- a description of the baseline relevant to the topic;
- a description of the impacts, planned mitigation and how this will avoid or reduce impacts, and evaluation of the significance of the residual impacts after mitigation;

- discussion of cumulative impacts, where relevant.

- Chapter 15 introduces the Project Environmental and Social Management System.

The report is supported by the following Annexes:

*A.* The ESIA Team
*B.* EIA Decision letter from the Ministry of Environment and Forests
*C.* Environmental and Social Regulatory and Policy Review
*D.* The Project ESMP and Resettlement Policy Framework
*E.* Appraisal of Route Alternatives
*F.* Scoping Findings
*G.* Project Information Document and Summary of Stakeholder Comments
*H.* Project Drawings
*I.* Land Use Maps
*J.* Baseline Geology, Contaminated Land and Surface Water
*K.* Air Quality
*L.* Noise
*M.* Biodiversity and Nature Conversation
*N.* Archaeological
*O.* Social Impacts and Scoping Checklist
*P.* Bibliography

# 2 PROJECT DESCRIPTION

## 2.1 PROJECT OVERVIEW

### 2.1.1 The Project Proponent

ATAŞ (Avrasya Tüneli İşletme İnşaat ve Yatırım A.Ş. - Eurasia Tunnel Operation, Construction and Investment Inc. Co.) has been selected by the Turkish Ministry of Transport General Directorate of Railways, Harbours and Airport Construction (DLH - Demiryollar Limanlar ve Hava Meydaniari Inşaati Genel Müdüriüğü) to design and build a new road tunnel beneath the Bosphorus in Istanbul – the Eurasia Tunnel. The Project will involve the construction of a 5.4 km tunnel beneath the Bosphorus running from Sultanahmet on the European side to Selimiye on the Asian side, together with widening of approach roads to the tunnel along Kennedy Caddesi and the D100 Istanbul-Ankara State Highway. The route will cover a total distance of 14.6 km.

The Project is to be developed through a "Build, Operate, Transfer" (BOT) contract between DLH and ATAŞ. Under the terms of this contract ATAŞ will be responsible for the detailed design and construction of the Project, building on an outline tender design prepared by DLH. On completion of construction they will hand back the widened approach roads to the Greater Municipality of Istanbul for their operation and maintenance, but ATAŞ will continue to operate and maintain the tunnel for a further period of 25 years, 11 months and 9 days. The cost of the Project will be financed by debt and equity under a project finance structure. The cash flows for the repayment of the debt and distribution of dividends to equity shareholders will be generated by tolls levied on vehicles using the tunnel.

The ESIA has been based on the outline tender design developed by DLH with some initial refinements proposed by ATAŞ, and on preliminary consideration of feasible construction methods. During the next stage of development ATAŞ will appoint an EPC Contractor to undertake the Engineering, Procurement and Construction of the tunnel and approach roads. The final design and details of the construction approach and methods will be developed by the EPC Contractor. Should the final scheme design and methods of construction differ from the outline used for this assessment, ATAŞ will consider whether the environmental and social impacts will be significantly different from those identified by the ESIA and if this is the case, will implement additional mitigation to ensure that the actual impacts are not materially worse than those reported in this ESIA Report.

### *2.1.2 Need for the Project*

Istanbul requires a substantial investment and improvement in its transportation infrastructure. Together with rapid population growth and economic development in recent years, there has been a significant increase in car ownership, placing considerable pressure on the existing transport system. Growth in car travel, together with the difficult topography and dense urban structure of the city, result in severe commuting and parking problems for the residential and working populations and businesses in Istanbul.

Car-based transport (including taxis and other service vehicles) accounts for over 53% of all journeys in the city and also uses over 90% of the road space. There are more than 1.3 million vehicles circulating in the city on a daily basis. As a result the connection between the two continents has become a major issue with the two bridges crossing the Bosphorus both operating well above their design capacity and experiencing severe congestion over long periods every day.

The Istanbul Transportation Master Plan (ITMP) (1) forecasts continued population growth based on the 2007 land use plan for Istanbul, of over 3% per year, with the population increasing from 11 million in 2005 to more than 20 million in 2023. The number of vehicles is predicted to increase threefold to 4.19 million as passenger car ownership extends to 67% of households. These factors are all predicted to result in a further growth in traffic across the city with the number of Bosphorus crossing trips estimated to increase 1.5 times. The ITMP assumes the Eurasia Tunnel is in place as part of its base case for the future but even with this and the new Marmaray tunnel, daily demand is predicted to be 1.2 times available crossing capacity in 2023 and the Master Plan identifies the need for yet another road and rail bridge.

The Eurasia Tunnel is designed to contribute towards alleviating current pressure, providing a third road crossing of the Bosphorus alongside the Metro tunnel which is already under construction. Initial predictions indicate that journey times from Europe to Asia will reduce from up to 100 minutes today to as little as 15 minutes with the Project. This should provide

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[1] Japan International Cooperation Agency/IMM; *The Study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in the Republic of Turkey*; 2008

substantial economic benefits in improved accessibility, reduced journey times and improved reliability, and lead to an overall reduction in fuel consumption, greenhouse gas and other emissions, and noise.

### 2.1.3 *Overview of the Scheme*

The Project comprises the upgrading of two existing roads, on the European and Asian sides of Istanbul and construction of a double-deck tunnel under the southern end of the Bosphorus. The length of the Project is approximately 14.6 km and it falls into three main sections shown in Figure 2-1.

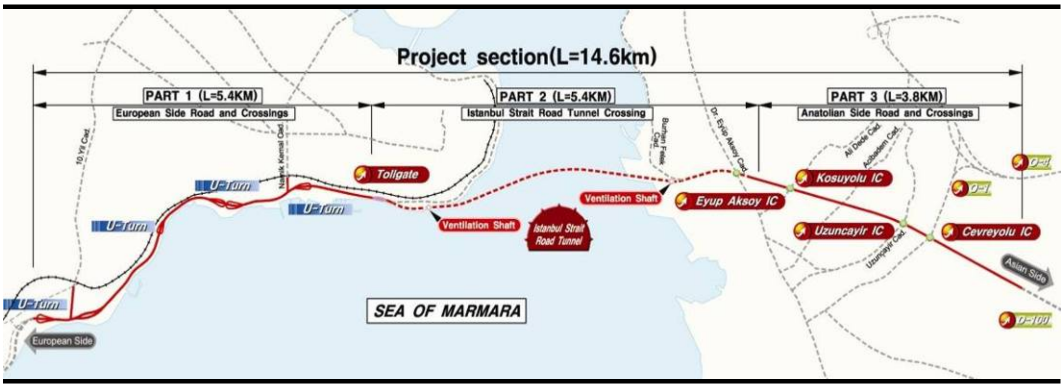


*Figure 2-1* *Project overview of the three sections*

- **Part 1**, on the European side: widening of Kennedy Caddesi from Kazliçesme to the Bosphorus, from 3x2 lanes to 2x4 lanes, over a length of approximately 5.4 km, including 5 U-turn underpasses and seven pedestrian footbridges.
- **Part 2**, under the Bosphorus: construction of a double-deck tunnel with two lanes at each level over a length of 5.4 km, together with a toll plaza and operations building at the western entrance, and ventilation shafts at both ends.
- **Part 3**, on the Asian side: widening the existing D100 road leading to the Ankara-Istanbul State Highway at Göztepe, from 2x3 and 2x4 lanes to 2x4 and 2x5 lanes, over a length of approximately 3.8 km, including two interchanges, one underpass, one overpass and three pedestrian footbridges

More detailed plans of the route are presented in Annex H.

Traffic through the tunnel will be restricted to cars and minibuses. The speed limit for the whole route will be 80 km/h except in the U-turn underpasses where it will reduce to 40 km/h. There will be no traffic lights or at grade crossings and traffic flow will be continuous.

The toll rate will be 4 USD plus VAT for cars and 6 USD plus VAT for minibuses in each direction. Prices will rise in line with the US Consumer Price Index.

### *2.1.4 Implementation Programme*

At the present stage of planning it is estimated that the further design, and construction of the Project will take approximately 55 months. The period during which ATAŞ will operate the tunnel then extends for a further 25 years, 11 months and 9 days after which the tunnel will be handed over to DLH. The total BOT Contract period is 30 years 6 months and 9 days. Construction is planned to start during 2011 and the Tunnel is expected to open in 2015. The approach roads will be handed over to the municipality for operation once their construction is complete.

## 2.2 BACKGROUND TO THE DEVELOPMENT AND ALTERNATIVES TO THE PROJECT

### *2.2.1 Route Selection*

A pre-feasibility study for a new road crossing of the Bosphorus was commissioned in 2003, building upon the findings of a Transportation Master Planning Study undertaken by the University of Istanbul for the Municipality in 1997. This concluded that there would be significant environmental, planning and design difficulties with a further bridge crossing and recommended the development of a road tunnel. A feasibility study [2] was carried out by Nippon Koei Co. Ltd in 2005 which examined route options for a new tunnel crossing. The section of the feasibility study report dealing with the appraisal of alternatives is presented in Annex E. The Project alignment was selected as the preferred route for three key reasons:

- its location in relation to the two existing bridges provides for an even distribution of Bosphorus crossings;
- its short tunnel length results in the lowest capital cost;

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[2] Nippon Koei Ltd; *Karayolu Boğaz Geciş Tüneli Fizibilite Çalısması*; for Ministry of Transport (Turkiye Cumhuriyeti Ulaştırma Bakanlığı'na); 2007

- sufficient space for establishment of the construction sites and operating facilities (toll plaza, operation building) is available.

Environmental and social factors were only briefly considered in the feasibility study and a further review has therefore been undertaken as part of the ESIA investigations. The results are presented in Annex E. This high level appraisal based on the broad corridor alternatives identified in the Feasibility Study supports the selection of the proposed route as the preferred option based on a balance of environmental, social cost and risk factors.

### 2.2.2 *Outline Design Development*

The BOT Tender design which forms the starting point for this assessment was developed by the Turkish Government Ministry of Transportation, DLH from the route proposal identified in the 2005 Feasibility Study.

### 2.2.3 *Design and Construction Alternatives*

As result of the ESIA the team has identified certain changes to the BOT tender design which offer the potential for reducing environmental impacts. These have been discussed with ATAŞ and the conclusions regarding their feasibility are outlined below. The consequences of these design changes are discussed in the assessment but it must be noted that they have yet to be approved by DLH, whose approval will be sought during the next stage in the process. Any final design changes will then be disclosed and their implications reflected in the ESMP for the Project.

1. In order to reduce the impact of traffic passing the historic peninsula along Kennedy Caddesi, the option of extending the tunnel further to the west beneath Kennedy Caddesi was raised. Extending the tunnel to Kazliçesme would take it beyond the historic city walls and remove any potential for adverse effects on the setting of the old city. This would double the length of the tunnel resulting in almost a doubling in capital cost. It would also:

    - double the quantity of tunnel spoil with consequent impacts from construction traffic and waste disposal;
    - increase the number of ventilation shafts; and
    - increase the risks associated with incidents in the tunnel.

    Taking account of these factors and the effect of planned mitigation measures described later in this report in reducing impact on the historic peninsula, it was considered that the benefit to the historic peninsula of extending the tunnel did not outweigh the additional cost and environmental impact. The longer tunnel option was therefore rejected.

2. In order to avoid the movement of trucks delivering tunnel segments and removing construction spoil around the outskirts of the old city, reduce construction impacts on the shoreline park, and avoid temporary visual impact from the presence of a large slurry treatment plant, we have proposed starting the tunnel boring operation from the Asian side, rather than the European side as proposed in the BOT tender design. Following investigations regarding the availability of space on the Asian side this has now been adopted as the preferred option. A suitable nearby site belonging to DLH is being investigated as a storage site and its availability awaits final confirmation by DLH. The short distance to the harbour and the railway may also allow delivery and disposal of materials and delivery of the tunnel boring machine by ship or rail. In contrast operations on the European side are likely to involve mainly road delivery. This alternative now forms the basis for the assessment.

3. The area of the proposed Yenikapi underpass has been identified as an area where there is a risk of discovery of archaeological finds. At this location the approach road was planned to drop down through an underpass so that a pedestrian crossing could be provided at ground level to link the long distance ferry terminal and a new Marmaray station. This would entail excavating below the level of the modern coastal reclamation in an archaeologically sensitive area. To avoid this, the alternative of keeping the main road at ground level and constructing pedestrian footbridges to link the Marmaray station with the ferry terminal has been proposed. The pedestrian footbridges will be designed with ramps to facilitate the use of pushchairs, wheelchairs and baggage trolleys. This alternative now forms the basis for the assessment.

4. The BOT tender design envisages an operations building located near the toll plaza on the European side. To reduce the impact on views of the old city, consideration has been given to lowering the building into the ground to reduce the height of the above ground structure. An alternative design (a building with a maximum aboveground height of 6 metres and a basement) has been developed and now forms the basis for the assessment.

5. The BOT tender design envisages a toll plaza located on the European side, with a 7.7 m high roof suspended from 15 m high poles. To

reduce the impact on views of the old city consideration has been given to changing the design to reduce the height of the structure to a maximum of 7 metres in compliance with municipal requirements for protection of the skyline. This alternative design has been developed and now forms the basis for the assessment.

## 2.3 *PROJECT DESIGN*

The main elements of the Project are described in the following sections:

- Part 1: Kazliçesme to the Bosphorus (2.3.1);
- The Toll Plaza (2.3.2);
- Operations Building (2.3.3);
- Part 2: The Tunnel (2.3.4);
- Part 3: Haydarpasa to Göztepe (2.3.5);
- The Tunnel Ventilation System (2.3.6);
- Electrical Supply (2.3.7);
- Drainage (2.3.8);
- Traffic Management (2.3.9).

The technical design standards to which the route is designed and commentary on design for protection against seismic activity, fire, corrosion and water are discussed in Section 2.3.10.

The locations of the principal features described below are shown in detailed plans of the route in Annex H.

### 2.3.1 *Part 1: Kazliçesme to the Bosphorus*

The alignment of the European approach road is shown in Figure 2-2 and more detail is provided in Annex H.

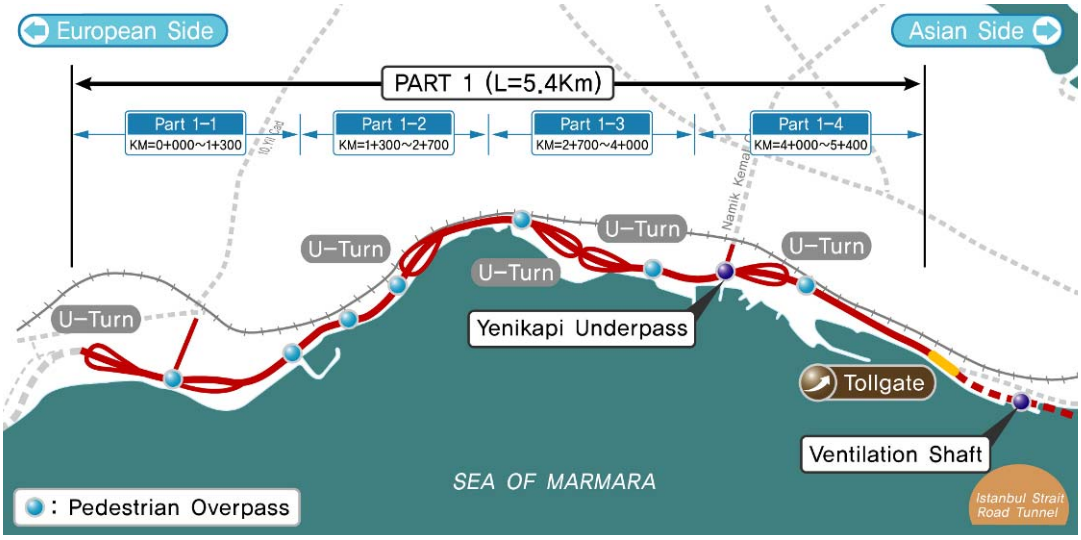
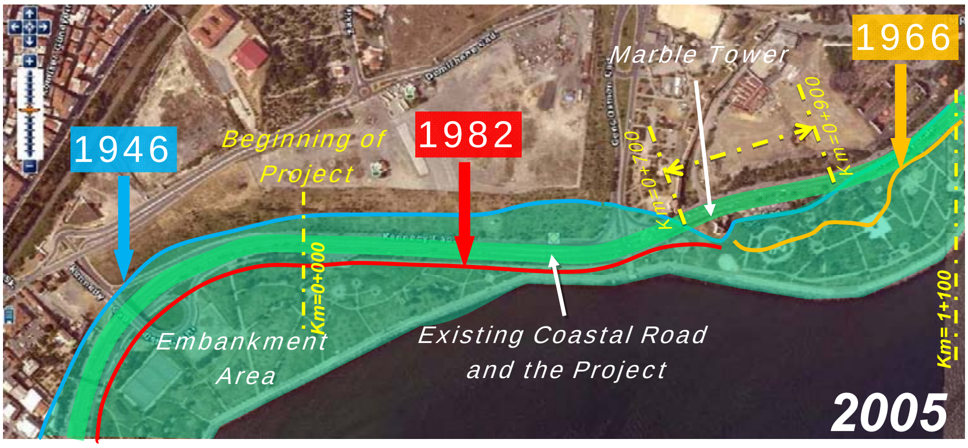



*Figure 2-2 Alignment overview of Part 1*

The European approach road to the tunnel follows the route of Kennedy Caddesi which was constructed in the 1960s. It is almost entirely located within a strip of flat land reclaimed from the sea in stages between 1946 and 2005. This is illustrated in Figure 2-3. Much of the reclaimed area is now occupied by parks, playgrounds and sports pitches. The main railway line is located to the north as are most of the remaining sections of the old city sea walls. Beyond these to the north lies the historic old city of Istanbul.

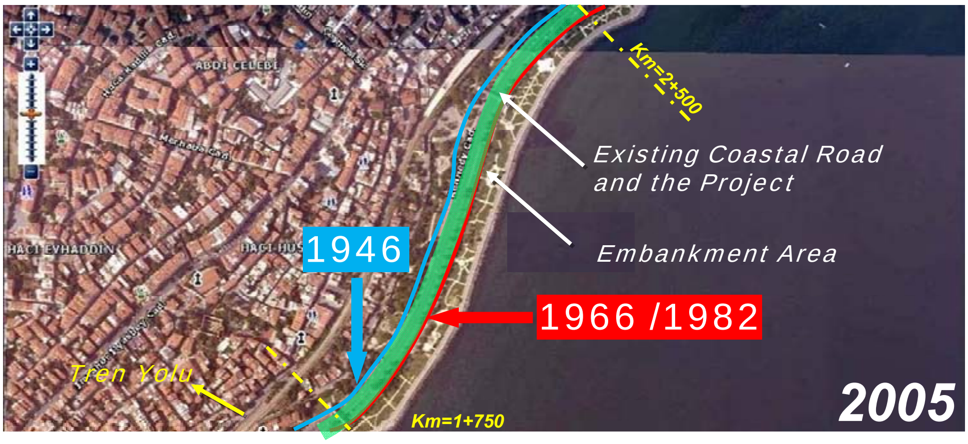
In two sections the road runs on original land which has not been reclaimed. These are in the vicinity of the Marble Tower at the junction between the Theodosian land walls and the city sea walls, and between Kocamustafapaşa and Samatya where a short section of Kennedy Caddesi runs to the north of the sea walls. The original sea walls and the railway can be seen in the 1930s photo in Figure 2-4.

*Figure 2-3 Location of the European Approach Road in relation to Recent Reclamation Activities (1945, 1966, 1982 and 2005)*

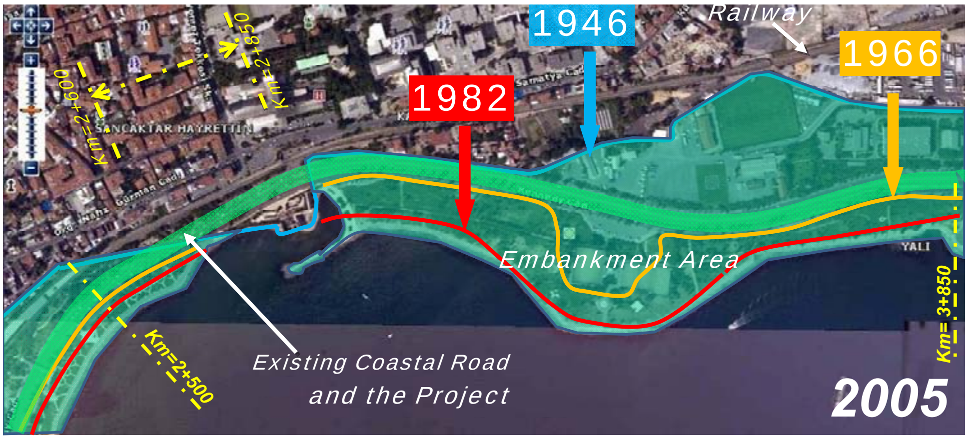



**1. Kazlıçeşme - Yedikule (Km = 0+000 – 1+100)**

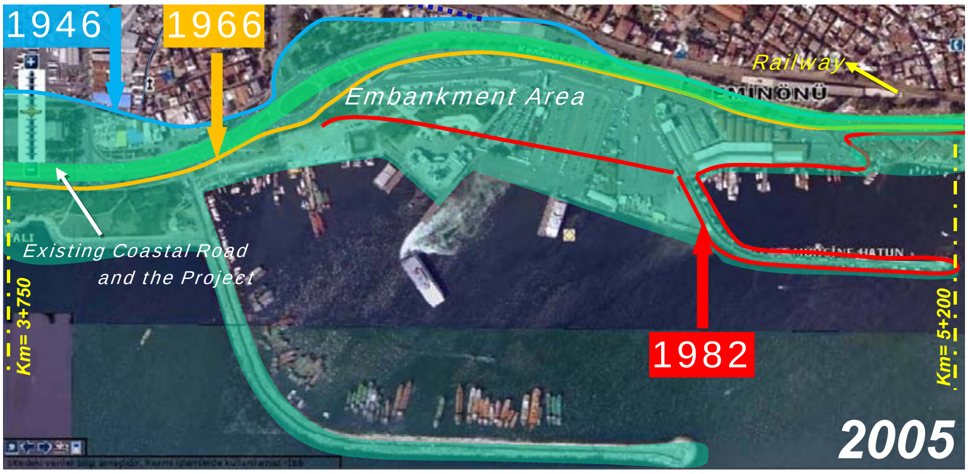

**2. Yedikule / İmrahor (Km= 0+950 - 1+600)**



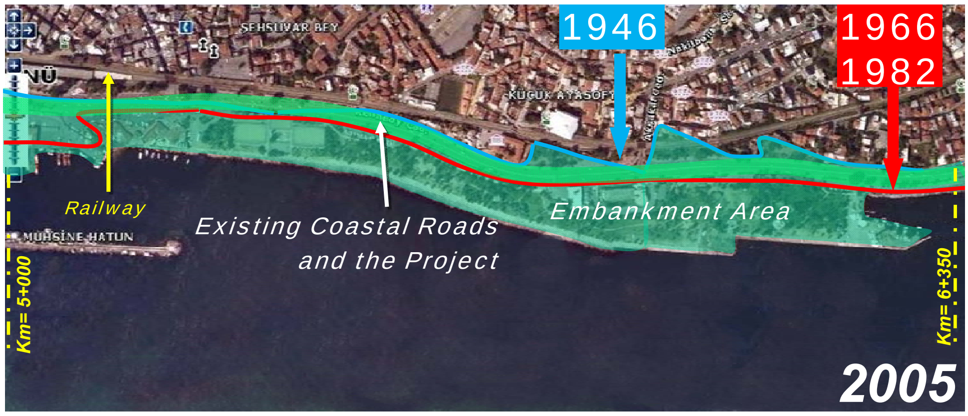

**3. Samatya (Km= 1+750 - 2+500)**




**4. Cerrahpaşa (Km= 2+500 - 3+850)**




**5. Yenikapı (Km= 3+750 – 5+200)**




**6. Kadırga - Çatladıkapı (Km= 5+000 - 6+350)**

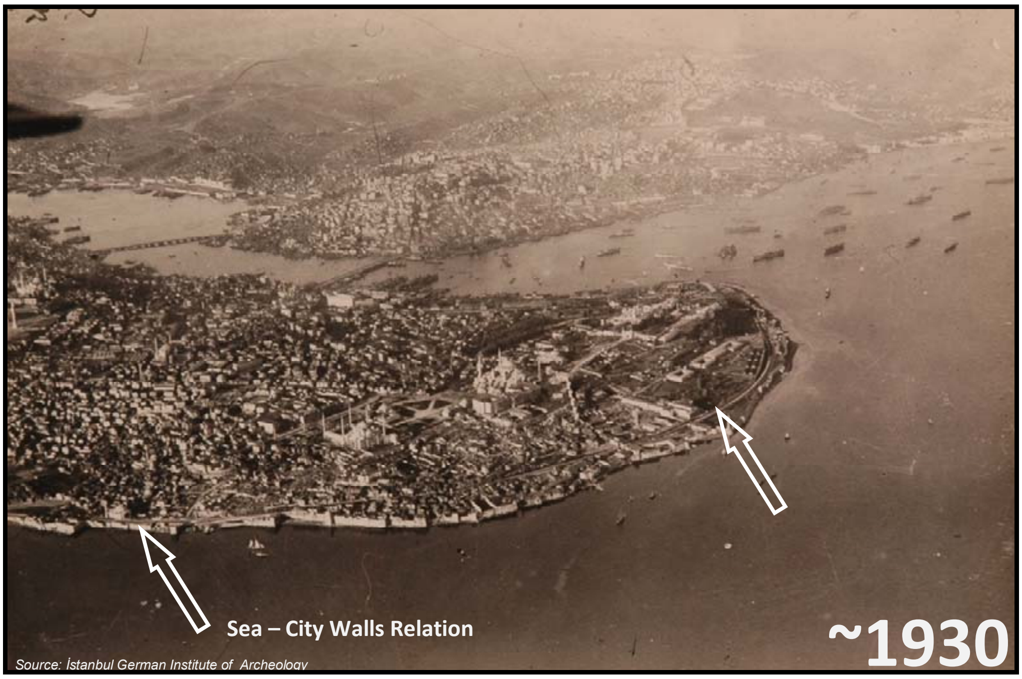



*Figure 2-4* *The City Sea Walls in the 1930s*

The Project starts about 450 m west of the junction of Kennedy Caddesi and Genç Osman Caddesi at Kazliçesme with a 2 lane U-turn beneath the existing road. The U-turn comprises an open U-section box with a ramp leading down into a cut and cover box beneath the main road and a further open box ramp back up to ground level. The form of these structures is illustrated in Figure 2-5.

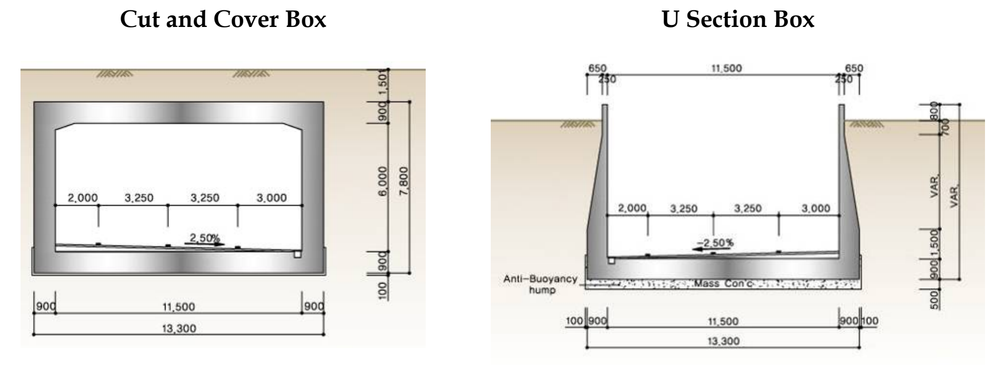



*Figure 2-5* *Cut and Cover and U-Section Box Structures*

The ramps will be constructed in the park areas to the north and south of the existing road. The U-turn will allow traffic driving south on Genç Osman Caddesi to turn right towards the airport and then turn back eastwards towards the tunnel. Eastbound traffic from the airport direction will not be able to turn north onto Genç Osman Caddesi without travelling on about 2½ km to the Samatya U-turn.

Two lanes will be added to Kennedy Caddesi from this point eastwards. The at-grade Kazliçesme junction will be slightly realigned to accommodate the widened road and Genç Osman Caddesi will be widened up to the junction with Abay Caddesi. A Y-shaped pedestrian footbridge will be built over the Kazliçesme junction to replace at-grade pedestrian crossings.

East of Kazliçesme the road will pass by the end of the Theodosian land walls where they run north from the coast. The new road will be split into two carriageways running north and south of the Marble Tower. An existing side road junction will remain allowing westbound traffic to turn right onto Mermekule Sk. The carriageways then converge and a parking area will be provided on the south of the road to the east of playgrounds and sports pitches within the coastal park. A pedestrian footbridge will be located south of Yedikule Train Station by the small boat harbour at Yedikule.

There will be two more parking areas and two footbridges between Yedikule and Kocamustafapaşa. South of Kocamustafapaşa Train Station there will be a single lane U-turn allowing westbound traffic to turn east towards the Bosphorus. Westbound traffic will be able to turn on and off Org Abdurrahman Nafiz Gurman Caddesi where there is an existing side road junction. A further pedestrian footbridge will be located just to the east. At this point Kennedy Caddesi crosses north of the line of the city sea walls and a section of the walls remains south of the road. The widening of the road has been designed to avoid any physical disturbance of the city walls here and elsewhere along the route.

Two U-turns will be located at Samatya allowing both east and westbound traffic to reverse (1 lane eastbound to westbound and 3 lanes in the other direction). The main alignment will swing slightly south of the existing road so that the northern ramps fit within the existing verge. The southern ramps are located in the coastal park.

There will then be a footbridge before the at-grade junction with Namik Kemal Caddesi. The existing T-junction will be removed and replaced by on and off slip roads allowing access only from and to the westbound carriageway. Traffic wishing to travel east or to turn left onto Namik Kemal Caddesi will use the Samatya U-turns.

The next junction is at Yenikapi where the tender design envisaged a grade-separated underpass junction to replace the existing roundabout. As discussed in Section 2.2, the ESIA has identified this as an area where there is the potential for discovery of buried archaeology in deposits beneath the modern reclamation. For this reason an at-grade junction is now proposed. Pedestrian footbridges will be constructed to link the new Metro station to the north with the ferry terminal south of the road.

Together with the Samatya west to east U-turn this junction will provide all-ways access to and from Gazi Mustafa Kemal Pasa Caddesi and the Yenikapi Ferry Terminal and harbour. As illustrated in Figure 2-6, the route to the north is the major traffic artery through the old city leading to the Ataturk Bridge across the Golden Horn.

1. **Atatürk Bridge**
2. **Galata Bridge**
3. **Ferry - Sirkeci**
4. **Ferry – Yenikapı**
5. **Coastal Road**
6. **Yedikule Gate**
7. **Belgrat Gate,**
8. **Silivri Gate,**
9. **Mevlana Gate,**
10. **Millet Avenue**
11. **Vatan Avenue**
12. **Fevzi Paşa Avenue**
13. **Haliç Coastal Road**

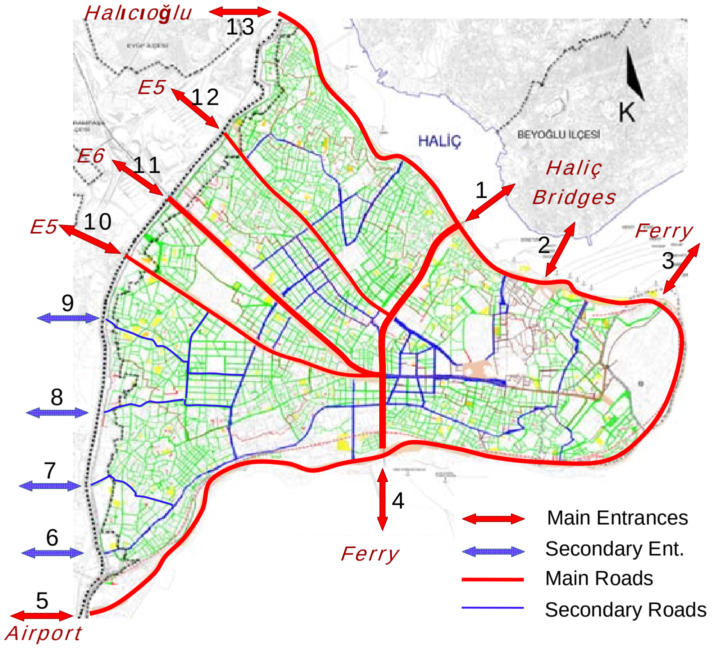



*Figure 2-6* *Main Roads in the Area of the Old City*

Midway between Yenikapi and Kumkapi Train Stations a footbridge will replace the existing at-grade crossings linking the railway and the ferry terminal.

At Kumkapi Station, an underpass will diverge from the tunnel approach to allow traffic to continue along Kennedy Caddesi and around the peninsula.

The tunnel approach road runs to the south and splits into two carriageways on the approach to the toll plaza.

A cross section of a typical road layout on the European side is shown in Figure 2-7. The road corridor will be approximately 38 m wide comprising eight 3.25 m wide running lanes, a 1.3 m central reserve, and 1 m hard shoulders, 0.5 m verges and 2.5 m minimum width footpaths on both sides. This compares to the existing road corridor which is typically about 30 m wide over most of its length (six running lanes, two central reserves, verges and footpaths) although it does vary considerably along the route.

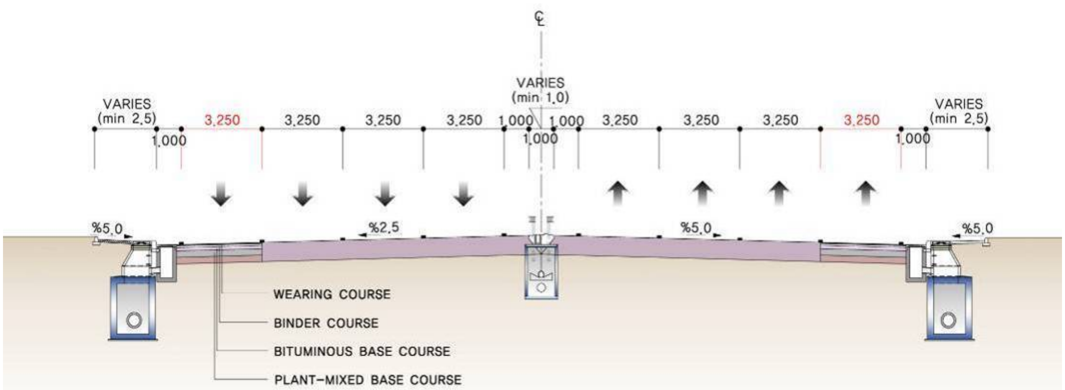



*Figure 2-7 Typical Road Layout on European Approach*

### 2.3.2 *The Toll Plaza*

The toll plaza for the tunnel will be located on the European side at the western end of the tunnel. It will comprise 11 traffic lanes with the central lane capable of operation in both directions depending on traffic flow. Compared to the BOT tender design the layout of the toll plaza has been revised so that it will not exceed a maximum height of 7 m in accordance with municipal requirements for protection of the skyline of the old city. Since the maximum clearance height within the tunnel is 3 metres the same clearance height is sufficient for the toll plaza.

A dynamic toll system will be used with three collecting systems matching and integrated with those currently used on the bridges across the Bosphorus:

- the automatic passing system OGS (Otomatik Geçiç Sistemi)
- the card passing system KGS (Kartii Geçiç Sistemi)
- and cash payment.

Tolls will be collected in both directions.

The system mix will be flexible, so for example it is envisaged that in 2021 there will be two OGS, two KGS and one Cash lane eastbound and two OGS, two KGS and two Cash lanes westbound in the morning but this will be reversed in the evening.

### 2.3.3 *Operations Building*

Immediately to the east of the toll plaza there will be an operations building located between the two carriageways where they diverge to enter the tunnel. The building will be approximately 78 m long and 15 m wide. It will have two above-ground storeys with an underground basement. The above ground structure will extend to approximately 6 metres above ground level. The layout of the operations building is illustrated in Figure 2-8.

The building will serve as the operations centre for the tunnel. The basement will contain a water store, technical room, generator room for uninterrupted power supply of the building and the related oil store. On the ground floor there will be parking, including parking for special fire trucks needed for the tunnel, a cafeteria with kitchen and changing rooms, and a document archive. The first floor comprises office, team rooms, main control rooms and a room for emergency team. A second emergency team will be based on the Asian side close to the tunnel entrance.

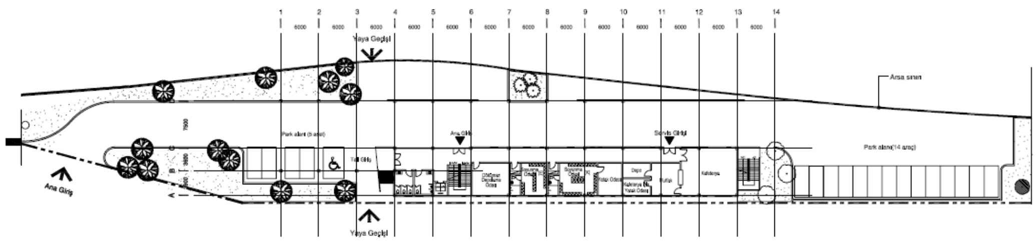


*Figure 2-8 Layout of the Operations Building (ground floor)*

### 2.3.4 *Part 2: The Tunnel*

As the road exits the toll plaza it starts to descend into the tunnel. The tunnel runs through different formats designed to accommodate the varying ground conditions along the route. These are illustrated schematically in Figure 2-9 and typical cross sections are shown in Figure 2-11. Lane width within the tunnel will reduce to 3 m allowing only cars and minivans to access this section of the Project.

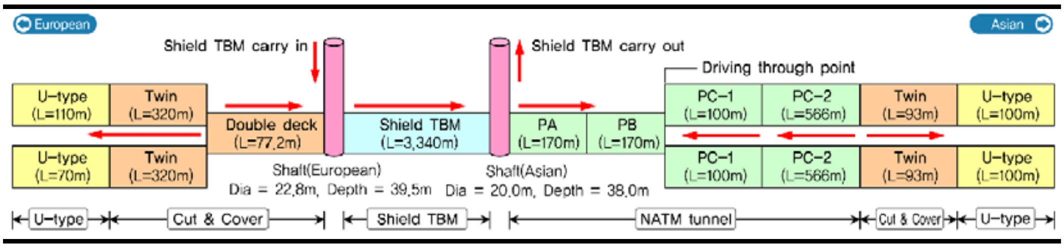



*Figure 2-9 Schematic of the Tunnel Sections*

The vertical alignment of the tunnel section is shown in Figure 2-10 (note the vertical scale is exaggerated).

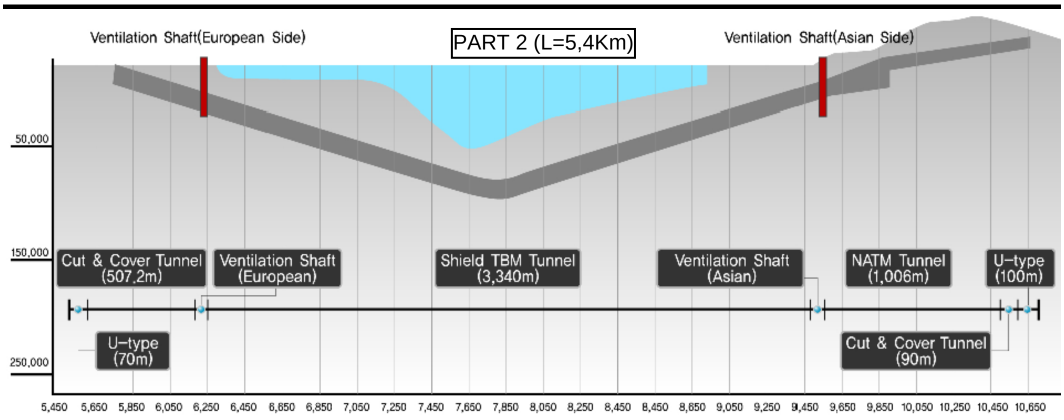



*Figure 2-10 Tunnel Vertical Alignment*

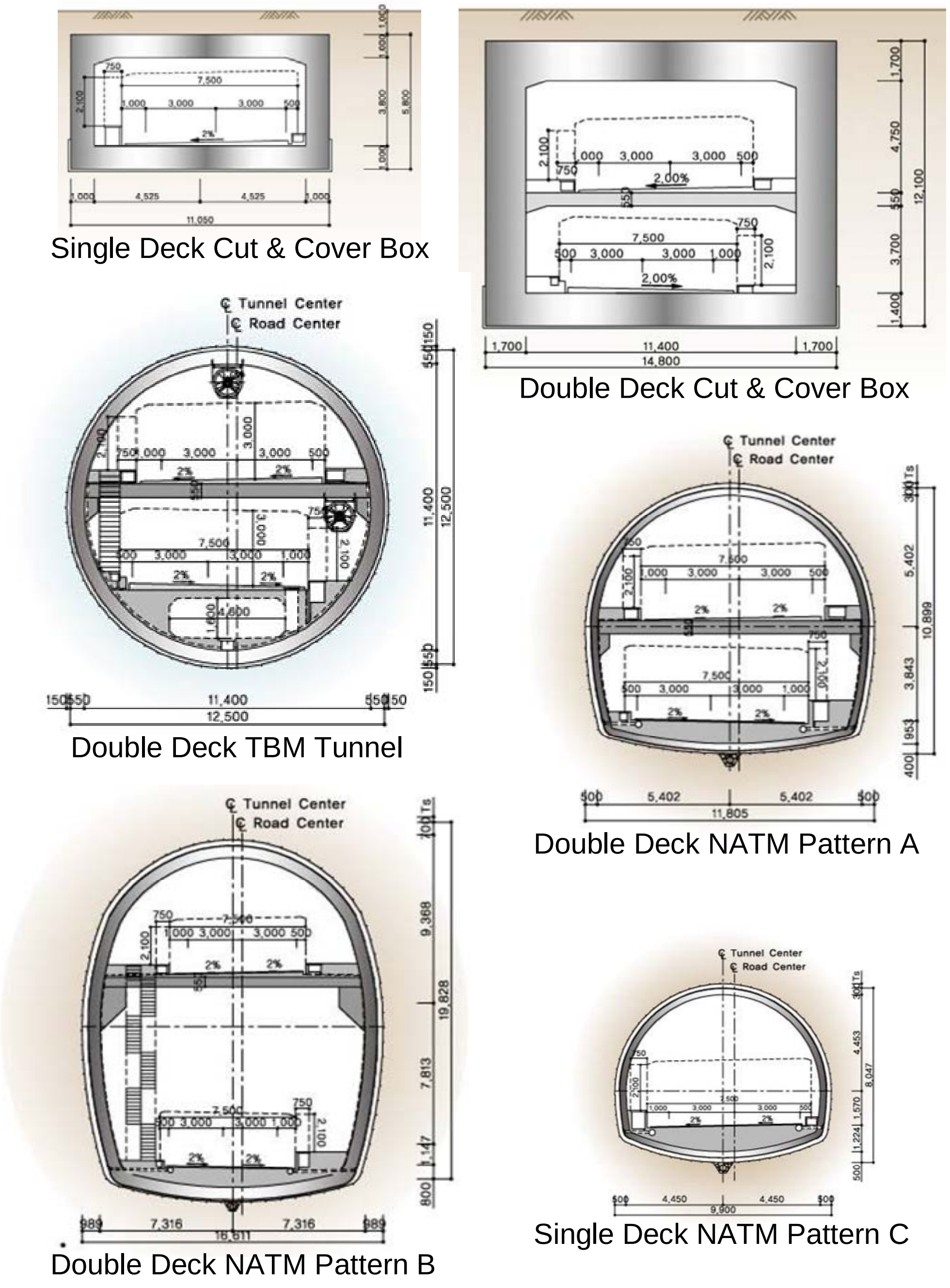



*Figure 2-11 Tunnel Designs*

The first section comprises two open U-section boxes with ramps descending into twin cut and cover boxes. The two boxes converge and the eastbound tunnel drops beneath the westbound. After 430 m the two boxes merge into a single double deck cut and cover tunnel which runs for about 80 m to the European ventilation shaft. Cut and cover methods are suited to use in soft ground comprising soft clays and submarine sediments with a high water content and this method is therefore used in reclaimed ground and in soft soil sections. All cut and cover sections will meet the requirements of British Standard BS5400 with respect to vertical and horizontal load.

The ventilation shaft is located in open space just west of the small boat harbour at the end of the peninsula. Further details of its design are provided in Section 2.3.6. It forms the start of the 3.34 km bored tunnel, referred to here as the TBM (Tunnel Boring Machine) tunnel. The TBM method has been selected to suit the complex ground conditions expected along the route including different rock and soil types.

The TBM section will be a 12.5 m diameter double deck tunnel descending at a slope of 4% to the deepest point located ca. 95 m below sea level. At this point the top of the tunnel will be about 25 m below the sea bed. The TBM section then rises at 4% to end at the Asian ventilation shaft north of Haydarpaşa container terminal.

From the Asian ventilation shaft the tunnel continues as a double deck New Austrian Tunnelling Method (NATM) tunnel for approximately 340 m. It then splits into two single deck NATM tunnels for a further 670 m. The route of the sections of NATM tunnel is illustrated in Figure 2-12.

The final section of tunnel on the Asian side runs in twin cut and cover and finally U-section boxes, for about 190 m, at which point it returns to ground level with ramps emerging on either side of the existing Eyup Aksoy Interchange.

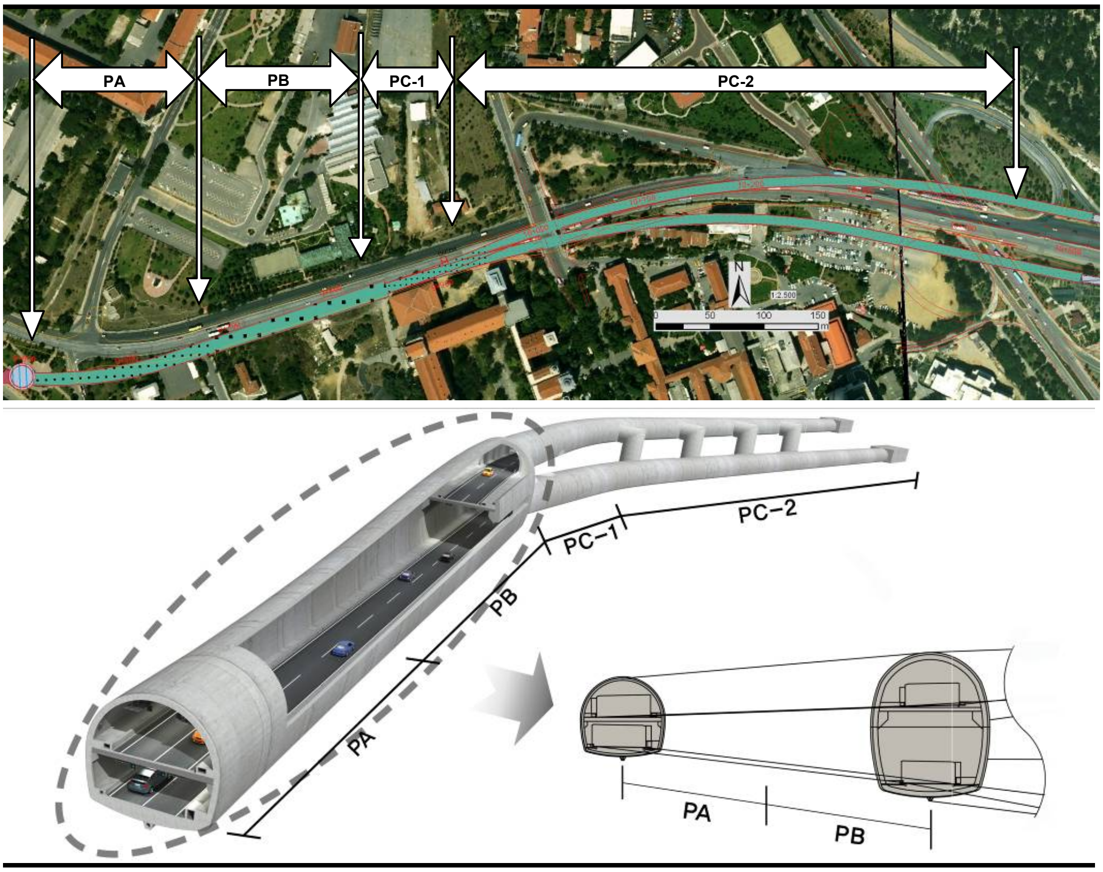



*Figure 2-12* *The NATM Tunnel Sections*

### 2.3.5 *Part 3: Haydarpaşa to Göztepe*

The alignment of Part 3, the Asian approach road, is illustrated in Figure 2-13 and more detailed plans are presented in Annex H.

The Asian approach road leaves the tunnel to join the D100 eastbound of the Eyup Aksoy Interchange (between D100 and Dr. Eyüp Aksoy Caddesi). Three connecting carriageways will be added to the south to create a complete clover leaf intersection. The road will continue on its existing line as two 4-lane carriageways. An existing footbridge at Kosuyolu Caddesi will be retained and the underpass carrying Ali Dedde Caddesi beneath the D100 will be replaced by a new Kosuyolu Interchange. The existing access and exit lanes connecting to Dinlenc Caddesi, Onur Sk, Bag Sk, Koftunci Sk and Kosuyolu Caddesi will all be improved. A short underpass beneath Koftunci Sk will connect eastbound traffic from Onur Sk onto the D100.

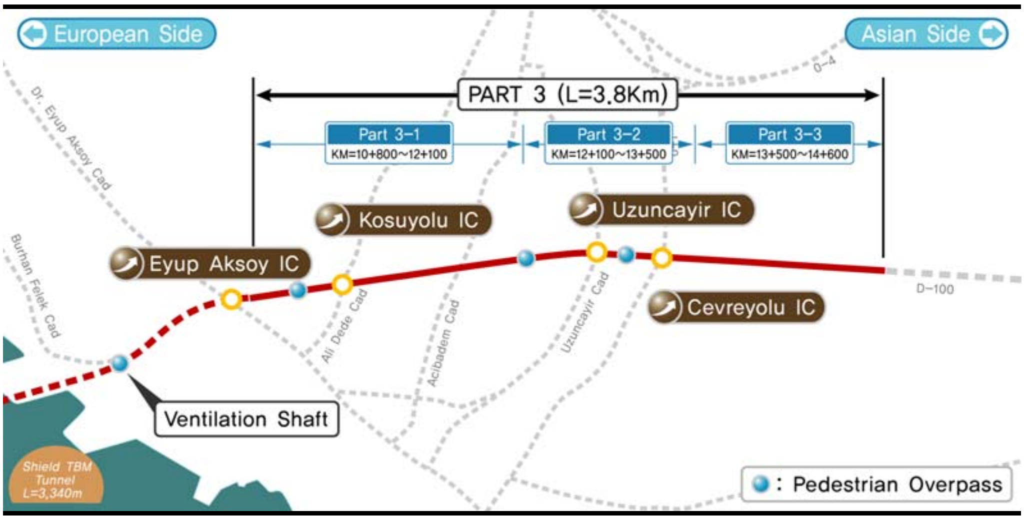



*Figure 2-13 Part 3: The Asian Approach Road*

From Dost Osan Sk the road descends under Acibadem Caddesi and then returns to ground level. The existing road bridge will be improved. The junction with Boyaci Mehmet Sk in the south and Nafizbey Sk in the north will be improved and the footbridge replaced.

The existing bridge over Kadiköy Uzuncaya Yolu will be retained.

At the intersection of the D100 with Uzuncayir Caddesi a new Uzuncayir Interchange will be formed. The roundabout on Uzuncayir Caddesi will be removed. The slip road connecting Uzuncayir Cad to the eastern direction of D100 will be improved and a slip road and overpass will be installed so that traffic coming from the north and south can turn to the east and eastbound traffic can turn north. Shortly after this intersection an existing footbridge will be replaced.

The incomplete interchange at Cevreyolu will be extended to provide access to the north for westbound traffic and to improve the slip road from westbound to south.

East of Cevreyolu the slip road located south of D100 will be improved and a footbridge will be replaced.

The road works end just before the Göztepe Interchange with improvements to the eastbound slip road of the D100 including widening of the overpass crossing a watercourse that runs to the south. The footbridge before the interchange will be retained.

A typical cross section for the Asian approach road is show in Figure 2-14.

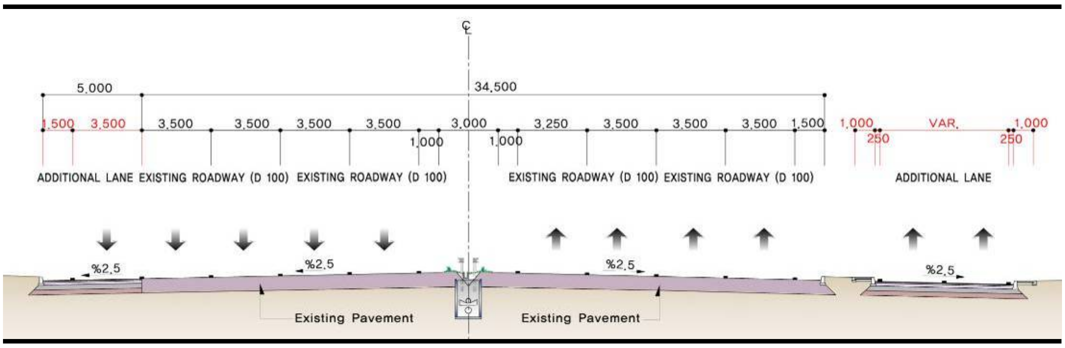



*Figure 2-14 Typical Cross Section for Part 3*

The road corridor width will vary, comprising eight 3.5 m running lanes, a variable central reservation, and 1 or 1.5 m shoulders, 0.5 m verges and minimum 2.5 m footpaths on each side.

### 2.3.6 *Tunnel Ventilation*

The tunnel will be ventilated to provide fresh air during operation and to evacuate smoke and provide fresh air for the safety of passengers, maintenance and rescue crews in the event of fire in the tunnel. During normal operation the ventilation system will extract air containing vehicle emissions of which the main contaminants will be carbon dioxide and monoxide, nitrogen oxides and particles.

The size and design of the ventilation system required for the Eurasia Tunnel has been calculated based on the estimated traffic volume, design speed, number of lanes, tunnel length, slope, diameter and elevation. For traffic speeds above 50 km/h the tunnel will ventilate naturally by the piston effect of the moving vehicles. At lower speeds and for ventilation during fire events, mechanical ventilation will be required using a system of 1.03 m diameter jet fans within the tunnel and ventilation shafts located at either end of the TBM tunnel.

The two ventilation shafts will each be fitted with mechanical fans and also include stairs for emergency exit from the tunnel and access for maintenance.

The below-ground dimensions of the shafts will be as detailed below. Each will be topped by a circular building of a diameter not exceeding 7 metres. The height of the two ventilation shafts will be restricted to 5 metres to comply with municipal requirements for protection of the silhouette, especially of the old city. Both structures will be designed to fit with their local setting.

| | | |
|---|---|---|
| European Ventilation Shaft | Dia. 22.8 m | Excavation depth below ground level: 39.5m |
| Asian Ventilation Shaft | Dia. 20.0m | Excavation depth below ground level: 38m |

Their locations and profiles are shown in the Figure 2-15.

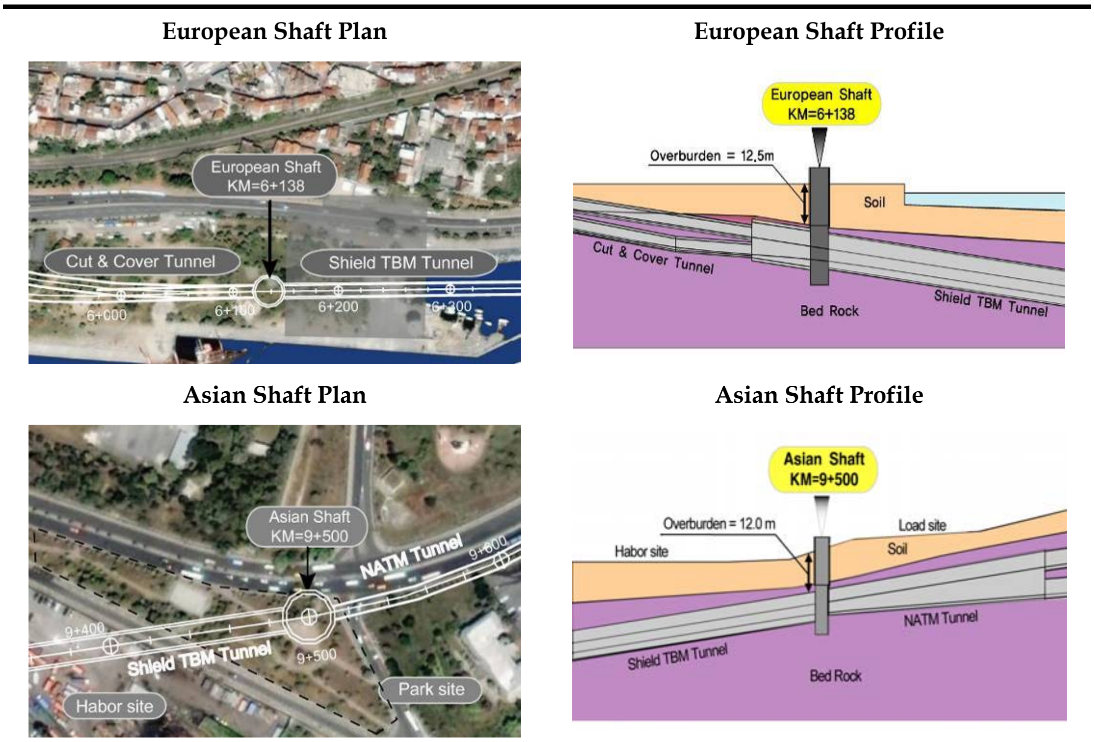



*Figure 2-15 Ventilation Shaft Locations and Schematic Profiles*

The western shaft is located in open space just west of the small boat harbour at the end of the peninsula and the eastern shaft in a small park located east and north of Haydarpaşa container terminal, south of Selimiye Military Barracks and west of DLH Marmara Regional Directorate.

The positions of the shafts east of the tunnel portal on the European side and west of the portal on the Asian side will reduce the emissions from the portals. They are located at the start and end of the TBM section so that they can be used for entry and removal of the tunnel boring machine during construction.

An indicative internal arrangement is illustrated in Figure 2-16.

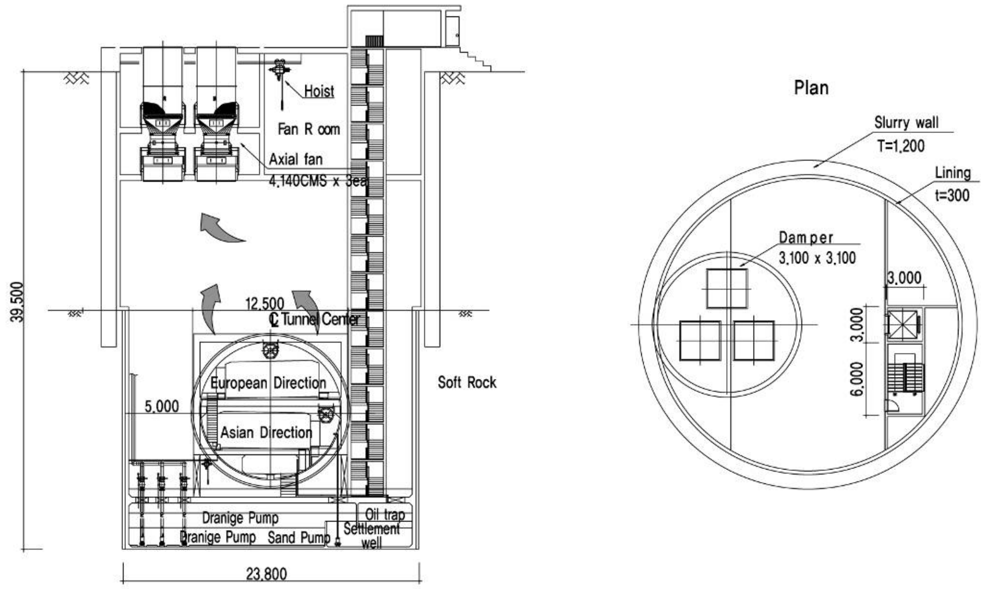
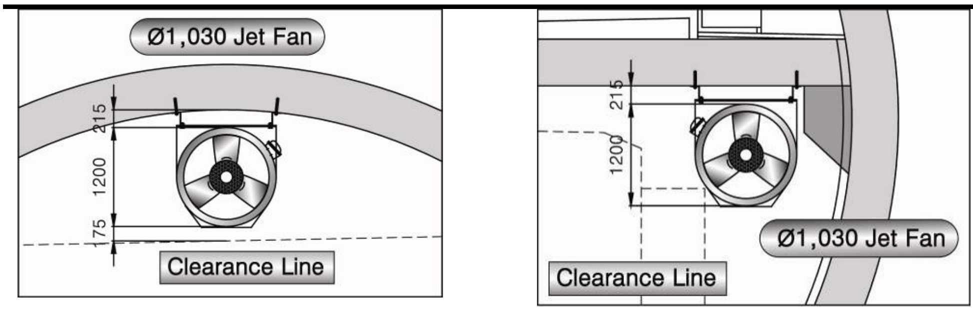



*Figure 2-16 Inner Section of European Vertical Shaft with Emergency Space*

The fans within the tunnel will be located as illustrated in Figure 2-17 and will be positioned every 150 m along the length of the tunnel.




**European side (upper deck)** **Asian side (lower deck)**

*Figure 2-17 Ventilation Jet Fans in the Tunnel*

### 2.3.7 *Electricity Supply*

Two electrical buildings will be located immediately to the south of the European ventilation shaft and to the southeast of the Asian ventilation shaft. The buildings will house transformers to supply electricity at the correct voltage for tunnel operation (ventilation, lighting, CCTV etc).

Electricity will be supplied from the Istanbul grid via subsurface cables with three phase current at 10 kV, 50Hz, and breaking current 25kA (no overhead lines are foreseen).

All equipment and materials used in the electrical buildings will comply with applicable EU standards.

### *2.3.8 Drainage*

A closed drainage system typical of that used for roads in urban areas will be installed with water being collected at the lowest point within underpasses. The Lenders' Technical Adviser has recommended a review of the plans to consider how the system will interface with the existing stormwater network and this study will be undertaken during detailed design to ensure an appropriate drainage arrangement is provided.

### *2.3.9 Traffic Management Systems*

The tunnel will be equipped with CCTV (Closed Circuit Television), a Vehicle Detecting System (VDS), electronic variable message signs (VMS) and emergency phones. An Information Display Panel will be installed at the tunnel entrances. New traffic signs along the approach roads will be placed to improve traffic guidance and traffic flow.

### *2.3.10 Design Codes and Standards*

The Project will be designed to comply with Turkish national and local authority standards and also with various international standards as set out in Table 2-1. In particular, the tunnel design will comply with the American Design Code NFPA 502 in relation to safety and with EU Directive 2004/54 on the minimum safety requirements for tunnels in the Trans-European Road Network.

*Table 2-1 Design Codes for Project Design Structures*

| Item | Design Code | Description |
|---|---|---|
| Road | AASHTO | American Association of State Highway and Transportation Officials |
| Tunnel | JSCE | Japan Society of Civil Engineers |
| | NFPA502 [3] [4] | Standard for Road Tunnels, Bridges, and Other Limited Access Highways |
| Structures | BS5400<br>AASHTO<br>NFPA502 | British Standard for design and construction of steel, concrete and composite bridges used in highways and railways<br>Standard for Road Tunnels, Bridges, and Other Limited Access Highways |
| Electrical Equipment | PIARC [1]05.05B<br>IEC [2] 60227-1<br><br>NFPA70<br>NFPA502 | Fire & Smoke Control in Tunnels<br>Polyvinyl chloride insulated cables of rated voltages up to and incl. 450/750 V<br>National Electric Code<br>Standard for Road Tunnels, Bridges, and Other Limited Access Highways |
| Machinery | PIARC 05.05B<br>NFPA10<br>NFPA92A<br><br>NFPA502 | Fire & Smoke Control in Tunnels<br>Standard for Portable Fire Extinguishers<br>Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences<br>Standard for Road Tunnels, Bridges, and Other Limited Access Highways |
| Life and Fire Safety | NFPA502 | Standard for Road Tunnels, Bridges, and Other Limited Access Highways |

(1) PIARC is the World Road Association, a non-political and non-profit making association granted consultative status to the Economic and Social Council of United Nations in 1970. It is a global forum for all transport related issues representing the road administrations of 118 governments plus private and non-governmental organisations.

(2) IEC is the International Electro technical Commission, a world body producing International Standards for electrical, electronic and related technologies

(3) NFPA is the US National Fire Protection Association, a globally acknowledged advocate of fire prevention and an authoritative source on public safety.

(4) NFPA 502 explicitly addresses general requirements regarding fire protection as well as safeguard during construction, fire life safety factors, emergency response plans, emergency communications, signage, fire detection, fixed water-based fire fighting systems, means of egress, emergency power and lighting, emergency ventilation for road tunnels.

A number of key design issues are discussed below.

#### 2.3.10.1 *Earthquake and Tsunami Risk*

Seismic protection of the Project is one of the most critical design issues since the Project is located in an area of high earthquake risk.

The BOT Tender Employer's Requirements set out seismic design criteria for the Project for two earthquake scenarios:

1. The Functional Evaluation Earthquake (FEE): this is an earthquake that could be expected to occur within the next 50 years and under which the Project should remain operable with minor damage.

2. The Safety Evaluation Earthquake (SEE): that is an earthquake with a 2% chance of occurring within the next 50 years and under which the life of users and the structural integrity of the tunnel should not be endangered; damage should be repairable within a reasonable time period.

Based on these requirements, ATAŞ has completed a seismic assessment of the main structures including the TBM and NATM sections and retaining walls and these have been designed to meet the tender standards.

The seismic design has been reviewed by an independent technical adviser on behalf of potential lenders. The Lenders' Technical Adviser concluded that the seismic design requirements set out in the Employer's Requirements meet and exceed those required by the Turkish Seismic Code (2007), and are in line with best practice on similar major infrastructure projects in seismic regions (Lenders Technical Advice by Ove Arup & Partners Ltd, October 2009).

In order to meet these standards flexible segments are planned at the boundary sections where the tunnel is passing between rock and soft sediments so as to allow for the larger relative displacement resulting from differences in stiffness. The Lenders' Technical Advisor has recommended provision of additional flexible segments between the TBM and NATM sections because of the different stiffness of these tunnel sections and these will be incorporated into the detailed design.

The Adviser also recommended further studies relating to assessment of tsunami risk, the potential of materials around the tunnel and approach roads to liquefy in the event of seismic activity, and protective measures during construction. These studies are underway and the Project will be designed to meet appropriate standards for these risks.

ATAŞ will calculate tsunami wave heights and inundation areas for the FEE and SEE earthquake scenarios using the best available data. Appropriate mitigation measures will then be developed so that the performance criteria set out in the Employer's Requirements are met for all structures (approach roads, underpasses and tunnel). Specific measures will be planned to mitigate the effects of tsunami waves and to prevent inflow into the tunnel including increasing the height of the sea wall and elevating the approach to the tunnel so that the entrance is above wave heights forecast in the design scenarios.

To date, the assessment of liquefaction risk has indicated that the tunnel should be located at least 25 m below the sea bed to ensure sufficient cover is ensured. This will be verified by further investigations. Liquefaction risks in the reclaimed land on the European side and at underpass and overpass locations on both sides are also being assessed and appropriate ground improvements will be carried out to mitigate any residual risk.

### *2.3.10.2 Fire*

The Lenders' Technical Advisor has also completed a review of the design of the tunnel for access and evacuation in the event of fire. A number of recommendations have been made regarding the internal layout of the tunnel and these are being incorporated into the design. Further details of arrangements for response in the event of emergencies are presented in Section 2.5.4.

### *2.3.10.3 Corrosion Protection*

Groundwater on the European side is likely to be saline due to proximity to the sea. This will present risks of corrosion of reinforced concrete and other structures. An epoxy resin coating will be used for reinforced concrete in thee areas to provide moisture and chloride resistance.

### *2.3.10.4 Waterproofing*

The tunnel will be exposed to high water pressures and thus needs a watertight design. ATAŞ propose to equip the TBM tunnel with two types of gasket system and an epoxy resin coating to seal the tunnel lining segments. Blast furnace slag cement, with high corrosion-resistance and low permeability and hydraulic conductivity, will be used as backfill material and in segment cement to improve water-tightness.

The NATM tunnel will be fully enclosed within PVC waterproofing.

These proposals have been reviewed by the Lenders' Technical Adviser who has recommended further checks on the gasket arrangements. ATAŞ will undertake these and ensure that the proposed systems provide adequate protection from water ingress.

## 2.4 CONSTRUCTION PROPOSALS

### 2.4.1 *Indicative Construction Schedule and Working Hours*

An outline construction programme is presented in Figure 2-18. Construction is estimated to take approximately 40 months with a further three months for commissioning. Usual working hours will be 08.00 to 18.00 (including 1 hour break) 7 days per week, except for the TBM section where tunnelling will be a 24 hour continuous operation. The dates (2010 – 2014) shown in Figure 2-18 no longer apply, but the duration of each construction activity and task is still valid. Construction is estimated to start during 2011.

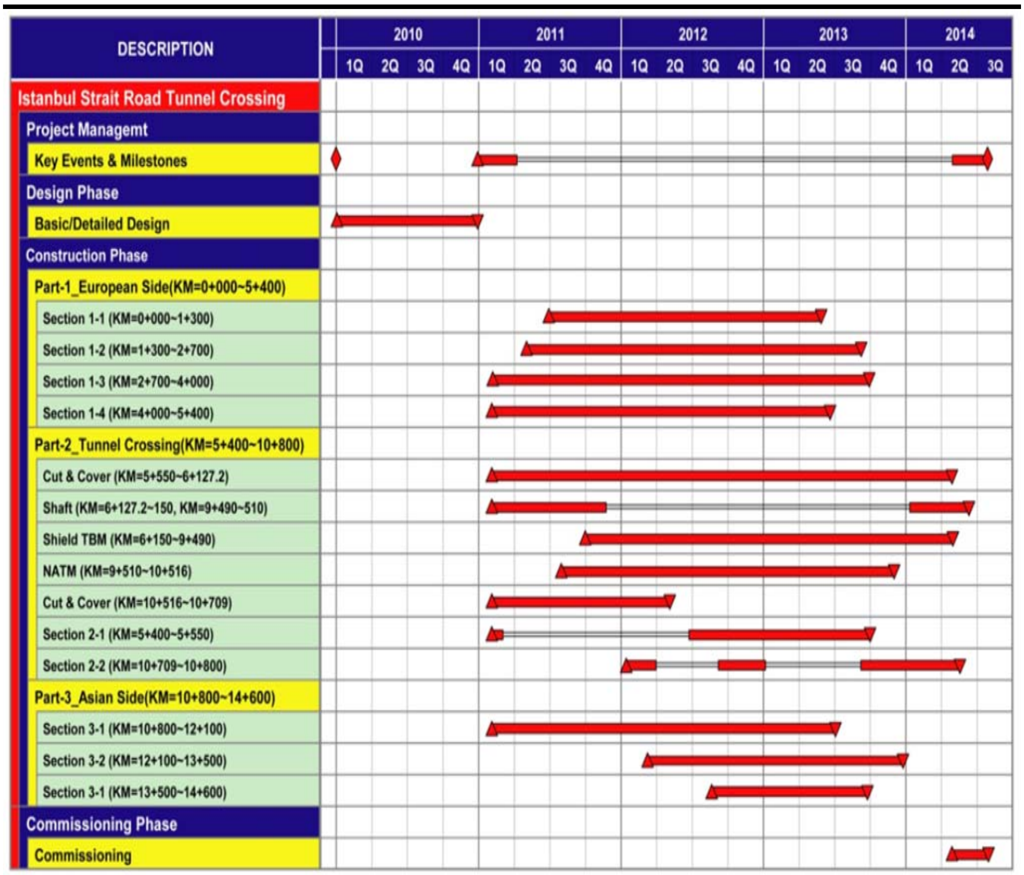



*Figure 2-18 Indicative Construction Schedule*

### 2.4.2 *Tunnel Construction*

#### *2.4.2.1 Creation of TBM Access and Ventilation Shafts*

The critical section of the Project is the TBM Tunnel and the works will start with construction of the ventilation shaft opening on the Asian side which will be used to lower the TBM into position. Access from the Asian side will avoid the potential for impact on the old city if access was obtained on the European side and will possibly allow delivery of the TBM by ship and/or rail. The TBM tunnel will then be excavated westward from the Asian ventilation shaft until it reaches the European ventilation shaft where the TBM will be removed.

The Asian and European ventilation shafts will be constructed as follows:

1. Excavation and installation of a slurry wall, followed by inner and outer soil cement walls. The slurry wall will be of reinforced concrete to provide structural integrity. The soil cement walls are added to prevent collapse after excavation of the shaft and to provide an impermeable barrier to ingress of water.

2. The shaft will then be excavated to the base of the soil layer using breakers and excavators, with spoil being removed by truck.

3. The final section in rock will be excavated by vibration-controlled drilling and blasting.

4. The TBM will be brought to the site in sections of a size suitable for the selected transport mode, and assembled at ground level before being lowered into the shaft by 250 t crane.

#### *2.4.2.2 Cut and Cover and U Sections*

The cut and cover sections will be constructed in the following sequence:

1. Creation of temporary retaining walls to contain the earth on either side of the box using concrete piling and a steel cage.

2. High pressure jet grouting of the earth behind the piles to stabilise the walls prior to excavation, using a mixture of sodium silicate, water, cement and bentonite.

3. Excavation of the box. Some blasting may be needed if hard rock is encountered. This is not expected but cannot be ruled out. If required small fully controlled charges will be used.

4. Reinforcement of the box using sprayed concrete (shotcrete) and rock bolting.

5. Construction of the floor, walls and ceiling of the box using reinforced concrete.

6. Backfilling to cover the structure using part of the excavated material.

U-sections will built in a similar manner but without creation of the roof and backfilling above the box.

Surplus spoil from the cut and cover and shaft excavations will be removed for off-site disposal (see Section 2.4.5).

Concrete for all the works will be supplied from ready mix concrete plants in the vicinity of the Project.

#### 2.4.2.3 *TBM Tunnel*

The slurry TBM tunnelling machine is expected to proceed at an average rate of 170 m per month or approximately 6 to 8 m per day (equivalent to three 2 m ring sections). The excavation will take 22.4 months in total including 2 months for installing and assembling the TBM and one month for its removal. The TBM will be electrically powered with supply being provided from the local electricity grid. It will move forward as the cutter head rotates with the cutter head being changed as conditions vary along the route, at intervals of between 200 and 500 m in rock and 2,000 m in soft ground.

A bentonite slurry will be injected at the cutter head to prevent tunnel collapse and the excavated material will be removed by pipe, mixed with the slurry, to a holding tank and treatment plant located at the access ventilation shaft. A crusher will operate behind the TBM to prevent blockage in the slurry-spoil removal pipes.

Spoil will be separated from the slurry using cyclones and centrifuges in a slurry treatment plant located close to the access shaft on the Asian side. Biodegradable flocculant chemicals made from modified starches will be used in the centrifuges to aid separation. The slurry will be recycled back into the process and the separated spoil removed either for use elsewhere on the project or for off-site disposal (see Section 2.4.5). The slurry treatment plant will be acoustically shielded so that the sound power level outside the plant does not exceed 85dB(A).

Various chemicals are used in TBM tunnelling to protect and lubricate the TBM and to stabilise the grout used to seal the tunnel lining segments. The exact chemicals to be used will depend on the selected TBM but they will be selected to be of no or low hazard to the water environment (3).

Despite their low environmental hazard these substances will need to be treated as hazardous in the event of their disposal as waste.

As the TBM moves forward the concrete lining segments will be installed behind it and backfilled via an injection hole in each segment using a plastic grouting material made from blast furnace slag cement. The segments will be pre-fabricated most likely in a plant located approximately 40 km from the Asian ventilation shaft. The segments will be held at a storage area of approximately 12 by 20 m near the access shaft before being transported to the tunnel face by locomotive. The storage area will hold enough segments for two days (in total 64 segments).

Segments will be carried by trains fitted with air brakes to cope with the steep slope of the tunnel (4%).

If unstable ground conditions are encountered along the route special grouting will be applied to these sections. Grouting will also be applied where rock and soft ground meet beneath the sea. This will be done from the TBM and no grouting from the seabed will be required.

As the TBM proceeds towards the European ventilation shaft, prefabricated segments will be placed as part of the bottom slab behind the TBM. Once TBM tunnelling is complete the TBM will be removed from the European ventilation shaft. The upper deck plates will then be placed starting from the Asian side. The upper deck will be installed using prefabricated plates transported by locomotive. The concrete tunnel floor will then be laid and a prefabricated drainage chamber, deck plate and utilities box installed above. Approximately 9,000 $m^3$ of concrete for road paving will be provided from ready mix suppliers via trucks and piped into the tunnel.

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[3] Information has been provided on chemicals used by the supplier CONDAT. Materials Safety Data Sheets indicate that they typically fall into classes WGK0 (= not hazardous) and WGK1 (= slightly hazardous). WGK is a German classification of the physical, chemical and biological characteristics of chemicals according to their hazard to water. Some chemicals are biodegradable but other are mineral and do not biodegrade. One substance was classified as irritating to skin.

Excavation of the Asian cut and cover, U-type section and NATM tunnels will proceed in parallel with the TBM tunnel.

*2.4.2.4 NATM Tunnel*

The NATM Tunnel will be constructed in two directions at once, from the Asian ventilation shaft and the end of the Asian twin cut and cover tunnels. Where the tunnel splits into lower and upper sections the lower section will be constructed and reinforced before starting the upper tunnel.

NATM tunnelling involves excavating a series of layers (benches) from the top down using drilling and blasting. A modern blasting method will be used which maximises blast efficiency, limits noise and vibration, protects the surrounding rock mass and maximises the accessibility of drilling work. The explosive will be an emulsion type suitable for hard rock and wet conditions, with low production of smoke and odours and safe handling.

The ground above the tunnel will be grouted to protect above ground structures and the tunnel will be lined using sprayed concrete (shotcrete), reinforced by steel ribs and soil nails where needed. In the double deck section the upper deck brackets will be installed in the concrete as it is sprayed in place.

Excavated spoil will be removed via the ventilation shaft and the cut and cover tunnel.

### *2.4.3 Approach Road Construction*

Construction of the approach roads will proceed in parallel with tunnel construction on both European and Asian sides.

On the European side work will begin in two locations:

- east from Org Abdurrahman Nafiz Gurman Caddesi and Kocamustafapaşa U-turn (construction section 1-3 in Figure 2-18) to the Samatya U-turns and the access to Namik Kemal Cad.
- at Yenikapi intersection where the roundabout will be replaced by a new intersection, followed by widening of the road as far as the toll plaza.

After about 6 months works will start at Kazliçesme progressing eastwards to Yedikule.

On the Asian side work will start at the tunnel entrance and progress to the east over a period of 35 months.

Work on the operations building, toll plaza and electrical buildings will run for about 16 months from Month 18.

On all sections of the approach roads, new underpasses and U-turns will be built first and then the carriageway will be widened in sections allowing traffic to continue to use the existing roads, although with restricted capacity.

The main sequence of events at each new underpass and U-turn structure will be as follows:

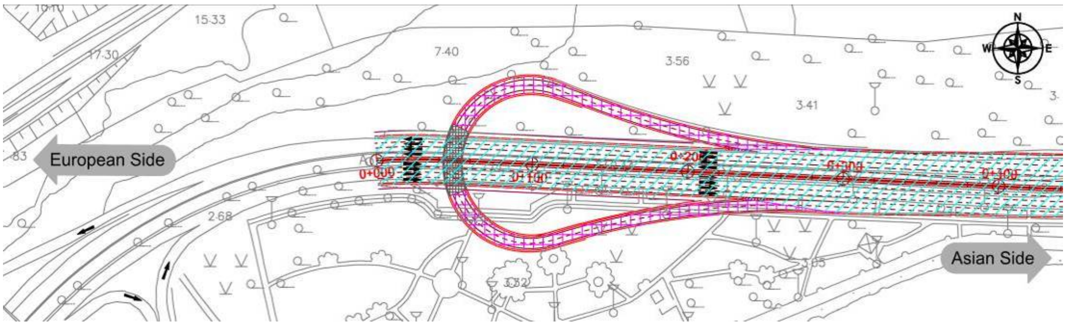
1. Build temporary carriageways around the junction to take traffic during the construction.
2. Construct the below-ground box using the cut and cover method as described above for the cut and cover tunnel sections.
3. Re-lay the main carriageway above the box.
4. Construct the U-type sections and access ramps into the box. These will usually be aligned along the route of the temporary carriageways.

This is illustrated by a typical location in Figure 2-19.

Along the main line sections of the road, new lanes will be built alongside the existing carriageway first to allow traffic to continue to use the old road, and lanes will then be closed in sequence across the road whilst the old road is re-paved, the old central reservations are removed and the new reservation installed. New pedestrian footbridges will then be built before the old bridges are removed. Where retaining walls are needed to accommodate the widened road these will be constructed in advance of widening.

**1st stage : Installation of temporary diversions (two 3 lane carriageways) and construction of box**


**2nd stage : Reinstatement of main carriageway and construction of U-type sections/ramps**




**3rd stage : Completion of construction**

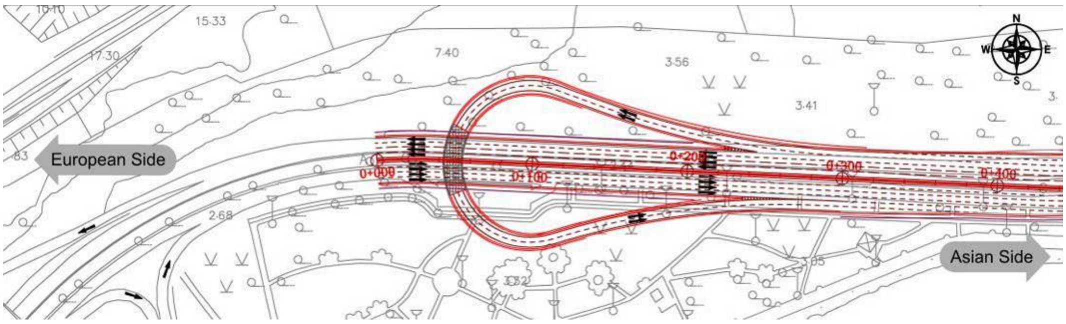



*Figure 2-19 Construction of a typical U-Turn Section*

### *2.4.4 Construction Materials*

Estimates of the quantities of materials required for construction are listed in Table 2-2. They will include concrete, steel, road aggregate and pavement materials.

*Table 2-2 Estimated quantities of materials required for construction*

| Material | Unit | Asian Section | European Section | Tunnel |
|---|---|---|---|---|
| *Ready mix concrete | m3 | 88,682 | 220,812 | 67,314 |
| *Mortar | m3 | 8,557 | 12,103 | 20 |
| D-bar (Reinforcing Bar) | t | 1,502 | 534 | 532 |
| H-bar (Reinforcing Bar) | t | 3,009 | 20,845 | 12,561 |
| Coarse Aggregate (for road construction) | m3 | 57,373 | 134,920 | - |
| Fine Aggregate (for road construction) | m3 | 15,323 | 7,105 | - |
| Tack Coating (asphalt works for pavement) | m3 | 141 | 204 | - |
| Prime Coating (asphalt works for pavement) | m3 | 69 | 185 | - |
| Number of segments | pcs | - | - | 1,670 |
| Concrete for segments | m3 | - | - | 68,964 |
| Reinforcing Bar for segments | t | - | - | 10,345 |
| Pavement Concrete for TBM Section | m3 | - | - | 5,880 |

* Ready mix concrete and reinforcing bar quantities do not include those for segments

### 2.4.5 *Spoil Re-use and Disposal*

Quantities of spoil generated in each part of the Project are identified in *Table 2-3*.

For the purpose of the assessment, it has been assumed that all spoil will be exported from the site by road to a disposal site in Şile located approximately 50 km to the north-east of the tunnel entrance on the Asian side. This is a municipal landfill licensed by the Metropolitan Municipality of Istanbul in 2007 for disposal of approximately 4.7 $Mm^3$ of construction waste. Final details of the disposal arrangements will be agreed with the Municipality by the Contractor when the construction programme and methods have been finalised. The arrangements may differ from those outlined here but ATAŞ will ensure that all disposal is carried out at suitable licensed sites and that transport is carefully managed and controlled to minimise its environmental impact.

*Table 2-3* *Spoil Quantities*

| Part | Section | Amount ($m^3$) Soil | Soft Rock | Hard Rock | Total ($m^3$) |
|---|---|---|---|---|---|
| Part-1 | **1-1** | 22,543 | - | - | 22,543 |
| | **1-2** | 13,551 | - | - | 13,551 |
| | **1-3** | 32,702 | - | - | 32,702 |
| | **1-4** | 129,006 | - | - | 129,006 |
| *Sub Total* | | *197,802* | - | - | *197,802* |
| **Part-2** | | 249,348 | 8,189 | 475,057 | 732,594 |
| *Sub Total* | | *249,348* | *8,189* | *475,057* | *732,594* |
| **Part-3** | **3-1** | 30,397 | - | - | 30,397 |
| | **3-2** | 9,431 | - | - | 9,431 |
| | **3-3** | 2,332 | - | - | 2,332 |
| *Sub Total* | | *42,160* | - | - | *42,160* |
| **Total** | | **489,310** | **8,189** | **475,057** | **972,556** |

In practice a proportion of the spoil generated by the Project will be re-used within the Project and there may be opportunities to make use of additional material on other construction projects taking place in the region at the same time as the Project. ATAŞ will seek to maximise the beneficial use of spoil and minimise the need for off-site disposal.

### 2.4.6 *Site drainage arrangements*

All run-off from construction sites will be discharged to the existing road drainage system. Domestic sewage from the workforce will either be collected onsite and transported by tanker for disposal at the local sewage treatment works or discharged direct to sewer.

The need for dewatering of excavations will be reduced by installing retaining walls to 30% below the base of the excavation but some dewatering may still be necessary. Dewatering discharges will be discharged to the sea if of suitable quality or to the sewage system. Permits for any discharges will be obtained from the competent authority and appropriate pre-treatment will be undertaken (such as settling to remove sediments) before any discharge to sea.

### 2.4.7 *Temporary Construction Areas*

Land will be required temporarily during construction to accommodate work taking place alongside the existing road (the construction corridor), and for construction compounds, storage areas (including storage of tunnel lining segments and spoil which will be used elsewhere on the route), the slurry treatment plant, and worker accommodation.

These areas have not yet been defined but it is assumed that existing vacant sites near the route will be used as far as possible, for example there is a large vacant site adjacent to the start of the route at Kazliçesme and there are various parcels of land currently being used for the Marmaray construction which could become available at a time suitable for use on the Project. It is likely that a significant part of the coastal park on the European side will be used for construction, in particular around the toll plaza and tunnel portal.

On the Asian side the main construction site will be located at the Asian ventilation shaft to lower the TBM into position. Based on the feasibility study the construction site will cover the park area around the ventilation shaft as illustrated in Figure 2-20.

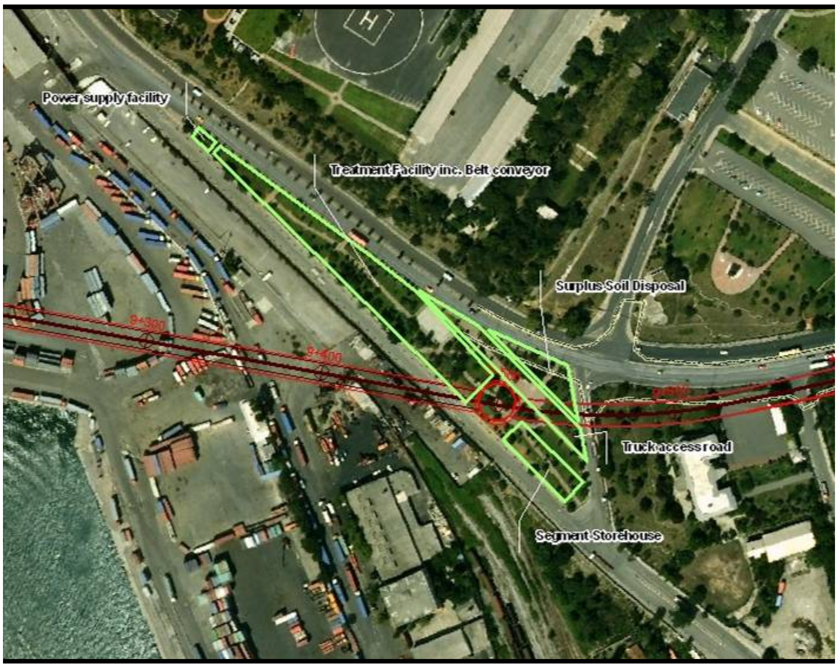



*Figure 2-20 Approximate layout of the construction site at the Asian ventilation shaft*

### 2.4.8 *Construction Workforce*

The construction workforce will be organised in a number of teams undertaking different sections of the work:

- three structure teams (SA, SB (Europe) and SC (Asia));
- three paving teams (PA, PB and PC);
- four tunnelling teams:
    - A – European cut and cover;
    - B – TBM access shaft, TBM installation, TBM tunnelling and TBM removal
    - C – TBM exit shaft;
    - D – Asian cut and cover and NATM sections.

The workforce is estimated to comprise some 1800 personnel over the 43 month construction programme providing a total of approximately 1,700-1,800 person years of employment over the construction period. ATAS proposes that the majority of the workforce will be recruited and live locally. A small camp may be required for temporary accommodation for specialist workers and this will be located at a site outside the city selected taking into account the potential for any adverse impact on the local community or environment.

### 2.4.9 *Traffic and Access Management*

Throughout the approach road works two lanes will be available for traffic in each direction. An additional two lanes to take directional flow in the morning and evening peaks on the European side. A traffic management plan will be developed for the construction of all U-turns and intersections to permit continued traffic movement.

Access will be maintained with all existing land uses, buildings and facilities along the existing approach roads. Where temporary diversions and alternative access arrangements are required; the relevant land use, businesses or residents will be informed well in advance of the alternative access arrangements. This information will also be freely available on the Project website.

## 2.5 OPERATION

### 2.5.1 *Management Team*

As noted in the introduction, once construction of the Project is complete the approach roads will be handed over to the Greater Municipality of Istanbul for their operation and maintenance, but ATAŞ will continue to operate and maintain the tunnel until the end of the BOT Contract period. The widened approach roads will be operated as part of the city road system and will be maintained by the City Roads Administration in the same way as the existing roads.

ATAŞ will be responsible for the tunnel operations with their tunnel management team being based at the Operations Building on the European side. The team will be organised in five divisions: business management, operations, road maintenance, structures maintenance and traffic management plus an Emergency Committee and an Environmental Management Committee. Their responsibilities are outlined in Table 2-4.

*Table 2-4 Organisation and Task Assignment during Operation*

| Team | Task |
|---|---|
| Business Management | Establish annual business plan |
| | Establish short and medium term financial plan |
| | Make, assign and adjust budget |
| | Recruit and manage personnel |
| | Train employees and provide employment benefits |
| | Manage asset, supplies and purchases |
| | Business PR, Company PR and Advertising |
| | Accounting, reporting and audit |
| Operations | Collect tolls and run toll plaza |
| | Receive and handle complaints |
| | Manage toll plaza facilities and toll collectors |
| Traffic Management incl. Road Safety | Operate traffic information centre |
| | Collect traffic data on peripheral roads |
| | Check and maintain ITS |
| | Patrol and provide first aid/life saving |
| | Control operations and illegal vehicles |
| Road Management | Maintain road and pavement |
| | Manage maintenance equipment and material |
| | Manage de-icing and snow removal in winter |
| | Manage and maintain landscaping (structures and planting) |

| **Team** | **Task** |
|---|---|
| Structure Management | Maintain tunnel<br>Maintain mechanical and electrical facilities<br>Maintain structures and supplementary facilities |
| Health and Safety Manager | Overall responsibility for Health & Safety related issues of employees |
| Emergency and Disaster Management Committee | Prevent and respond to accidents caused by natural disaster of rainfall, strong wind or snowfall and take quick initial rehabilitation action<br>Provide first aid/life saving n the event of traffic accident, structure collapse or fire and prevent secondary damage<br>Organize procurement team, repair team and safety contact team with CEO as a chairman |
| Environment and Complaint Handling Manager | Overall responsibility for Environment and Complaint Handling (including operation of Grievance Procedure)<br>Overall responsibility for Community affairs and supervise issues related to affected communities during construction<br>Supervise environmentally and socially relevant activities during operation<br>Carry out regular inspections during operation<br>Supervise contractor activities to ensure that the environmental requirements are met during operation<br>Ensure that corrective measures are taken, if necessary<br>Report to Committee on a regular basis, and to CEO monthly |
| Environment and Complaint Handling Committee | Operate organization and conduct supervision according to environment management plan.<br>Operate management system complying with ISO 14001 (a specific requirement of the BOT Contract).<br>Identify community leaders and responsible civil servants to participate in a local liaison group chaired by the CEO |

### 2.5.2 *Traffic Projections*

Traffic flow through the tunnel is estimated to grow from an average daily flow of 80,000 vehicles in the year of opening (2015) to 130,000 in 2025 when the tunnel reaches its maximum capacity [4]. This equates to a total annual flow of 47 million crossings in 2025. The traffic will comprise 96% cars and the balance minibuses.

[4] Jacobs Consultancy; Istanbul Strait Road Tunnel Crossing: Traffic and Revenue Analysis Final Report; January 2010

### 2.5.3 *Toll Collection*

Tolls will be collected at the rate of US$4 per car and $6 per minibus in each direction. Tolls will be adjusted annually in line with the US Consumer Price Index. The current two-way toll collected eastbound across the Fatih Sultan Mehmet and the Bosphorus Bridges is TL3.75 (ca. $2.50) for both cars and minibuses.

### 2.5.4 *Emergency Planning*

The Emergency and Disaster Management Committee will be responsible for planning measures to prevent and respond to emergencies in the tunnel working under the chairmanship of the CEO. The tunnel will be supervised from the Control Room in the Operations Buildings 24 hours a day by CCTV. Cameras will be located at regular intervals throughout both decks of the tunnel. A patrol team will regularly check the route. The tunnel will be equipped with a PA system with loudspeakers every 50 metres to provide information to passengers about how to escape. There will also be the facility to make emergency announcements through car radios. Exit signs will be placed every 50 metres pointing to the nearest exit route. Lane Control System signs every 400 metres will control traffic and enable lanes to be closed for emergency access and Variable Message Signs at the tunnel entrances will stop vehicles entering the tunnel. Emergency telephones will be located every 250 metres which passengers can use to report any incidents.

The Emergency Management Plan will set out the plans for response to natural disasters such as flood and storm, snow, earthquake and fog. In addition it will address prevention and response to other incidents related to fire, collapse of the tunnel or other structures, explosion, traffic accidents, environmental contamination (e.g. spills), NBC (nuclear, biological, chemical) events and other types of accidents. It will also include plans for repair and re-opening of the tunnel as soon as possible after any incident.

Emergency crews and fire vehicles will be based on both sides of the tunnel to enable fast access depending on the location of the emergency incident. Due to height restrictions, ATAŞ will have its own fire trucks. Ambulances are likely to be provided by private ambulance operators.

The nearest emergency rescue stations are 5 and 6 minutes from the European tunnel entrance and 2 and 6 minutes from the Asian tunnel entrance. The nearest fire stations are 6-9 and 11 minutes from the European side and 6 and 8 minutes from the Asian.

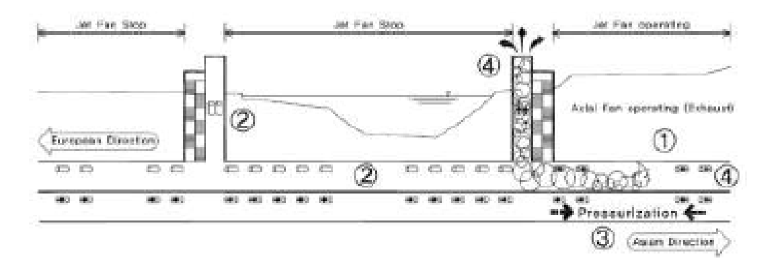
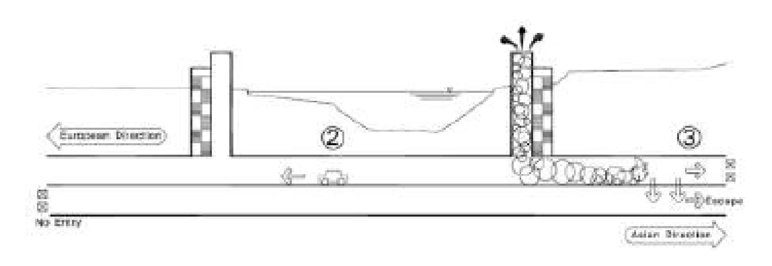
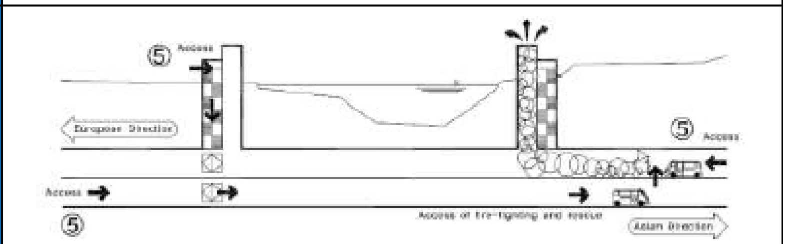
Proposals for incidents of fire, earthquake or tsunami and adverse weather, are outlined below.

*Fire*

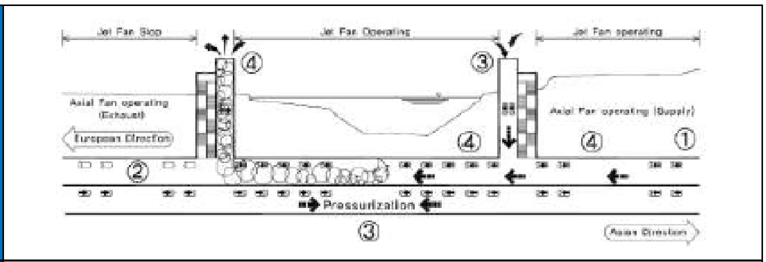
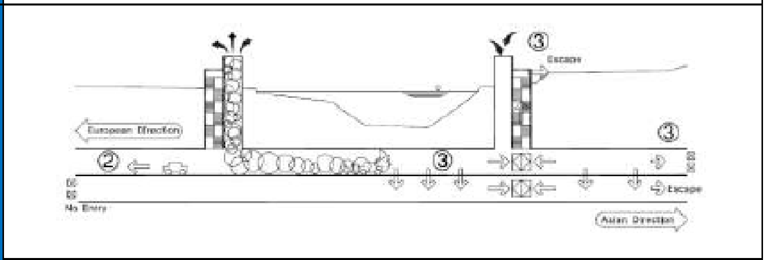
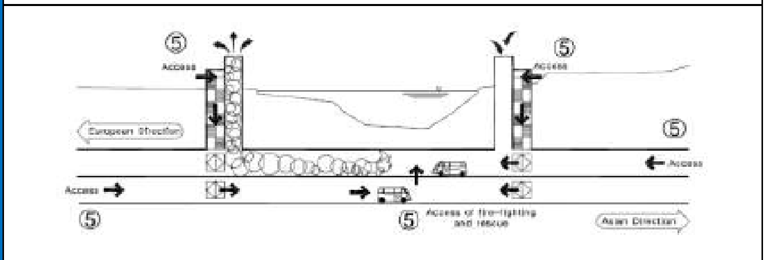
A key issue for public health and safety is the arrangements for evacuation from the tunnel in the event of a fire or explosion.

Three different fire scenarios have been developed depending on the location of the fire: (1) fire at entrance section (between entrance and shaft), (2) fire at middle section (between the shafts) and (3) fire at the exit section (between shaft and exit). The fire may occur in either the upper or lower deck of the tunnel and will be handled in the same way. The three different scenarios are described in the following, including information on ventilation arrangements to protect escaping passenger and rescue teams from smoke.

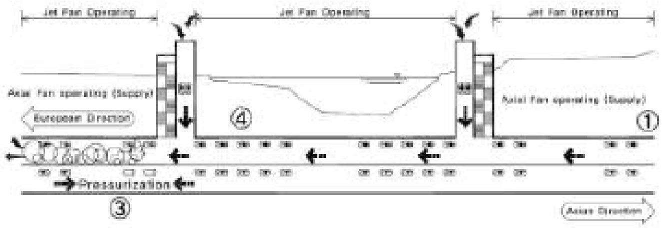
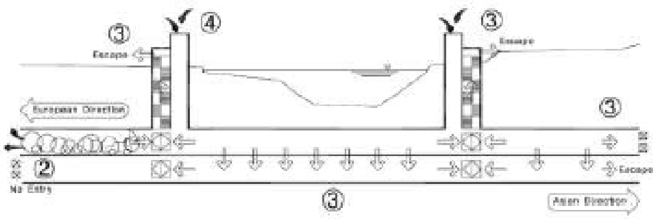
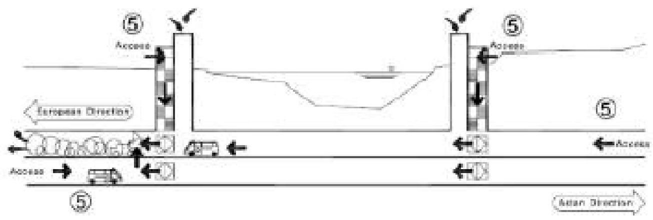
*(1) Fire at entrance section (between entrance and shaft)*

| | |
|---|---|
| **Smoke Exhausting** |  |
| **Evacuation** |  |
| **Rescue** |  |
| **Step ①** | - Fire detection using fire detector, emergency button, CCTV, and etc)<br>- Warning to block in-coming traffic by means of VMS(Variable Message Sign) to tunnel users before the tunnel entrance. |
| **Step ②** | - Jet-fans in fired tunnel stop operating |

*(2) Fire at the middle section (between the shafts)*

| | |
|---|---|
| **Smoke Exhausting** |  |
| **Evacuation** |  |
| **Rescue** |  |
| **Step ①** | - Fire detection using fire detector, emergency button, CCTV, and etc)<br>- Warning to block in-coming traffic by means of VMS(Variable Message Sign) to tunnel users before the tunnel entrance. |
| **Step ②** | - Jet-fans in fired tunnel stop operating<br>- Cars ahead of fire spot keep going forward to escape from tunnel |
| **Step ③** | - Axial fan at entrance side supplies fresh air (pressurization)<br>- Evacuees behind fire spot escape to non-fired tunnel using stairway or shelter tunnel or through nearby ventilation shaft or portals<br>- In non-fired tunnel, pressurization is applied to prevent infiltration of smoke from fired tunnel by operating jet-fans from both side of fire spot in line |
| **Step ④** | - Operate jet-fans at both entrance and middle part of tunnel to generate smoke controlling wind velocity so that passengers in jammed cars at backside the fire spot can be protected from the flow of smoke.<br>- * Start operating jet-fans after confirming that nobody stays ahead of fire spot<br>- * Axial fan at exit side starts smoke exhausting operating |
| **Step ⑤** | - Fire fighting and rescue team access through the entrance of fired tunnel and emergency stairways from non-fired tunnel, or from ventilation shaft |

*(3) fire at the exit section (between shaft and exit)*

| | |
|---|---|
| **Smoke Exhausting** |  |
| **Evacuation** |  |
| **Rescue** |  |
| **Step ①** | - Fire detection using fire detector, emergency button, CCTV, and etc)<br>- Warning to block in-coming traffic by means of VMS(Variable Message Sign) to tunnel users before the tunnel entrance. |
| **Step ②** | - Jet-fans in fired tunnel stop operating<br>- Cars ahead of fire spot keep going forward to escape from tunnel |
| **Step ③** | - Axial fan at entrance side supplies fresh air (pressurization)<br>- Evacuees behind fire spot escape to non-fired tunnel using stairway or shelter tunnel or through nearby ventilation shaft or portals<br>- In non-fired tunnel, pressurization is applied to prevent infiltration of smoke from fired tunnel by operating jet-fans from both side of fire spot in line |
| **Step ④** | - Operate all the jet-fans to generate smoke controlling wind velocity so that passengers in jammed cars in at backside the fire spot can be protected from the flow of smoke and smokes can be exhausted through tunnel exit.<br>- * Start operating jet-fans after confirming that nobody stays ahead of fire spot<br>- * Axial fan on exit side starts supplying fresh air (pressurization) |
| **Step ⑤** | - Fire fighting and rescue team access through the entrance of fired tunnel and emergency stairways from non-fired tunnel, or from ventilation shaft |

*Earthquake and Tsunami*

Studies are also ongoing regarding the protection of the tunnel against flooding in the event of a tsunami and regarding response arrangements in the event of an incident. The tunnel will be designed to provide a suitable standard of protection against tsunami waves. Adverse Weather

The Emergency Plan will identify the roles and responsibilities for response to severe weather events. As part of this system, weather alarm criteria will be determined and weather forecasts will be regularly checked. If heavy rain or storms meeting the alarm criteria are forecast, a decision will be made on whether to call out the emergency crews. Flood/storm status will be monitored and reported. For snow, warning signs will be set-up and snow removal will be organized.

### *2.5.5 Maintenance*

ATAŞ will be responsible for maintenance of the tunnel and all associated structures throughout the BOT Contract period and for handing over the tunnel in good condition at the end of the contract. A regular inspection regime will be established and all maintenance undertaken in a timely manner. Maintenance will involve use of a range of materials similar to those used during construction, and including some hazardous materials. These will meet all legal requirements and be stored in a suitably secure facility in the operations building.

### *2.5.6 Operational Employment*

It is estimated that ATAŞ will employ a permanent workforce of approximately 110 people over the lifetime of the BOT Contract. This will comprise:

- 10 managerial and professional;
- 80 skilled workers;
- 20 unskilled workers.

There will be occasional requirements for additional labour during major maintenance operations.

# 3 ESIA SCOPE

## 3.1 INTRODUCTION

The purpose of scoping is to identify the impacts of the Project which are considered likely to be significant, so that the assessment studies can be planned and focussed on these important issues. This chapter reviews the approach that has been taken to developing the scope and approach to the ESIA studies and presents the resulting overall scope for the assessment.

## 3.2 APPROACH TO SCOPING

An initial phase of work to develop the scope for the Eurasia Tunnel Project ESIA was undertaken immediately following appointment of the ESIA Team in September 2009. The first stage involved identifying the components of the Project and the activities involved in its construction and operation and considering how these could be expected to interact with known environmental and social conditions in the vicinity of the Project. This process was guided by reference to the IFC Performance Standards (1) and to the EU Guidance on EIA Scoping (2).

Given the timeframe, the initial scoping was based mainly on the professional experience of the ESIA Team informed by discussions with the wider project team, review of the outline design of the project, and an overview of the environment of the area expected to be influenced by its construction and operation. Views expressed during consultations held by DLH and ATAŞ during earlier stages of the project were taken into account. Of particular interest were the views expressed during a meeting with local government departments at city and district levels and agencies responsible for cultural heritage interests held in March 2009. This was organised by DLH and a presentation of the proposals for the Project was given by ATAŞ and DLH. The Protective Councils responsible for cultural heritage interests expressed concerns about the potential adverse impact of traffic and vibration from the Project on sites of archaeological and historic importance and about the effect of the Project on the setting of the old city and its skyline.

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(1) International Finance Corporation; Performance Standards on Social & Environmental Sustainability; April 2006. http://www.ifc.org/ifcext/sustainability.nsf/Content/PerformanceStandards

(2) European Commission Guidance on EIA Scoping; June 2001 http://ec.europa.eu/environment/eia/eia-guidelines/g-scoping-full-text.pdf

In accordance with IFC Performance Standard 1: Social and Environmental Assessment and Management Systems, the following matters were considered during scoping:

- impacts should be assessed for all phases of the project cycle including construction, operations, non-routine operations including accidents and emergencies, and decommissioning/closure;
- all elements of the project and all facilities, infrastructure and activities associated with the project, including actions by third parties on which the project depends, should be assessed, whether they are funded as part of the project or by other parties;
- the assessment should address the potential impacts of the project on the social, cultural and economic environment as well as the physical and natural environment, and including impacts on the health and safety of the community and workers;
- cumulative impacts with other existing or planned developments should be addressed;
- the assessment should address positive or beneficial impacts as well as adverse effects, and measures to enhance them should be proposed.

A draft Scoping Report was prepared at the end of October 2009 which:

- described the overall approach to the ESIA studies;
- presented an outline description of the proposals;
- provided an initial qualitative assessment of the potential impacts of the Project and the scope for mitigation;
- identified where impacts were considered likely to be significant; and
- outlined the investigations that were planned to complete the assessment of these impacts;
- outlined the planned approach to consultations during and after the ESIA studies

The Scoping Report was provided to potential Lenders and comments were received on the identification of likely significant impacts and the proposed approach and methods for the assessment.

A short Project Information Document (PID) was also sent to a range of national, provincial and local government with a request for comment. A copy of the PID (in Turkish and English) is presented and the recipients are identified and their responses are summarised in Annex G.

### 3.3 *SCOPING FINDINGS*

The results of scoping are presented in Annex F in the form of a table providing information for each of the following potential impact topics:

- Displacement of Land Uses, Property and People
- Resources and Waste
- Geology, Soils and Contaminated land
- The Water Environment
- Air Quality and Climatic factors
- Noise and Vibration
- Biodiversity and Nature Conservation
- Archaeology and Built Heritage
- Landscape and Visual Impacts
- Socio-Economic Impacts
- Community Health and Safety
- Working Conditions

For each topic information is provided on:

- **Sources of impact**: The potential causes or sources of impact for the topic
- **Potential impacts of significance**: discussion of the types of impact that could occur from construction or operation of the road based on available information on the project and the baseline environment.
- **Mitigation options**: types of mitigation measures that may be considered where significant impacts are identified during the assessment.
- **Proposed assessment approach**: an outline of the work required to complete the assessment and the methods to be used.

Where comments have been made on the Scoping Report and in response to the PID, these have been added and highlighted in ***italics*** to show how they have been addressed in the assessment.

Based on the results presented in Annex F, the following have been identified as the key potential issues arising from the proposals that require thorough consideration during the ESIA and development of appropriate mitigation.

- **Impacts on the historic sites and features of the old city.** Areas of concern include:

- physical damage to historic features such as the city walls;
- damage caused by vibration during construction or from traffic during operation;
- disturbance to the amenity of the old city from increased traffic, air pollution and noise; and
- visual intrusion into the silhouette of the old city;
- impacts on the overall setting and integrity of the UNESCO World Heritage Site including severance of linked features.

- **Risks of discovery of buried archaeology.** Given the historical importance of Istanbul and recent experience with the Metro Marmaray Tunnel Project where a major archaeological discovery was made during construction, there is considerable concern that the Project will lead to damage to as yet unknown buried archaeology in areas where deep excavations are required.
- **Impacts from increased traffic.** The Project will lead to increased traffic flows on the approach roads to the tunnel and it may cause knock-on changes in patterns of traffic movements elsewhere around the city including within the old city. Concern has been expressed about the potential for congestion to occur on existing roads up and downstream of the Project, causing delay and increased cost of travel for travellers and the economy in general. On roads where traffic flows increase there will be increased traffic noise, vibration and air emissions with the potential to impact on the health and welfare of residents and other people. Equally if traffic flows reduce on some roads as traffic is attracted towards the tunnel there may be benefits in those areas. Any increase in traffic flows inside the old city will be of particular concern. The Project will also result in overall changes in the level of road-based transport in the region with implications for Greenhouse Gas Emissions.
- **Disturbance during construction.** The Project will involve a major and lengthy construction programme with the potential to cause noise, dust, traffic and visual intrusion affecting residents, visitors and other sensitive land uses (parks, places of worship, historic sites, natural habitats).
- **Construction pollution.** During construction there will be increased risks of pollution from effluents and run-off and from accidental spills.
- **Construction transport.** Large volumes of material will need to be transported to and from the works during construction, including road materials and surplus spoil. This traffic may cause disruption to other road

users and disturbance to residents and others along the routes used by this traffic.

- **Involuntary resettlement.** Widening of the approach roads will involve land take with impacts on those who currently own, occupy or use the affected areas. Neighbouring land uses (public spaces and businesses) may also be affected by changes in accessibility where users have to cross a widened road to reach their destinations. There may be further land take and disruption to access temporarily during construction and although land will be restored on completion of the works there will be short term impacts on owners, occupiers and users.
- **Management of the construction workforce and worker health and safety.** Major construction projects involve large workforces and if workers are brought in from outside the area, their presence and the need for worker accommodation and services can place strains on local communities and infrastructure. Migrant workers can also introduce increased risks of disease and social disorder. The construction sector also presents significant risks to the health and safety of workers, site visitors and the general public. Particular attention will be required to employment conditions (workers' rights) and provision of suitable accommodation if workers are to be housed in dedicated worker camps.
- **Management of accidents and emergencies.** Road tunnels present higher risks than open roads associated with vehicle accidents, fire and other accidents and emergencies. In this Project these are of particular significance because of the history of seismic activity in the region. The proximity of the coast also raises questions relating to flooding especially in the event of an earthquake.

On the basis of scoping the following topics were identified as not likely to be significant:

- **Impacts of Tunnelling on the Marine Environment.** The Eurasia Tunnel will be a bored tunnel located at least 25 m below the seabed and constructed from access points set back from the coast. The tunnel itself will not therefore have any direct impact on the marine environment.
- **Impacts of Spoil Disposal at Sea.** A possible source of impact during construction would be any marine disposal of tunnelling spoil. The decision has been made that all surplus spoil will be disposed of on land so that this risk will not arise. ATAŞ will seek to minimise the quantitative of spoil requiring disposal by using it on the Project and finding other beneficial uses off-site as far as possible.

- **Risks of Marine Pollution during Construction and Operation:** The proximity of the site to the coast does mean that there will be risks to the marine environment from intentional and accidental discharges and spills during construction and operation. These are addressed together with other risks to the surface water environment in Chapter 7.
- **Impacts on biodiversity.** The location of the European approach road on the edge of the urban centre and in an area of recently reclaimed land means that there are few features of ecological significance in the affected area. Equally on the Asian side, although the corridor is less densely developed, it is almost entirely urban. The only features of possible biodiversity interest are expected to be located along the roadside and in the coastal park and these are likely to be of only local interest as green spaces with the city. The assessment has considered these, including the loss of trees, but impacts on important biodiversity resources including the marine environment and the internationally designated Important Bird Area of the Bosphorus are not predicted to occur. Further information is presented in Chapter 10.
- **Risks to vulnerable and marginalised groups.** International best practice requires particular attention to be given to any groups within society who may be particularly vulnerable to the impact of projects, for example as a result of their economic or social status or their way of life. Istanbul is a modern and cosmopolitan city and no evidence of any particular groups who might be especially vulnerable to the types of impacts generated by this Project has been identified. There have been concerns in recent years about the impact of urban development upon the way of life of Roma people who have traditionally lived in the northwest of the old city. The affected area is distant from the Project and the Project is not predicted to have any impact upon these people.

Based on the information provided in Annexes F and G, certain IFC Performance Standards are expected to be triggered by the project and these are indicated in Table 3-1.

*Table 3-1 Application of IFC Performance Standards*

| **IFC Performance Standard** | **Y/N** | **Comment** |
|---|---|---|
| PS 1: Social and Environmental Impact Assessment | **Y** | The Project must establish a system for management of social and environmental impacts and comply with the requirements relating to ESIA, ESMP and disclosure (as determined by categorisation of the project). |
| PS 2: Labour and Working Conditions | **Y** | The project will be required to comply with international guidance on construction employment and to establish a system for management of Occupational Health and Safety. |
| PS 3: Pollution Prevention and Abatement | **Y** | The ESMP must set out comprehensive plans for pollution prevention and emergency prevention and response during construction and operation. |
| PS 4: Community Safety, Health and Security | **Y** | Plans for protection of community health and safety will be required, including plans to prevent and respond to emergencies affecting road users (vehicles and pedestrians) and the wider community and to protect the community from any adverse effects during construction (noise, dust, security, health). |
| PS 5: Land Acquisition and Involuntary Resettlement | **Y** | Limited displacement of commercial and recreational and residential property is expected to be required. Temporary relocation may also be required. A Resettlement Policy Framework will be required to set out how acquisition and resettlement of existing users will be planned and managed. |
| PS 6: Biodiversity Conservation and Sustainable Natural Resource Management | N | No significant biodiversity resources are expected to be affected by the project. |
| PS 7: Indigenous People | N | There are understood to be no indigenous people in the project area (indigenous people are seen as social groups with identities that are distinct from dominant groups in national societies). |
| PS 8: Cultural Heritage | **Y** | The project has the potential for adverse impacts on archaeology and the built heritage. Detailed plans for mitigation will be required including prior investigation of any high risk areas, modifications to the design if appropriate, and establishment of a watching brief and Chance Finds Procedure during construction. |

### *3.4 Structure of the Assessment Findings*

Based on the results of the scoping work the assessment of impacts has proceeded and the results are presented in the following chapters:

- 4: Land Use and Property;
- 5: Resources and Waste;
- 6: Geology, Soils and Contaminated Land;
- 7: The Water Environment;
- 8: Air Quality and Climatic Factors;
- 9: Noise and Vibration;
- 10: Biodiversity and Nature Conservation;
- 11: Cultural Heritage – archaeology, built heritage and landscape;
- 12: Socio-Economic Impacts;
- 13: Community Health and Safety;
- 14: Working Conditions.

Arrangements for management of environmental and social impacts are outlined in Chapter 15 and details of planned mitigation are presented in the Environmental and Social Management Plan (ESMP) and Resettlement Policy Framework (RPF) in Annex D.

# 4 LAND USE AND PROPERTY

## 4.1 INTRODUCTION

### 4.1.1 *Scope*

This chapter addresses the impacts of the Project on land use and property and the people using these assets, including:

- permanent changes in land use and loss of property and other assets caused by occupation of land by the Project, including occupation and demolition of residential, industrial, commercial, recreational and community uses, including any informal or illegal uses, and consequent displacement of people and economic or other activities;
- temporary changes in land uses caused by short term occupation of land for construction;
- changes in accessibility to existing land uses resulting from the temporary or permanent presence of the Project.

### 4.1.2 *Approach*

The assessment has involved:

1) identification of existing land uses from maps, aerial photographs and field visits; reference has also been made to a survey of land and property to be acquired for the Project undertaken by ATAŞ;
2) identification of planned future land uses from development plans for the city;
3) determining the direct impacts of the project on land use and property by overlaying the land required permanently and temporarily for the Project over the baseline land use information;
4) identifying required mitigation.

Information regarding existing land use along the Project alignment is based on the general parcelling map (scale 1:1,000) of the Istanbul Municipality. [1] ATAŞ has commenced a detailed survey of land that may be required to be expropriated and the initial results of this have been used to inform the assessment. Aerial photographs taken in 2005 were also used. Existing land uses have been confirmed by various field visits in September and October 2009.

The detailed land use results have been mapped over a 400 m corridor centred on the centre line of the Project alignment. More general land use information is provided outside this 400 m corridor, up to 1 km corridor from the centre line of the Project alignment.

## 4.2 BASELINE

The results of the land use survey are presented in a series of maps overlain on aerial photographs. These are presented in Annex I. It should be noted that the mapped information and aerial photography do not always match as land uses have changed between 2005 (the date of the aerial photography) and 2009.

### 4.2.1 *European Side*

Detailed land use on the European side is shown in the Land Use Maps in Annex I, Sheets 1–3 and an overview is presented in Figure 4-1. Key features along each side of the road are described below. Distances are identified as metres from the centre line of the widened road (distances from the edge of the widened road will be about 20 m less), and as "chainages", that is distances from the start, (*eg* km1+600 is 1 km and 600m (1.6 km) from the start).

[1] It should be noted that this survey has identified a number of holders of title to land which was taken for construction of Kennedy Caddesi, but where title has never been formally transferred. These areas are excluded from the assessment as their use was changed and the owners and occupiers displaced many years ago. The land is considered to be existing road land.


*Figure 4-1 Land Use Overview for the European Side*

The European approach road starts with a new underpass at Kazliçesme on the existing Kennedy Caddesi, approximately 12 km east of Atatürk Havaalanı Airport. The alignment proceeds along the existing coastal road to the Bosphorus, where it enters the tunnel just east of Kumkapi.

At Kazliçesme the first 500 m of the route up to Genç Osman Caddesi is surrounded by open space and park extending 100 m to the north and 200 m to the south. This is the beginning of the coastal park which occupies most of the foreshore alongside the European approach road [Photo 1]. This is principally land reclaimed from the sea in the past 60 years. The foreshore land and the existing road corridor are all held by the Treasury and the Municipality.

To the north of the road is a large vacant area within which are a mosque and a church lying between 100 and 200 m from the road. There is a public meeting area in the park to the north and a children's playground about 50 m south of the underpass. There is a small car park at the location of the proposed Kazliçesme underpass.

At Genç Osman Caddesi the coastal park narrows before widening out into the green area containing the Marble Tower (Mermerkule), shown in Photo 2.

**Photo 1:** Coastal park

**Photo 2:** Marble Tower

At this point the new approach road will split with the eastbound carriageway running south of the Marble Tower and the westbound to the north. On or close to the line of the proposed southern carriageway is a sports area, a playground and a small car park. A substantial section of the Theodosian Land Walls runs north alongside Genç Osman Caddesi and to the east of this is a large vacant site which was previously a gas works. This continues north of the route to km 1+600, separated from it by a narrow green strip containing a grass sports field. The coastal park continues to the south with two hard sports courts and two playgrounds.

At km1+300 the Kocamustafapasa Fishing Harbour is located to the south. The railway approaches from the north and then continues to run north of the route along the rest of its length. A large area of urban housing mixed with other uses starts here and continues along the north side of the European approach to km2+700 [Photos 3 and 4].

The reclaimed land on which Kennedy Caddesi and the coastal park are located lies at a lower level than the town and is separated from it by the line of the old sea walls. The railway and land uses to the north are at a higher level all the way along the approach road. In some places sections of the city sea walls remain [Photo 3] with more modern retaining walls elsewhere [Photo 4].

**Photo 3:** Residential areas

**Photo 4:** Residential areas

At km1+700 there is a standing section of the City Sea Walls about 50 m north of the route and next to it a church. A green corridor about 50 m deep runs both north and south of the road and contains three playgrounds and two car parks all within the location of the proposed Kocamustafapasa underpass.

There are several mosques, churches and schools within 200 m of the route in this area, as well as Kocamustafapasa railway station and the historical Aga Turkish baths.

At El Yernes Caddesi (km2+700) Kennedy Caddesi crosses north of the City Sea Walls and there is a section of about 150 m of the walls standing south of the route next to a small harbour and parking area. To the north are the Istanbul Samatya Education and Research Hospital and the Cerahpasa Medical Faculty and Hospital.

The coastal park continues to the south, with one small green area to the north. There are playgrounds on both sides of the road and a mosque about 120 m to the north.

The Yenikapi wastewater treatment plant runs north of the road from km3+200 to 3+900 including the construction site for a new wastewater tunnel. North of this is a concrete plant for a new subway station and then the railway. To the south the park continues and includes the modern Turkmenistan Monument [Photo 5], a piece of public art [Photo 6], and a parking area, all within the footprint of the proposed Samatya underpasses. Immediately to the south are further sports pitches and there is a third public monument [Photo 7] to the east on the edge of the road line.

**Photo 5:** Turkmenistan monument

**Photo 6:** Public art

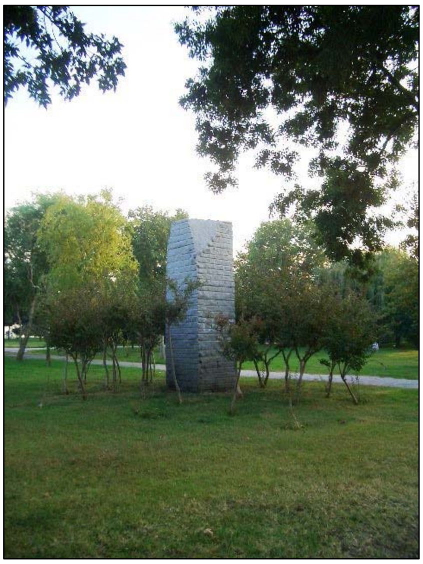

**Photo 7:** Public monument/statue
ferry

**Photo 8:** Bus stops at Yenikapi

From km3+900 to 4+200 a residential area lies north of the route separated from it by a storage and industrial area. A construction storage site for the Marmaray tunnel lies to the south. Next to this is the start of the Yenikapi port and ferry terminal which occupies the shoreline from km4+000 to 5+100.

There are several local bus stops [Photo 8] to the north of the Ferry Terminal, providing onward travel connections for ferry passengers, and located in land which will be taken for the new Yenikapi junction.

Beyond Mustafa Kemal Caddesi at km4+200, the railway returns alongside the road and separates it from a large mixed residential area which continues to the end of the European approach. The Balikhan Mosque is just outside the road line to the south at km4+750 and a school and two churches lie between 100 and 200m to the north.

East of Yenikapi is the Central Fish Market, a wholesale market which the Istanbul Metropolitan Municipality is planning to move to Beylikdüzü District, in the west of Istanbul, as part of the approved city development implementation plan[1]. The timing for the move is yet to be finalised so the wholesale market may still be in place during construction of the European approach.

Next to the Central Fish Market (at km5+100) is Kumkapi Fish Market [Photo 9] and a small fishing harbour. The market is a popular and well-used area of open fish stalls and small cafés facing the road and several larger restaurants facing the sea. The land is owned by the Treasury and the stalls and restaurants operate there with the permission of the Municipality authorized by the Treasury. The Municipality is planning to relocate these premises at the same time as the Central Market but, as with the wholesale market, they may still be present during construction of the Project.

At this point the alignment diverges from Kennedy Caddesi towards the shore to form the toll plaza and then descend into the tunnel. The toll plaza, Operations Building and tunnel entrance will be located in the coastal park, including an area of sports pitches [Photo 10] and parking. The cut and cover tunnel runs south of a restaurant, a petrol station and a bus parking area on Kennedy Caddesi and continues beneath the coastal park until it reaches the ventilation shaft.

[1] The decision to relocate the Central Fish Market is not related to the Project but is planned by the municipality because the current market area and facilities are considered to be insufficient. The new market will be located on a larger site in a convenient location near the airport and will be designed to modern and international standards.

**Photo 9:** Kumkapi Fish Market

**Photo 10:** Sports facilities

The ventilation shaft and adjacent electrical building will be located in the area of coastal park just west of the tall watchtower next to the small boat harbour at the end of the promontory.

### 4.2.2 *Asian Side*

Detailed land use on the Asian side is shown on Land Use Maps in Annex I Sheets 4-6 and in overview in Figure 4-2. Key features along each side of the road are described below.

The Asian side of the Project starts at km8+900 where the TBM tunnel crosses under Haydarpasa Port [Photo 11], the largest container port in the Marmara Region and Turkey's third port after Mersin and Izmir.

**Photo 11:** Haydarpasa Port

**Photo 12:** D100 road

The ventilation shaft will be located at km9+500 in a triangle of green land surrounded by roads and next to the office of DLH Marmaray Regional Directorate and a construction site.  There is a small café on the western side located at a bus stop.

The tunnel then joins the line of the D100 road [Photo 12]. Land uses at the surface include the Selimiye Barracks and the Selimiye Agricultural Vocational School to the north and the Marmara University and the Haydarpasa Numune Hospital to the south. The approach continues under the existing Eyüp Aksoy Interchange which will be extended as part of the Project. A plant/tree market [Photo 13] operates on land owned by the Municipality south-east of the existing interchange and east of this is a construction site for the Marmaray Metro Project. To the north is Karacaahmet Cemetery.

The route comes to the surface at km10+700 and then follows the line of the D100. There is a truck parking area, petrol station and a small residential area to the north of the tunnel entrance and a petrol station, parking and a construction site to the south.

**Photo 13:** Plant/tree market


**Photo 14:** D100

At the proposed Kosoyolu Interchange (km11+100), the Medipol Hospital and a car sales and maintenance area are located to the north and a construction site and car showroom to the south.   There is a café within the hospital carpark next to the slip road.

The alignment then passes a residential area which runs north of the D100 [Photo 14] as far as the Uzuncayir Interchange at km12+700. There is a small a vacant site between km12+350 to 12+550. Residential land runs also to the south as far as km12+300 then Dogus University [Photo 15] and a primary school are followed by a series of mixed-use commercial units.

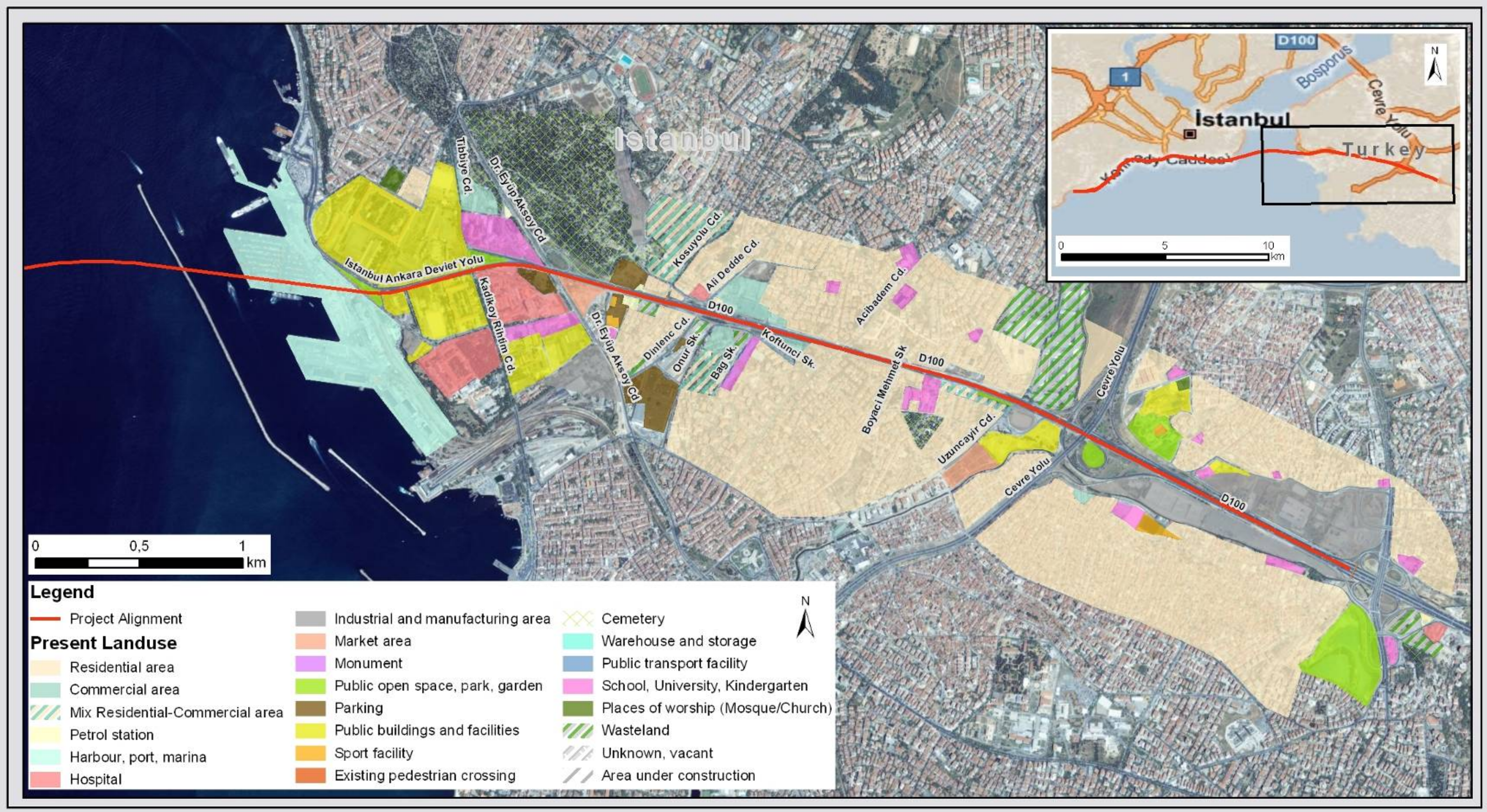


*Figure 4-2 Land Use Overview for the Asian Side*

Within the Uzuncayir Interchange (km12+750) and south of the road there is concrete mixing area used for the Marmaray Project under the ownership of the local office of the Ministry of Environment and Forestry. This area used to be occupied by football pitches run by the Incirlibostan Sports Club until the concrete plant was set up and there is a building belonging to the club within the site. North of the D100 is a large, modern shopping area.

The Project passes through the existing Cevreyolu Interchange at km13+100 [Photo 16] and continues along the D100. There are further construction sites for the Marmaray Project north of the road within the Cevreyolu Interchange.

**Photo 15:** Dogus University

**Photo 16:** Cevreyolu Interchange

North east of the interchange is temporary housing for Marmaray Project workers followed by the Sampiyon Sports Complex and a small residential area and school. To the south are various modern buildings which are part of the State Supply Office and next to this a large container storage terminal (Haydarpasa Liman Isl Konteyner) runs from km13+800 to 14+500. To the north is a large office area including more facilities of the State Supply Office and other government offices (Devlet Malzeme Ofisi Basim Muessesesi).

The Project ends just before the existing Göztepe Interchange. A school and mosque are located alongside the slip roads in a mixed residential and business area to the south and there is a further Marmaray construction site to the north. There is a municipal road maintenance facility south of the road which contains a small road salt warehouse.

### 4.2.3 *Future Development along the Project Alignment*

The Istanbul Transportation Master Plan (ITMP) [1] foresees the Eurasia Tunnel as part of its base case for the future to deal with increasing population, car ownership and demand for travel. The planned changes at the wholesale fish market and Kumkapi market are described above. No other changes in land use are foreseen for the alignment in the development plan for the city.

## 4.3 *PERMANENT IMPACTS ON LAND USE, PROPERTY AND PEOPLE*

This section identifies the impacts of the project in terms of permanent displacement of existing land uses (4.3.1) and demolition of buildings (4.3.2), and the impacts of this on owners and occupiers and the uses they make of these assets. The scope for mitigation of these impacts is discussed in Section 4.3.3.

### 4.3.1 *Permanent Land Take*

The Project will permanently occupy a total area of approximately 67 ha of which 51 ha is within the existing road corridor. The additional land required by the Project is approximately 16 ha. The land uses affected within this area are described in Table 4-1 and the total land take by type of use is summarised in Table 4-2.

***Table 4-1 Summary of Permanent Land Use Change***

| **Land use** | **Approx. Land take (ha)** | **% of total** |
|---|---|---|
| Public open space, parks and gardens and sports facilities | 9.41 | 59% |
| Markets, commercial, industrial, public utilities and storage land | 3.72 | 23% |
| Harbour, port, marina and parking | 2.45 | 15% |
| Residential gardens | 0.28 | 2% |
| Mosque garden and cemetery | 0.12 | 1% |
| **TOTAL** | **15.97** | **100%** |

(1) Japan International Cooperation Agency/IMM; *The Study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in the Republic of Turkey*; 2008

In addition to the 16 ha of land required within the road boundary, there may be a requirement for some additional land to be acquired where the land take within the Project boundary forms part of a larger unit which may not remain viable after part of the area is taken. In these cases it may be necessary for the Project to acquire the entire unit resulting in displacement of a larger area of land use. Where this could be required this is noted in Table 4-2. The area of land that could be affected cannot be quantified at this stage as it will depend on negotiations with the affected parties, but the land will be available to return to other beneficial uses following construction and its loss is therefore not considered to be a permanent impact.

*Table 4-2 Permanent Land Take*

| Chainage | Current Land use | Impact | Land Take (ha ) |
|---|---|---|---|
| **European Side** | | | |
| 0+000 – 6+250 | Coastal park | *Direct land take*: A corridor of land from the coastal park areas to the south and north of the existing road will be taken to accommodate road widening, junctions, lay-bys, car parking, bus stops along the length of the approach road and for the Operations Building, toll plaza, ventilation shaft and electrical building. Part of the green area around the Marble Tower will be located between the east and west bound carriageways.<br><br>7 to 10 children's playground areas located on or very close to the widened road corridor, mostly in western half are likely to be displaced. Three modern monuments located in the park opposite Yenikapi waste water treatment works my need to be moved. | 7.7 |
| 2+200 - 2+300 | Parking | Approximately 20% of a private car park north west of the road will be taken for Kocamustafapasa underpass. | 0.05 |
| 3+150 – 3+850 | Storage | A strip will be taken from the southern boundary of the Yenikapi wastewater channel construction area for the northern ramps of the Samatya Underpasses. | 0.17 |
| 3+300 | Parking | An area of car parking will be taken for the southern ramps of the Samatya U-Turns. | 0.18 |
| 3+900 – 4+100 | Open space | A narrow strip of green land on the southern edge of a series of commercial premises will be occupied. | 0.10 |

| Chainage | Current Land use | Impact | Land Take (ha ) |
|---|---|---|---|
| 4+000 – 4+700 | Harbour, port, marina | The widened road and Yenikapi junction will take land currently used for access roads and car parking in the Yenikapi Ferry Terminal and a large area of bus stops. | 1.48 |
| 4+750 | Mosque | A strip of land forming part of the grounds of the Balikhan Mosque will be taken by the widened road. The building will not be affected and access will be maintained. | 0.06 |
| 4+800 – 4+950 | Central Fish Market | The widened road will occupy a strip of land at the entrance to the Central Fish Market. This may require access arrangements to be altered until such time as the market is moved by the Municipality. | 0.18 |
| 5+100 – 5+250 | Kumkapi Fish Market | Widening the road will occupy a small part of the Kumkapi Fish Market taking the northeastern corner of the site which is currently occupied by one stall, two cafés and part (about 20% of the floor area) of one restaurant. The Municipality plans to relocate these premises at the same time as the Wholesale Market. but they may still be present during construction. If so, the stall and cafés will need to close but the restaurant could remain in operation with reduced size. The market buildings extend beyond the site boundary and the remaining premises may be affected by reduced access and amenity during construction. Alternative access provisions will be required if the market remains in operation. | 0.08 |
| 5+275 | Open space | Approximately half of a small area of green space to the east of Kumkapi Fish Market will be taken as the route widens into the toll plaza. | 0.11 |
| 5+300 – 5+425 | Sports facilities | This sports facility (4 hard courts) will be taken for the project. About ¾ of the site is within the Project boundary but the whole facility will be lost and is therefore included as a land use impact. It should be noted that the facility was in a very poor state of repair and appeared not to be in use in October 2009. | 0.63 |
| 5+425 – 5+525 | Parking | This car parking area will be removed for the construction of the toll plaza. | 0.16 |

| Chainage | Current Land use | Impact | Land Take (ha ) |
|---|---|---|---|
| 5+800 | Petrol station and shop | A site occupied by a petrol station (currently not in use) and shop may be used for construction of the cut and cover tunnel. They may be returned to another use on completion of construction but have been taken to be permanent losses. | 0.15 |
| **European Sub-Total** | | | 11.39 |
| **Asian Side** | | | |
| 9+500 | Open space | A triangle of open space at a road intersection will be taken for the ventilation shaft and electrical building. | 0.71 |
| 10+000 | Open Space | A strip of land will be required to widen a crossing above the tunnel. | 0.07 |
| 10+400 – 10+500 | Cemetery | A small strip of land will be required from the south-western corner of the Karacaahmet Cemetery for one of new interchange lanes of the Eyüp Aksoy Interchange. | 0.06 |
| 10+250 - 10+400 | Parking | Land currently used for parking will be required for a new interchange lane at Eyüp Aksoy Interchange. | 0.53 |
| 10+450 – 10+700 | Market area | A significant part of the plant / tree market will be displaced by the remodelled Eyüp Aksoy Interchange. | 1.30 |
| 10+700 – 10+900 | Parking and petrol station | A small strip of land from a parking area and a petrol station will be required. No buildings will be affected. | 0.06 |
| 11+500 – 11+700 | Commercial area | A strip of open space and landscaping will be taken from a Renault car sales area and a pharmaceutical plant. | 0.24 |

| Chainage | Current Land use | Impact | Land Take (ha ) |
|---|---|---|---|
| 11+700 - 12+700 | Residential | Parts of some residential plots will taken to provide land for a junction east of Kosuyolu interchange. The full plots may need to be expropriated and some of the buildings taken. | 0.18 |
| 12+550 – 12+700 | Open Space | Part of this small strip of open space will be taken for the slip road to Uzuncayir Caddesi. | 0.16 |
| 12+750 – 12+850 | Industrial Area and Sports Club building | This area is in temporary use as a concrete plant for the Marmaray Project but was previously sports pitches operated by the Incirlibostan Sports Club. If there is an existing commitment from the Marmaray Project to reinstate the sports pitches or provide an alternative site this will be honoured once their use of the site is complete. Otherwise the loss of the sports pitches will not be considered to be an impact of the Project. | 1.15 |
| 14+125 | Commercial area | Loss of a small area of land from the Container Terminal and a strip at the end of the project road to enter. | 0.03 |
| 14+500 | Mosque, residential and mixed use | Works to a slip road at Göztepe currently require a land from premises to the south of the road. This could require expropriation of the full plots including buildings but it may possible to avoid this by amendments to the detailed alignment design. | 0.10 |
| **Asian Sub Total** | | | **4.58** |
| **Grand Total** | | | **15.97** |

Temporary land take for the purposes of construction is discussed in Section 4.5.

The most significant permanent impact on land use and on the people using land will be the loss of public open space, primarily along the European shore. The coastal park runs for much of the length of the route (about 5.4 km) and varies in width from less than 50 metres to about 300 metres (including green spaces north of the existing road). It is laid out with lawns, planted areas and trees, and an extensive network of paths. It also contains children's play areas and recreational areas, public meeting areas, seating and related facilities.

The park is intensively used for both formal and informal recreation including shoreline fishing, walking, exercising and cycling and provides a valuable resource for the city. There are several sports facilities one of which, east of Kumkapi and comprising four pitches (hard courts), will be displaced by the road. Three other sports areas at the western end of the route (south of the Marble Tower, west of the Kocamustafapasa Fishing Harbour and south of the Samatya U-Turn) may also be affected by partial loss.

Between seven and ten children's play areas are located in the park either within or very close to the widened road and may be displaced. Three memorial sculptures in the coastal park may also need to be moved as a result of the project.

In total it is estimated that the coastal park will lose about 20% its area. In the absence of mitigation, the loss of recreational space, sports facilities and other amenities is considered to be a negative impact of major significance given the importance of the open space and recreational facilities in the densely developed city.

The project will also acquire land from of Yenikapi Ferry Terminal. However, this will not impact on the operational capacity of the port and once the project is operational, improved access from the ferry terminal to the road, bus and rail networks will be provided. No significant impact is expected.

Land will be lost close to the Balikhan Mosque but the building will not be affected and access will be maintained during construction and operation. No significant impact on the Mosque and its users is expected.

The transfer of the current concrete plant site at Uzuncayir from the Marmaray Project to this project will lead to an extension in the use of the site. As noted in Table 4-2, if there is an existing commitment from the Marmaray Project to reinstate the sports pitches that previously occupied the site or to provide an alternative site this will be honoured once the Project's use of the site is complete. In this case there will be no impact. Otherwise the loss of the sports pitches will not be considered to be an impact of the Project.

Car parking and bus facilities along the route used by people to access the coastal park and facilities along Kenney Caddesi, including the ferry terminal, will be displaced, but replacement facilities are provided for within the design of the project. No significant impact is expected.

### 4.3.2 *Acquisition of Buildings and Impact on Residents and other Users*

The current boundaries of the land take for the Project include all or at least part of 18 land parcels containing buildings. Some are wholly or partly within the Project footprint and will need to be demolished. Others lie within plots where some of the land will need to be acquired. This may mean that the whole plot and the building(s) within it will subject to acquisition, depending on the outcome of negotiations with the landowner. The affected buildings are identified in Table 4-3 and are shown in Annex I. In practice not all may actually be taken, but the maximum extent of potential acquisition is identified in Table 4-3 as a worst case. Building impacts are classified as follows:

- **Direct**: building is wholly or partially within the new road boundary and will need to be demolished;
- **Indirect**: building is outside the new road boundary but very close to the new road (or will have its access greatly reduced) so the building may need to be acquired and may be demolished if it cannot be re-used for its original or some other purpose; and
- **Potential**: buildings which are outside the new road boundary but may be acquired because of acquisition of land within the plot.

*Table 4-3 Buildings to be Expropriated*

| Chainage | Number (Annex I) | Building type/use | No. of floors | Approx. No. of residents | Affected Parties | Impact |
|---|---|---|---|---|---|---|
| **European** | | | | | | |
| 4+500 | 1 | Bus shelters at Yenikapi | 1 | 0 | Public | Direct |
| 5+050 | 6 | Informal restaurant (disused) | 1 | 0 | Private | Direct |

| Chainage | Number (Annex I) | Building type/use | No. of floors | Approx. No. of residents | Affected Parties | Impact |
|---|---|---|---|---|---|---|
| 5+200 | 7 | Kumkapi Fishmarket: group of buildings housing fish stalls and restaurant. One stall, two cafes and part of a restaurant will be demolished and the viability of the others may be affected during construction. | 1 | 0 | Private operators on public land | Direct and Indirect |
| 5+800 | 8-9 | Disused petrol station and market/restaurant | 2 | 0 | Private | Potential |
| **Asian** | | | | | | |
| 9+475 | 10 | Road-side café adjacent to bus stop | 1 | 0 | Private operator on public land | Indirect |
| 10+490–10+580 | 11-12 | Plant/tree market: 2 buildings | 2 | 0 | Private operators on public land | Direct |
| 11+030 | 13 | Commercial and residential | 6 | 40 | Private | Indirect |
| 11+100 | 14 | Café within car park of the Medipol Hospital | 1 | 0 | Public | Direct |
| 12+750 | 15 | Incirlibostan Sports Club building | 1 | 0 | Public | Indirect |
| 14+400 | 16 | Industrial and residential building | 3 | 8 | Private | Potential |
| 14+420 | 17 | Commercial and residential building | 3 | 8 | Private | Potential |
| 14+450 | 18 | Industrial and residential building | 3 | 8 | Private | Potential |
| 14+470 | 19 | Aziz Bayraktar Mosque | 3 | 0 | Public | Potential |
| 14+500 | 20 | Commercial | 5 | 0 | Private | Potential |
| 14+500 | 21 | Municipal warehouse (road salt store) | 1 | 0 | Public | Direct |
| 14+520 | 22 | Commercial building | 4 | 0 | Private | Potential |
| | | **Total** | | **64** | | |

Of the buildings or groups of buildings wholly or partially located within the Project boundary that may need to be demolished as a consequence of the

Project: the losses of the bus shelters at Yenikapi, the disused restaurant at km5+050, two buildings in the plant/tree market on Municipal land at Eyüp Aksoy Interchange, the sports club building at Uzuncayir interchange and the road salt warehouse at Goztepe are not considered to constitute significant impacts for land use or users. All are on public premises and will be relocated if needed by the relevant authority, following transfer of the land to DLH for the Project.

Loss of the fish stall, cafés and part of the restaurant at Kumkapi Fish Market, possible impacts on access and amenity of the remaining premises at Kumkapi, and possible removal of two cafés on the Asian side, would each have an impact on the operators and customers of these facilities.

The café at the Haydarpasa bus stop is likely to be closed for the construction period and possibly for the long term as the vent shaft will be located on the plot. It can be easily relocated to the new bus stop location. The café in the Medipol Hospital carpark may also need to be moved but it should be able to be relocated within the carpark. The impacts on the two cafes are therefore considered to be negligible as both can easily be re-established on alternative public land to provide continued operation if needed.

The impact at Kumkapi Fish Market could be more significant as this is an attractive and well-used facility within the coastal park. The market will be relocated by the Municipality when the neighbouring wholesale market is moved. In the meantime loss of some of the stalls and cafés and reduction in size of one restaurant would have a minor impact, but if operation of the whole facility becomes less attractive as a result of construction of the new road, this would be a major impact. It is not possible to say conclusively whether this will be the case as it will depend on the response of operators and customers, but if it is, mitigation of the impact by DLH will be required.

The project may also indirectly result in the acquisition and loss of use of a number of additional buildings outside the project footprint. These include a number of residential and mixed-use buildings, one by a slip road near the Medipol Hospital (chainage km11+030), and three next to a slip road south of Göztepe Interchange (chainage 14+400 to 14+520) which will lose part of their land and may, as a result, need to be acquired (depending on the result of negotiations with owners). It is very likely that this landtake can be avoided by minor changes to the design as discussed in Section 4.3.3, but if it cannot be avoided and if acquisition by agreement or expropriation is required, this would constitute a negative impact of moderate significance as it will result in the potential displacement of 40 residents at the first building and a further 24 in the remainder. The majority if not all are understood to be tenants in the properties. This impact is identified as a potential 'worst case' outcome but as noted above it is likely that it can be avoided.

The Aziz Bayraktar Mosque is also located alongside the slip road at Göztepe and could be affected in the same way. Its loss would constitute a major impact in the 'worst case' but as discussed in Section 4.3.3 it should also be possible to avoid this by minor changes to the design.

There are three further commercial and industrial buildings at Göztepe which may be affected in the same way and if acquisition is required this would constitute a minor impact for the businesses and their employees.

### *4.3.3 Mitigation of Permanent Impacts on Land Use, Property and People*

In the 'worst case', the assessment has identified the potential for impacts of major or moderate significance on public open space in the coastal park (including playgrounds, sports and recreation areas and monuments), the Kumkapi Fish Market, the Aziz Bayraktar Mosque at Goztepe, and a number of residential and commercial tenants whose apartments may need to will be acquired for the Project.

The approach to mitigation of these worst case impacts will involve three main strands:

- refinement of the design to minimise impact (Section 4.3.3.1);
- acquisition and remedy or relocation in accordance with international standards (Section 4.3.3.2); and
- improvement of remaining public areas and reinstatement of facilities (Section 4.3.3.3).

#### *4.3.3.1 Mitigation by Design*

ATAŞ will first seek to minimise the area of land take, expropriation and demolition required for the Project during the next stage of more detailed design. The ESIA is, as noted in Chapter 1, largely based on the outline tender design prepared by DLH. As the design is developed it is expected that opportunities will arise to 'fine–tune' the alignment, in particular of slip roads where most of the impacts arise, to reduce the need to acquire land outside the existing road corridor, to reduce the need to acquire land which would involve demolition or expropriation of buildings, and to reduce the need to acquire larger parcels of land than is absolutely necessary for the Project.

In all cases where residential property might need to be acquired and at the Aziz Bayraktar Mosque and the Medipol Hospital café , small changes to the slip road alignments have been identified which would avoid the impact. This would also avoid any impact on the commercial and industrial buildings at Göztepe. ATAŞ is committed to investigating these further during the detailed design of the Project and if successful there should be no requirement for acquisition of any residential or other sensitive property. It is also expected that the design of the Eyüp Aksoy Interchange can be revised to reduce the land needed from the plant/tree market run by the Municipality to a small area.

#### 4.3.3.2 *Acquisition and Compensation*

Where acquisition of land or other assets cannot be avoided (after detailed design), the responsibility for this will rest with DLH who will conduct the process in accordance with Turkish law.

This will be governed by the *Land Expropriation Law* (Law No: 2942, amended in 2001 by Law No: 4650). Private owners with registered title to land or property to be expropriated will be entitled to full monetary compensation for their loss of land and other fixed assets or can be provided with an alternative property or land by agreement. Compensation is calculated by a Valuation Commission and an Expert Council in accordance with specified criteria and information. Provisions are also made for partial expropriation. Where an occupier of land is not the owner or where the land is ownerless, the occupier is entitled to a smaller level of compensation for their loss if they have been in occupation for at least three fiscal years. There is a right of recourse to appeal if the affected party disagrees with the proposed compensation.

Where public land is to be acquired it will be transferred between state agencies under the terms of the law governing expropriation. The public owner from whom the land will be transferred would be responsible for making arrangements for any formal or informal occupiers of that land under Turkish law.

There are some differences between Turkish law and international standards for involuntary expropriation and these are summarised in Annex D-2. ATAŞ will agree with DLH and other involved parties including the Treasury and the Municipality, a process that ensures full compliance with lenders' requirements, including EBRD PR5. The requirements for compliance with lenders' requirements will be detailed in a Resettlement Action Plan to be developed and approved prior to commencement of expropriation. The acceptability to lenders of this Resettlement Action Plan (RAP) will be made a condition of effectiveness to lenders' further involvement.

To assist in this a Resettlement Policy Framework has been developed which identifies how expropriation should be pursued. This is presented alongside the ESMP in Annex D (Part D-2).

The Resettlement Policy Framework provides for:

- expropriation to be avoided where possible through development of the design (see Section 4.3.3.1);
- establishment of a cut-off date for eligibility for compensation which will be the date of the census and survey;
- early and ongoing consultation with potentially affected parties and opportunity for participation in planning and implementation;
- seeking voluntary agreement in preference to involuntary expropriation;
- providing financial compensation or compensation in kind to remedy the losses of both owner-occupiers and tenants;
- providing for compensation of informal and illegal occupiers of land and users of assets;
- extending the rights to compensation of non-owners to cover those who occupied or used land up to the date of signature of the BOT contract;
- providing other support to displaced persons to assist them in restoring their livelihoods and standards of living to pre-displacement levels or levels prevailing prior to the beginning of the Project in real terms, and improving them where possible;
- establishing a fair and impartial grievance process accessible to all ( for further details see Section 15.6) and ensuring that all parties are aware of this process and of their rights to recourse to the Courts if the grievance process does not resolve the problem;
- monitoring and evaluating the process to ensure it is satisfactorily completed.

Specific measures that are proposed for the properties identified as potentially experiencing significant impact from land acquisition are noted below:

- if relocation of residential or business tenants as a consequence of the Project cannot be avoided by refinement of the design, ATAŞ will supplement the government-led process of expropriation, if necessary, with advice and support to restore the livelihoods of tenants who have difficulty in relocating which will be identified and described in the Resettlement Action Plan;

- ATAŞ will work with the relevant authorities to ensure appropriate relocation is achieved for the mosque if its relocation cannot be avoided;

- at Kumkapi Fish Market, ATAŞ, will work with DLH and the Municipality, to identify a suitable remedy for losses incurred by any operators within the market, either during construction or in the long term, which will be described in the Resettlement Action Plan.

Proposals for mitigation of impacts on the park are described below.

#### 4.3.3.3 *Improvement and Reinstatement*

In the coastal park, ATAŞ will seek to compensate for the loss of about a fifth of the park area by carrying out improvements to the remainder of the park after construction, including replacing all the playgrounds and sports facilities lost, relocating all memorials within the park, replacing all landscaping and trees and providing additional landscaping. Measures that will be considered, in consultation with the relevant authorities, will include:

- replacing playground equipment and other park facilities (seating etc) which is broken or in poor condition;

- increasing the number and range of facilities available;

- relocating all memorials to be removed as a result of the project in prominent and public locations as close to their original location in the park and providing new information signs (where necessary);

- providing new information signs in the coastal park to inform the local community and visitors of the historical context and archaeological significance of the area. The form and detail of this will be developed in consultation with the Municipality and UNESCO (see also Chapter 11: Archaeology and Built Heritage);

- replacing all trees and other planting in to be removed with equivalent replacement areas and planting additional trees and landscaping to provide net gain in amenity (see also Chapter 10: Biodiversity and Nature Conservation).

### 4.4 *ASSESSMENT AND MITIGATION OF IMPACTS ON ACCESS TO EXISTING LAND USES*

In addition to the direct and indirect land use and property impacts identified in Sections 4.3, the project will also result in changes to the accessibility of land uses adjacent to the project.

The greatest impact will be on access to the public open space and associated recreational, sports and play facilities to the south of Kennedy Caddesi. In particular the Marble Tower will be located on an 'island' between the two carriageways instead of being accessible from the shoreline. The feasibility of providing a pedestrian underpass under the southern carriageway is being examined to provide access to the Marble Tower from the shoreline.

Currently, the shoreline and coastal park south of the route is accessed by three pedestrian footbridges and five signal-controlled at-grade pedestrian crossings. People also cross the road informally.

For safety reasons, at-grade crossing of the widened road will not be permitted. All the existing at-grade crossings and footbridges will be replaced by eight new and upgraded footbridges, thus retaining the existing level of formal access to the shore. At Yenikapi, new footbridges will be provided between the town (including the new Metro station) and the Yenikapi Ferry Terminal if the at-grade design discussed in Chapter 11 is adopted.

On the Asian side there is limited demand for crossing the existing road. There are five existing footbridges and these will all be replaced with upgraded structures.

To maximise access to the coastal park and the Yenikapi Ferry Terminal on the European Side, and access across the D100 on the Asian side, all footbridges will be designed to provide full accessibility for people with restricted mobility (mothers with prams and pushchairs, wheelchair users, people with luggage, *etc*) through the provision of ramps as well as steps. The existing pedestrian footbridges have only steps and are currently not accessible to those with restricted mobility.

Overall the replacement of older footbridges and at-grade crossings with modern footbridges is considered likely to result in a small perceived loss of accessibility along the route because of the need to use steps and slightly increased walking times. However the removal of at-grade crossings will yield benefits in terms of improved safety. All footbridges will be replaced before the old structures are removed.

One minor revision to the location of the planned pedestrian footbridge located at km4+615m in the DLH tender design is proposed, moving it 200m further to the east of Yenikapi to provide better connectivity to Kumkapi Train Station. This also provides a more even distribution of crossing points along the European Side.

Several parking areas and areas of bus stops, providing access for people to the coastal park, sports facilities and the ferry terminal and harbours, will be displaced along Kennedy Caddesi. These will be replaced by bus stop lay-bys and car parks providing equivalent provision along the route,

With these measures there is expected to be no adverse impact on the accessibility of the public open space, recreation and other facilities along the shore.

## 4.5 *TEMPORARY IMPACTS DURING CONSTRUCTION*

Access will be maintained to all existing land uses, buildings and facilities along the route during construction. Where temporary diversions and alternative access arrangements are required, the relevant land use, businesses or residents will be informed well in advance of the alternative access arrangements and detours will be clearly signposted. This information will also be freely available on the Project website.

In addition to the permanent occupation and acquisition of land required for the Project, additional land alongside the Project corridor will be used temporarily during construction.  This will include a working corridor for road widening, together with construction compounds, site offices, storage areas, land for temporary plant and access and haul roads.

Responsibility for identifying temporary land required for construction will rest with the EPC Contractor once appointed, and will depend on the detailed construction methodology and programme. The Contractor will be required and encouraged to make use of areas of vacant and un-used land as far as possible in order to minimise adverse impacts on existing land use. There are a number of sites along the route that are either un-used or currently being used for other construction projects that are likely to be available.

It is, however likely that a considerable area of the coastal park on the European side and the facilities within it, will be either used or made inaccessible for part the 43 month construction period. Construction is expected to be organised in sequence along the route so that each stretch will be used for only part of the time, except around the tunnel entrances, but the cumulative loss will have a major temporary impact on recreation and amenity in the city.

ATAŞ have identified areas potential sites for construction compounds at the tunnel entrances located to the west of the European ventilation shaft and around the Asian ventilation shaft. These will provide site offices, storage areas and temporary short term accommodation available for small numbers of workers in the case of urgent need. The Asian site will also house the tunnel segment storage area and the TBM slurry treatment plant.

There is little scope to mitigate the impact of temporary land take on the European side during construction, but ATAŞ will seek to minimise the period during which any area is made inaccessible and to facilitate access to remaining useable areas. Adoption of good site management within the construction area (keeping the sites clean and tidy, controlling noise and dust, etc – see Chapters 7 to 9) will minimise adverse impact on the amenity of the remaining areas and facilities in the park (including the Kumkapi Fish Market if this remains open). If closure of the fish market proves necessary during construction, ATAŞ will assist DLH and the Municipality to identify an alternative temporary site.

Where footbridges providing access to the park are to be removed, replacement structures will be built before the old bridges are demolished.

ATAŞ will also seek to re-open any parts of the coastal park as soon as it is safe to do so and will maintain access to the shoreline and fishing ports at all times.

On the Asian side the nature of adjacent land uses means that temporary landtake will have less impact but there will be loss of open green space at the Asian tunnelling compound by the ventilation shaft just east of the port. This is located in a built up area occupied by port, military and educational buildings and its temporary loss is not considered to be significant.

# 5 RESOURCES AND WASTE

## 5.1 INTRODUCTION

This chapter describes the resources and materials needed for the construction and operation of the tunnel and approach roads and the wastes which are expected to be generated. It then discusses the impacts of supply of materials and disposal of waste.

## 5.2 CONSTRUCTION MATERIALS

An estimate of the material required to construct the Project is provided in Table 2-2 in Section 2.4. These materials (ready-mixed concrete, prefabricated concrete tunnel segments, steel, aggregates, asphalt, and specialist materials (grouting, sealants, etc)) will be procured by the construction contractor and at this stage their sources are not known. Given the size of the construction sector in Istanbul it is not expected that any specific facilities for local supply of materials will need to be developed outside the construction site and all will be supplied from existing construction material suppliers in Istanbul. No borrow areas or quarries will be operated by ATAŞ and all material will be obtained from existing licensed facilities. There should therefore be no adverse impacts from extraction of raw materials or production of finished materials that will be attributable directly to the Project.

Besides the delivery of materials, various types of vehicles and machinery typically used during road construction will be needed. These will be sourced locally from existing suppliers as far as possible.

All materials and machinery with the exception of the TBM will be transported by road from the suppliers. The tunnel boring machine will be procured internationally and brought to the site of the tunnel access at the Asian ventilation shaft in sections, by sea and/or road. The critical parts are likely to be transported by road, whereas the less critical parts may be brought by sea. The complete TBM will have an approximate length of 180 m and weight of 2200 tn.

The volume of construction traffic is discussed in Section 2.4 and the impacts of this activity are considered in Chapters 8 and 9.

During the detailed design and procurement stage, the contractor will be responsible for identifying sources for all materials and equipment and will be required to consider environmental impacts in selecting materials to be used on the Project. This will include using less harmful materials where possible, considering the carbon footprint of alternative materials and considering the impacts of extraction, processing and transport. In particular the contractor will be required to:

- source materials from as close as possible to the Project so as to minimise the impact of transport;
- use recycled materials and materials certified as being from "green" or lower carbon sources where practicable;
- source aggregates and road asphalt from quarries, borrow pits, crushing plants and asphalt plants operating with valid environmental and other permits and licences and where the sites are managed in full compliance with all applicable environmental standards and specifications;
- locate any dedicated asphalt and hot-mix plants as far as possible from the nearest sensitive receptor (e.g. residential houses, schools, hospitals, places of worship, play areas), in a location to be approved by the local environmental authorities, and with emission controls in accordance with the local environmental regulations.

### 5.3 *SPOIL DISPOSAL AND OTHER WASTE MANAGEMENT*

Tunnelling and, to a lesser extent, widening of the approach roads will generate significant volumes of waste from earthmoving, site clearance, demolition and construction of new structures. These wastes can give rise to significant adverse impacts if not collected, treated and disposed of in a correct manner.

Quantities of spoil (*ie* excavated soil and rock) generated in each part of the Project are identified in Table 2-3 in Section 2.4. In total it is estimated that up to 972,500 $m^3$ of soil, soft rock and hard rock will be generated from the construction.

To provide a worst case prediction for the purpose of the assessment, it has been assumed that spoil from the Asian side will be exported from the site by road to a disposal site at Şile located approximately 50 km to the north-east of the tunnel entrance on the Asian side. This is a municipal landfill licensed by the Metropolitan Municipality of Istanbul in 2007 for disposal of approximately 4.7 $Mm^3$ of construction waste. It has ample capacity to receive the quantity of spoil envisaged from the Project. For the European side, surplus material will be disposed of at the Tayakadin disposal site, also an official facility operated by the Municipality.

In practice a proportion of the spoil will be re-used within the Project and ATAŞ will look for opportunities to make use of additional material on other construction projects taking place in the region at the same time. In this way ATAŞ will seek to maximise the beneficial use of spoil and minimise the need for off-site disposal. Top soil will be kept for re-use and will not be disposed of (see Chapter 6 for further details of soil management).

Other wastes likely to be generated during construction will include stripped road surface materials (including asphalt), demolition materials, vegetation and soils from site clearance, contaminated soils, slurry treatment residues, residues from settling ponds, bunds and oil interceptors, domestic wastes from site offices and kitchens, occasional hazardous materials such as surplus treatment chemicals, residues from the slurry treatment plant, wastes from paint and cleaning materials and clean-up materials from accidental spills.

These wastes will all be managed in accordance with general requirements for handling of wastes in Turkey [(1)]. These are summarised in Annex C. The contractor will also be required to adopt the following measures

- Disposal and deposit of excavated soil, construction and debris wastes in seas, lakes, rivers, streets, forests and any other place that may cause adverse effects on the environment, except at recovery, storage, treatment and disposal facilities operating under a valid licence from the relevant authorities will be forbidden.

- Excavated soils will be used in the Project area as far as possible and alternative uses will be sought where practicable to minimise the requirements for of-site disposal

- All other wastes will be collected and stored on site in accordance with a written Waste Management Plan to be prepared by the contractor in accordance with international best practice[2]. This will provide for

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[1] Regulation on Control of Excavated Soil, Construction and Debris Wastes of 18.03.2004 No. 25406)
Solid Waste Control Regulation (Official Gazette Date/Number: 14.03.1991/20814)
Hazardous Waste Control Regulation of 14.03.2005 No. 25755) as amended on 04.09.2009 No. 27339
Regulation on the General Principles of Waste Management of 05.07.2008 No. 26927) – see Annex IV for the list of hazardous wastes

[2] IFC Performance Standard 3: Pollution Prevention and Abatement; IFC EHS Guidelines 2008: General EHS Guidelines and sectoral Guidelines on Construction Materials Extraction and Toll Rods

containers of a suitable size and design to be provided for secure storage and segregation of all wastes. Containers will be clearly labelled with the type of waste and placed in dedicated areas located on the European and Asian sides. A plan showing where wastes of different types can be deposited will be available to staff.

- Biodegradable waste will be collected daily and will not be permitted to accumulate such that it may present an environmental hazard. The site will be regularly inspected to ensure waste facilities are correctly used and are kept clean and tidy.

- All hazardous waste including asbestos, dyes, fluorescents, mercury, acids and similar materials will be collected and stored separately in Temporary Hazardous Waste Storage Areas and disposed of in accordance with the provisions of the Hazardous Waste Control Regulation. Access to hazardous waste areas will be restricted to suitably trained staff.

- Inventories of construction materials will be managed to minimise the amount of surplus material requiring disposal and where possible any surplus materials will be returned to the supplier, alternative uses will be found or the material will be recycled.

- The contractor will be required to segregate materials suitable for recycling, including stripped road surfacing material and demolition wastes, and to recycle these wastes either within the Project or elsewhere where the facilities and market exist for this in the area.

- Waste oils and oily wastes will be managed in accordance with the system of categorization under the Waste Oils Regulation (see Annex C):

    - Category I waste oils must be recycled by way of refining or regeneration at facilities licensed by the Ministry of Environment and Forestry;

    - Category II waste oils may be used as secondary fuel in facilities licensed by the Ministry for this purpose;

    - Category III waste oils not appropriate for refining and regeneration, posing risk to human and environmental health if used as fuel, must be treated as hazardous waste and converted to harmless products by incineration in a licensed hazardous waste incineration facility.

- Waste will be transported in marked vehicles designed to minimise the risk of release of materials and windblown debris. Drivers employed by the construction contractor will be trained in the handling and disposal of their cargo and will carry documents describing the nature of the waste and its degree of hazard. Waste transport and disposal contractors will be required to comply with the same requirements.

- All waste spills will be promptly cleaned up.

- Full records will be maintained of the type, quantity, composition, origin, disposal destination and method of transport for all wastes.

With full and strict implementation of these mitigation measures there should be no significant adverse impacts from disposal of wastes from construction.

### *5.4 OPERATIONAL MATERIALS AND WASTE*

Quantities of materials used and waste generated during operation are expected to be small. Occasional hazardous waste may arise from maintenance operations, clearance of drainage sumps and clean up of accidental spills. All waste will be managed in accordance with legal requirements. No significant impact is predicted to arise from resource use or waste disposal during operation.

# 6 GEOLOGY, SOILS AND CONTAMINATED LAND

## 6.1 SCOPE

This chapter presents an assessment of the potential impact of the Project related to geology and soils. The following issues are addressed:

- loss of geological features of importance for science;
- risks of increase in land instability:
- risks associated with seismic activity and associated tsunamis, and from sea level rise and storm surges;
- impacts on soils and risks associated with presence of contaminated land.

Following a description of the work undertaken to complete the assessment, the baseline situation is described. The impacts noted above are discussed and details of the proposed mitigation measures and residual impacts remaining following the implementation of these measures are presented.

## 6.2 INFORMATION SOURCES AND APPROACH

### 6.2.1 Geology and Seismic Risk

The potential earthquake risks were recently evaluated through a comprehensive investigation conducted by Pacific Consultants for the Greater Municipality of Istanbul. The study was funded by Japan International Cooperation Agency (JICA) and the final report entitled "A Study on A Disaster Prevention / Mitigation Basic Plan in Istanbul including Seismic Microzonation in the Republic of Turkey" (*JICA study*) was published in 2002[1]. The report describes the geological situation of the Istanbul area and evaluates the seismic risk. It is used as the main information source for this desk study.

The report indicates that extensive discussions were undertaken with relevant institutes/researchers in order to determine the earthquake scenarios. Based on these discussions and the recent of research on the North Anatolian Fault (NAF), scenarios were identified so that the appropriate damage estimation could be taken into account in disaster prevention planning.

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[1] http://www.ibb.gov.tr/en-US/SubSites/IstanbulEarthquake/Pages/DisasterPreventionandMitigationBasic.aspx

Geotechnical investigations to provide further information for the detailed design on the geological conditions of the Bosphorus crossing are presently underway and findings will be included in the final ESIA Report when available.

The aim of this assessment is to identify whether there are any geological features of importance or any risks associated with land instability.

### 6.2.2 *Soils and Contaminated Land*

Due to the location of the Project area in the middle of a largely urbanized area, no natural soils are present. A field survey was carried out in October 2009 to identify potentially contaminated land which could be encountered during construction activities. In addition, historic aerial photographs (1940s) were evaluated.

The aim of this assessment is to identify the risks to soils from construction and to suggest appropriate measures to minimise these risks. In addition, the review of historic land uses along the corridor will identify any risks of encountering contaminated ground and set out appropriate measures for managing any contaminated soil.

## 6.3 *EXISTING ENVIRONMENT*

### 6.3.1 *Geology*

The region of Istanbul is characterized by the Bosphorus strait splitting the Çatalca plateau in the west (European side) from the Kocaeli plateau in the east (Asian side). Flat land is rare and gradients of more than 10% are widespread in the city. The road on the European side is located in a flat terrain with low elevation along the shore of the Bosphorus (approx. 3-5 m above sea level (a.s.l)). North of the road, the historic peninsula inclines up to elevations of 60 m a.s.l. On the Asian side, the road is located on a rising terrain with elevations of up to approx. 50 m a.s.l.

Paleozoic aged sediments are observed on the Çatalca (western) peninsula of Istanbul Province along the banks of Bosphorus and on the Asian side. Cenozoic and Quaternary sediments are found on the western parts of Istanbul city. Alluvial deposits are located on the coastlines and valley floors and recent and historic fill along the reclaimed coast of Marmara Sea.

Paleozoic and Mesozoic rock units that cover wide areas on both sides of Bosphorus and the Kocaeli peninsula are known as the Istanbul Massif. Lower Ordovician aged terrestrial sediments that appear in the Metropolitan territory and the adjacent areas are the oldest rock units of the Istanbul Massif. These units are underlain by an Infra-Cambrian aged metamorphic foundation that include schist, gneisses and meta-migmatites. As of Early-Mid Ordovician era, the region underwent a general transgression represented by sedimentary quartzites of the Aydos formation. The region was covered by sea that increasingly deepened during Silurian and Devonian eras.

Due to the tectonic movements in the Carboniferous and Permian eras, faults folding in the N-S axis and extending in the E-W direction with low angle and reverse-partitioning developed in the region. Magmatic intrusions represented by “Sancaktepe Granite” (Permian) in the western part of Gebze (east of Istanbul) developed in this period.

The fact that rock piles representing the Jurassic and Early Cretaceous era are not found within the borders of Istanbul province shows that the region was in a process of erosion in that era. In the late Cretaceous era, a new transgression started that affected the entire region, and a sea developed where Upper Cretaceous aged volcano-sediments of the Sarıyer formation, and clastic and shallow-facies carbonate piles of the Akveren Formation dating back to Upper Cretaceous-Paleocene deposited. Andesitic volcanic dykes seen intensively in the “Çavuşbaşı Granodiorite” piles dating back to Upper Cretaceous and Paleozoic eras developed in this period.

Compressive movements that impacted most of Anatolia during Eocene caused intensive folding and faulting in the Marmara basin including Istanbul region before Lutetian. During Early-Eocene sedimentation of Paleozoic and Mesozoic aged rock units, Upper Cretaceous – Early Eocene aged piles stratified and the Sarıyer-Şile Fault in the NNW-SSE direction developed as a result of these movements.

The region underwent another transgression during Mid-Eocene (Lutetian) and the Çatalca and Kocaeli regions were covered by a sea in the Mid Eocene-Early Oligocene, where sands and calcareous materials from atolls deposited along the coast and clay mud in the inner sections.

In the Mid-Late Oligocene, the region entered into a process of an ongoing land formation as a result of tectonic movements that affected the entire Thrace Basin (i.e. European side of Turkey). River sediments of Late Oligocene – Late Miocene period were accompanied by lagoon and lake formations. Due to the squeeze roughly in the N-S direction, intensive shear fault and joint systems especially in the NW-SE and NE-SW direction developed. Weakness zones that developed along these shear fractures controlled the formation of the Bosphorus, Dardanelles Golden Horn and other large river valleys of the region and caused them to have a zigzagging geometry.

According to the 1:5000 Geological Map used in the JICA study (see Annex J-1), the European Approach Road is located on quaternary sediments and anthropogenic fill (Dolgu, Alüvyon and Kusdili formation) with loose pebbles, sand and clay as well as clay with sand and pebble lenses. On the Asian side, besides young Quaternary sediments of Dolgu and Alüvyon (anthropogenic fill, loose pebbles-sand-clays), Lower Carboniferous grey shales with turbidite sandstone and conglomerates are present (Trakya).

### 6.3.2 *Seismic Risk*

The tectonic framework of the Anatolian peninsula is characterized by the collision of the Arabian and African plates with the Eurasian plate. The Arabian plate is moving northward relative to Eurasia at a rate of about 25mm/year, and the African plate at a rate of about 10mm/year. The Arabian plate collides into the southeast margin of the Anatolian micro plate, forcing anti-clockwise rotation of the Anatolian micro plate, accommodated by right-lateral slip on the North Anatolian Fault (NAF). The location of the NAF is shown by the red line in Model C Figure 6-3). GPS data show that the relative motion between the westward moving Anatolian micro plate and the Eurasian plate across the NAF is around 18 to 25 mm/year. The crustal deformation in the convergence zone is complex; many normal faults and graben exist from west of the Anatolian peninsula to the Aegean Sea.

Istanbul lies on an active seismic zone ranging through Java, Myanmar, Himalaya, Iran, Turkey and Greece, where many large earthquakes have occurred in the past as shown in Figure 6-1 and Figure 6-2.

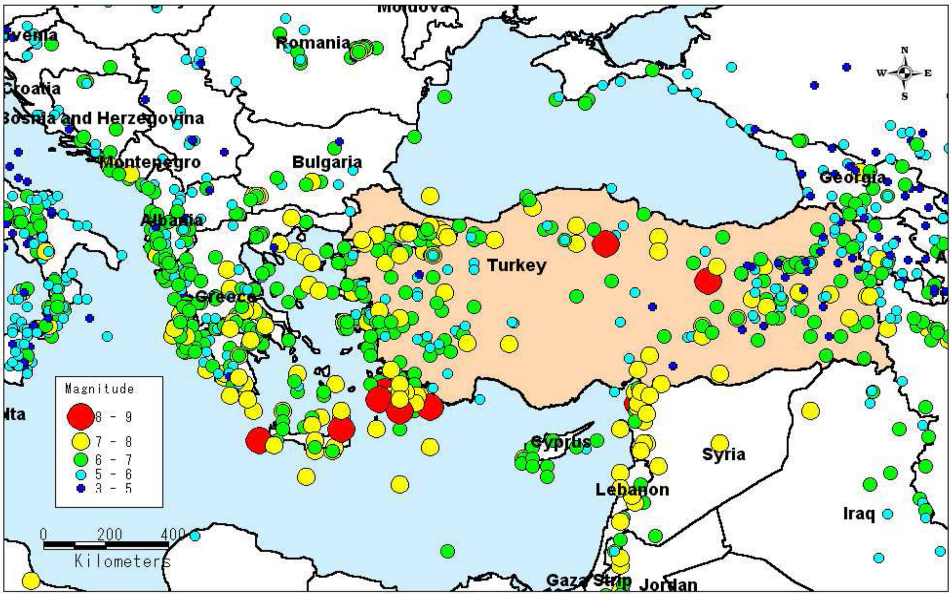


*Figure 6-1 Distribution of Earthquakes by Magnitude (Turkey and Vicinity)*

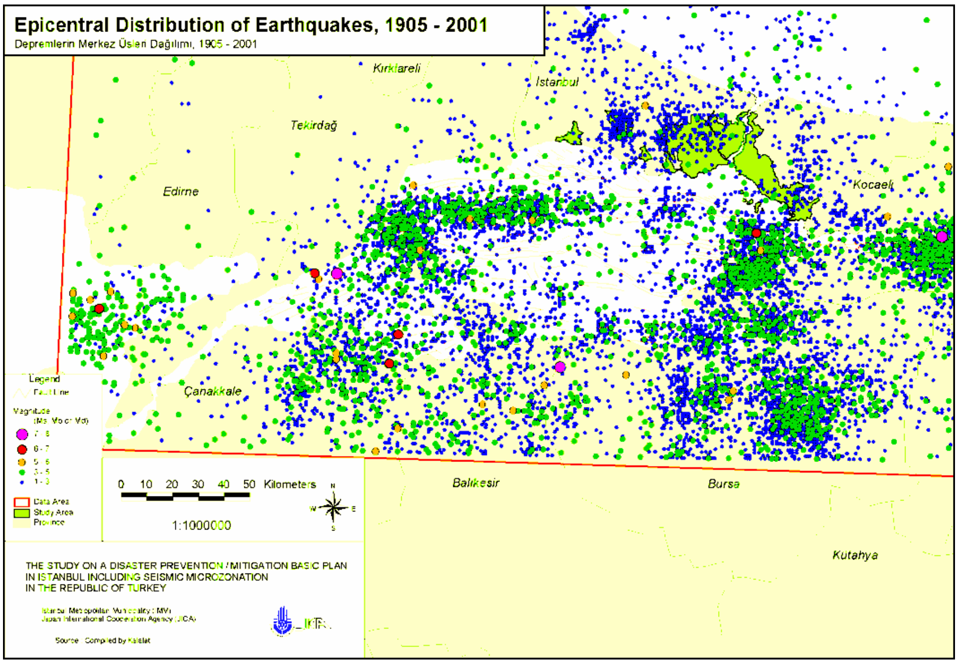


*Figure 6-2 Distribution of Earthquakes by Magnitude (Marmara and Istanbul Region)*

#### 6.3.2.1 *History of Earthquakes in Istanbul*

Based on world wide historical catalogues, such as that of Utsu (1990), Istanbul has repeatedly suffered damage due to earthquakes. Table 6-1 shows a summary of damaging earthquakes occurring in Istanbul before the 20th century. The seismic intensity of former earthquakes in Istanbul has been estimated from the quite precise records of damage from literature. According to these records Istanbul has experienced earthquakes equal to or greater than intensity 9 at least 14 times in historical years. This means Istanbul has suffered damage due to earthquakes every 100 years on average.

***Table 6-1 Historical Earthquakes Affecting Istanbul***

| Year | Month | Day | Latitude | Longitude | Magnitude | Mercalli Intensity at Istanbul | Tsunami Observed | Damaged area | Damage extent |
|---|---|---|---|---|---|---|---|---|---|
| 427 | | | 40.5 | 28.5 | | 10 | | Turkey: Istanbul | severe |
| 438 | | | 40.8 | 29 | 6.6 | 9 | | Turkey: Istanbul | |
| 440 | 10 | 26 | 41 | 29 | | 7 | | Turkey: Istanbul | severe |
| 441 | | | | | | | | Turkey: Istanbul | severe |
| 447 | 11 | 8 | 40.2 | 28 | 7.3 | 9 | Yes | Turkey: Marmara Sea, Istanbul | severe |
| 477 | 9 | 25 | 41 | 29 | 7.0 | 10 | | Turkey: Istanbul | severe |
| 533 | 11 | 29 | 36.1 | 37.1 | | | | Syria: Aleppo(Halab)/ Turkey: Istanbul | extreme |
| 541 | 8 | 16 | 40.7 | 39 | 6.6 | 9 | | Turkey: Istanbul | |
| 553 | 8 | 15 | 40.7 | 29.3 | 7.0 | 10 | | Turkey: Istanbul | severe |
| 555 | 8 | 16 | 41 | 29 | 7.6 | | Yes | Turkey: Izmit (Nicomedia), Istanbul | some |
| 557 | 10 | 6 | 41 | 29 | | | | Turkey: Istanbul | |
| 557 | 12 | 14 | 41.8 | 29 | 7.2 | 10 | Yes | Turkey: Istanbul | severe |
| 732 | | | 41 | 29 | | | | Turkey: Istanbul | |
| 740 | 10 | 26 | 40.7 | 29.3 | 7.3 | | Yes | Turkey: Marmara Sea, İstanbul,Izmit | severe |
| 815 | 8 | | 41 | 29 | | | | Turkey: Istanbul | |
| 865 | 5 | 16 | 40.8 | 28 | 6.7 | 9 | | Turkey: Istanbul | |
| 957 | 10 | 26 | | | | | Yes | Turkey: Istanbul | |
| 975 | 10 | 26 | | | | | Yes | Turkey: Istanbul, Thracian coast | some |
| 989 | 10 | 26 | 40.9 | 29.3 | 7.3 | | | Turkey: Istanbul/ Greece | some |
| 1037 | 12 | 18 | 41 | 29.5 | | | | Turkey: Buccellariis, Istanbul | some |
| 1063 | 9 | 23 | 40.8 | 28.3 | 7.0 | 9 | | Turkey: Istanbul | |
| 1082 | 12 | 6 | 40.5 | 28.5 | | 10 | | Turkey: Istanbul (1083?) | some |
| 1087 | 12 | 6 | 40.9 | 28.9 | 6.5 | 9 | | Turkey: Istanbul | |
| 1346 | | | | | | | | Turkey: Istanbul | some |
| 1419 | 5 | 11 | 41 | 28.6 | | 9 | | Turkey: Istanbul | considerabl e |

| Year | Month | Day | Latitude | Longitude | Magnitude | Mercalli Intensity at Istanbul | Tsunami Observed | Damaged area | Damage extent |
|---|---|---|---|---|---|---|---|---|---|
| 1490 | | | 41 | 29 | | | | Turkey: Istanbul | |
| 1509 | 9 | 14 | 40.8 | 28.1 | 7.7 | 10-11 | Yes | Turkey: Tsurlu, Istanbul | severe |
| 1556 | 3 | 10 | 41 | 29 | | | | Turkey: Istanbul | |
| 1556 | 5 | 10 | 41 | 29 | | | | Turkey: Rosanna near Istanbul | moderate |
| 1646 | 4 | 5 | | | | | Yes | Turkey: Istanbul | some |
| 1659 | | | 41 | 29 | | | | Turkey: Istanbul | |
| 1719 | 3 | 6 | | | | | | Turkey: Istanbul, Villanova | some |
| 1719 | 5 | 25 | 40.8 | 29.5 | 7.0 | | | Turkey: İstanbul,Izmit | severe |
| 1754 | 9 | 2 | | | | | | Turkey: Istanbul, Izmit/Egypt:Cario | some |
| 1766 | 5 | 22 | 40.8 | 29 | 6.5 | 9-10 | Yes | Turkey: Istanbul | some |
| 1856 | 2 | 22 | 41.3 | 36.3 | 6.1 | | | Turkey: Karpan?, Korgo?, Istanbul | limited |
| 1894 | 7 | 10 | 40.6 | 28.7 | 6.7 | | Yes | Turkey: Geiwe, İstanbul,Adapazari | limited |

Among the earthquakes listed above, three earthquakes that caused serious damage to Istanbul are described below[2].

*Earthquake on 1509/ 09/ 10 with Mercalli Intensity (M) = 7.7*

A destructive earthquake caused considerable damage throughout the Marmara Sea area, from Gelibolu to Bolu and from Edirne and Demitoka to Bursa in the 16th Century. Damage was particularly heavy in Istanbul, where many mosques and other buildings, part of the city walls, and about 1000 houses were destroyed, and 5000 people were killed. Many houses and public buildings sustained various degrees of damage in Demitoka, Gelibolu, Iznik, and Bolu. The shock was felt within a radius of 750 km and was followed by a tsunami in the eastern part of the Marmara Sea.

*Earthquake on 1766/ 05/ 22 with M = 6.5*

A destructive earthquake in the eastern part of the Marmara Sea in the 18th Century caused heavy damage, extending from Rodosto (Tekirdag) to Izmit and to the south coast of the Sea from Mudanya to Karamursel. Damage to buildings and tall structures were reported from as far as Gelibolu, Edirne, Izmit, and Bursa. In Istanbul, many houses and public buildings collapsed,

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[2] Ambraseys and Finkel,1991

killing 880 people. Part of the underground water supply system was destroyed. The Ayvad Dam located in upper Kagithane, north of Istanbul, was damaged, and in the vicinity of Sultanahmet the roof of an underground cistern caved in. The earthquake was associated with a tsunami, which was particularly strong along the Bosphorus.

*Earthquake on 1894/07/10; M = 6.7*

In 1894, a destructive earthquake in the Gulf of Izmit and further to the east caused extensive damage in the area between Silivri, Istanbul, Adapazarı and Katırlı. Maximum effects were reported from the region between Heybeliada, Yalova, and Sapanca where most villages were totally destroyed with great loss of life. The shock caused the Sakarya River to flood its banks and the development of mud volcanoes. In Adapazarı, 83 people were killed and another 990 in the Sapanca area. In Istanbul, damage was widespread and, in some places, very serious. Many public buildings, mosques, and houses were shattered and left on the verge of collapse and most older structures fell down, killing 276 and injuring 321 people. Three of the dams for the water supply of Istanbul were badly damaged.

#### 6.3.2.2 *Earthquake Risks for Istanbul*

The following four scenario earthquake models were defined in the JICA study. They are illustrated in Figure 6-3.

**Model A**: This fault section is about 120 km long from west of 1999 Izmit earthquake fault to Silivri. This model was thought to be the most probable model of the four scenarios because the seismic activity is progressing to the west. The moment magnitude (Mw) was assumed to be 7.5.

**Model B**: This section is about 110 km long from the eastern end of 1912 Murefte-Sarkoy earthquake fault to Bakılkoy. The moment magnitude was assumed to be 7.4.

**Model C**: This model supposes a simultaneous break of the entire 170 km section of the NAF in the Marmara Sea. The moment magnitude is assumed to be 7.7. The maximum magnitude of historical earthquakes in the Marmara Sea area is 7.6. There is no evidence of a simultaneous break of the entire section occurring in the past, though the eastern one-third did rupture in May 1766 and the rest in August 1766. If a rupture of the maximum length of the fault is assumed, this is the reasonable worst case.

**Model D**: The continuous fault that was found in the north of the Marmara Sea follows the base of the northern steep slope of the Cinarcık Basin. A normal fault model was developed, which follows the northern slope of the Cinarcık Basin with reference to many recent researched works. The moment magnitude (Mw) was assumed to be 6.9 with the empirical formula for a normal fault.

The JICA report identifies a number of issues that might develop following the earthquake including loss of life, building damage, impact to infrastructure and fire. The report also identifies emergency plans and gives an overview of potential remedial measures that could be taken to minimize the impact of the earthquakes.

Liquefaction potential, slope stability and flooding conditions are of particular concern for the Eurasia Tunnel. Flooding conditions might occur from tsunamis induced by earthquakes in the Marmara Sea discussed in Section 6.3.2 The Tsunami assessment is discussed in Section 6.3.4. Detailed studies of liquefaction and slope stability are being undertaken by ATAŞ and will be subject to review by the Lenders' Technical Advisor. A first set of marine borings (consisting of 10 bore holes) was performed in the first half of February 2010, by Fugro Consult GmbH. In these marine borings, necessary parameters such as CPT values were obtained. In situ and laboratory test results will enable a sound liquefaction analysis to be performed.

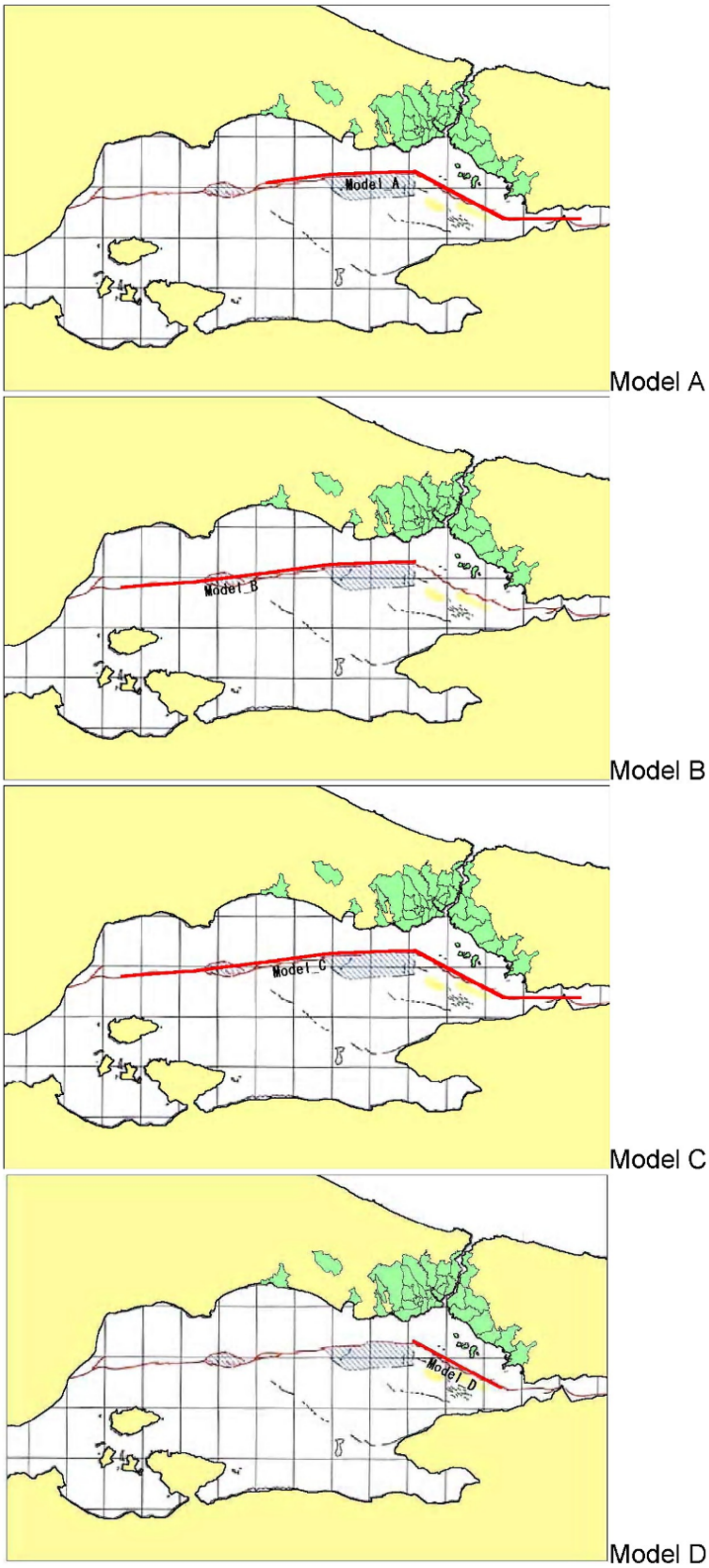


*Figure 6-3 Potential Earthquake Scenarios (JICA study 2002)*

### *6.3.3 Liquefaction Risk*

An evaluation of liquefaction potential was conducted in the JICA study in order to provide an overview of risk in the study area and its regional characteristics. Detailed analyses using geological investigation results and numerical analysis were conducted. The main content of the evaluation was comparison of soil strength with seismic motion. According to the JICA study, the road section along the European side will potentially be impacted from liquefaction occurrence under earthquake conditions. This aspect was further assessed by numerical simulations for Scenario A (likely earthquake scenario) and Scenario C (most extreme earthquake scenario) as shown in Figure 6-4.

The following areas with high liquefaction potential were identified close to the Project:

- the coastal area close to the border between Zeytinburnu (no. 32 in Figure 6-4) and Fatih (no. 14)
- the coastal area close to the border between Fatih and Eminönü (no. 12)

The JICA report states that ground improvement is necessary and that investigation of important structures must be carried out.

There were no landslide risks associated within the areas of investigation.

ATAŞ is currently undertaking geotechnical investigations along the Project route and the in situ findings and laboratory tests will be used to complete a detailed liquefaction analysis which will be taken into account in the final design.

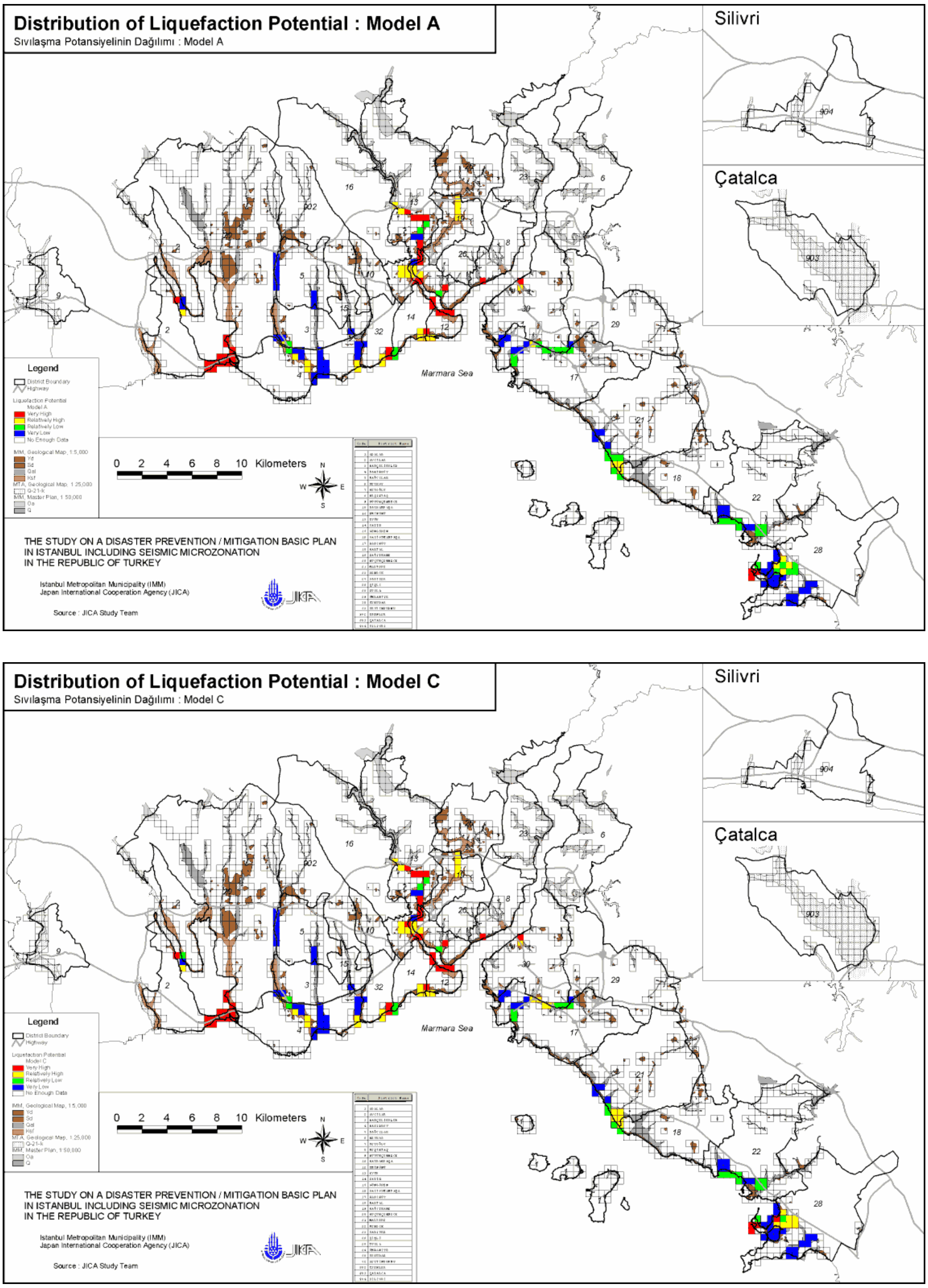


*Figure 6-4 Distribution of Liquefaction Potential (JICA Study 2002)*

### *6.3.4 Tsunami Risk*

The westward propagation of seismic ruptures along the North Anatolian Fault (NAF) during the 20th century together with the 1999 recent ruptures have increased the probability that a next rupture could occur offshore, in the Marmara Sea, in the nearby prolongation of the 1999 Izmit earthquake faulting[3]. The 1999 earthquakes provided the opportunity to gather new geological and geophysical data offshore to improve the knowledge of the NAF characteristics in its emerged part; a critical issue to understand the characteristics of the historical earthquakes and to assess the seismic hazard for the densely inhabited region around the Marmara Sea, especially Istanbul.

As future earthquakes are expected to break segments of the emerged NAF, the possibility that tsunamis could be generated by the co-seismic displacement of the seafloor or by triggered submarine landslides have to be considered. As Turkey is surrounded by several seas where active tectonics occur, numerous tsunamis have caused damage to Turkish coasts and populations in the past[4]. Records suggest that the coasts of the Marmara Sea are struck by tsunamis more often than other coastal areas of the Aegean, Mediterranean and Black Seas. There may have been as many as 40 tsunamis in the Marmara Sea between 120 and 1999 AD[5]. The lack of direct records or accounts makes a rigorous estimation of the run-up values rather difficult, and the analysis of available documents remains somewhat controversial.

Analysing events since the 16th century indicates that, for example, the 1509 earthquake[6] is likely to have triggered tsunami waves that spilled over the city walls of Istanbul and caused 6 m run-up heights[7]. Another recent study states however, that little is said about sea waves although waves possibly crashed over the walls of the city[8].

The strong May 1766 earthquake affected the Istanbul and Izmit Bay areas. There is a broad consensus that a tsunami was triggered by the earthquake and caused important damage along the Bosphorus and in the Gulf of Mudanya[9].

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[3] Parsons et al., 2000

[4] (Kuran and Yalc¸iner, 1993; Altinok and Ersoy, 2000; Yalc¸iner et al., 2002)

[5] Altinok et al., 2001a

[6] Ambraseys and Finkel, 1990

[7] Altinok and Ersoy, 2000; Yalc¸iner et al., 2002

[8] Ambraseys, 2002b

[9] Altinok and Ersoy, 2000; Yalc¸iner et al., 2002; Ambraseys, 2002b

In 1894, an earthquake was felt in the Istanbul and Izmit areas, and subsequently the sea inundated 200 m of land in the Istanbul area. The witnesses reported a sea receding first, followed by sea uprising, locally violently, and run-up heights reached possibly 6 m locally[10]. The sea waves were observed in Istanbul and in the Prince Islands by many witnesses, within an area probably larger than the one inferred from the observations gathered after the Izmit 1999 earthquake, an event to which the 1894 one is often compared. Submarine failures were also most probably triggered by the shock, as shown by the rupture of a submarine cable in the recent earthquake[11].

During the 20th century, the 1912 Murefte-Sarkoy earthquake, with an estimated magnitude Ms of 7.3[12], was located on the Ganos Fault and the rupture probably extended into the Marmara Sea. Sea disturbances were reported in the western Marmara Sea but also as far as in the Strait of Istanbul[13]. The Ms 6.3 earthquake in 1963 in the eastern Marmara did not produce waves higher than 1 m. Nevertheless, boilings in the sea and deposits of shells were reported along the coast of Mudanya[14].

The most recent tsunami in the Marmara Sea was triggered by the 1999 Kocaeli earthquake[15] whose rupture extent was partially submarine. It locally produced up to 10 m high waves (average run-up 2.5 m) on the southern shore of the gulf, most probably caused by several small faults and local submarine failures.

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[10] Altinok et al., 2001a; Yalc¸iner et al., 2002

[11] Ambraseys, 2002b

[12] (Ambraseys and Jackson, 2000)

[13] (Altinok et al., 2003)

[14] (Yalc¸iner et al., 2002)

[15] (Altinok et al., 2001b)

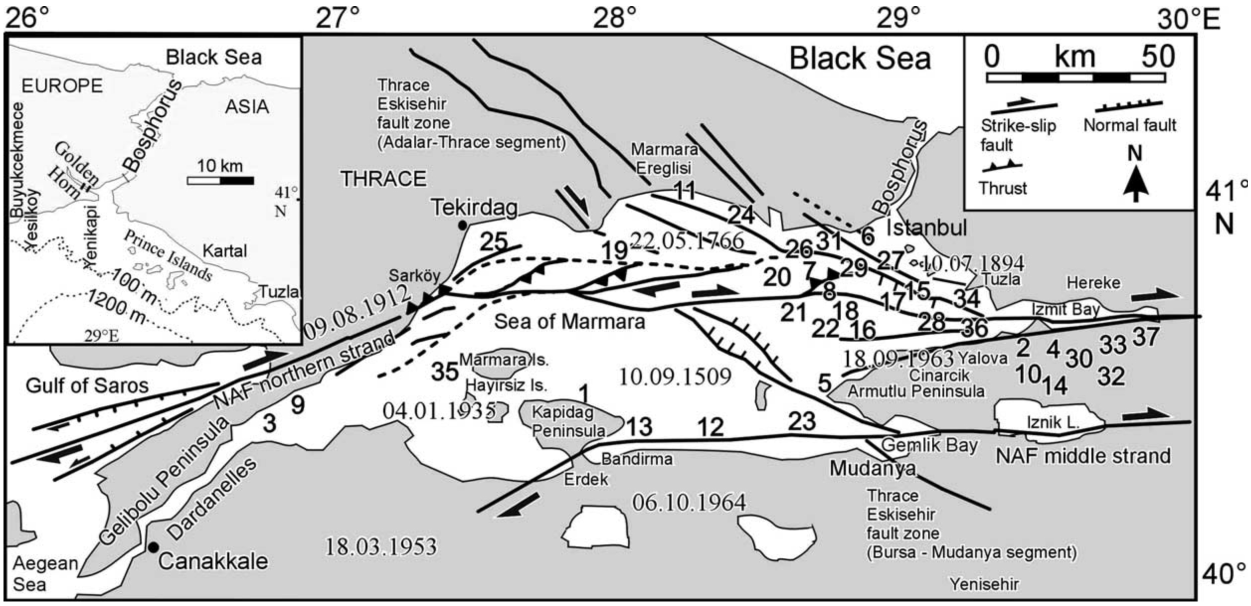



*Figure 6-5* ***Location of tsunamis reported to have occurred along the coasts of the Sea of Marmara in the past (AD 120-1999) (modified from Altinok and Ersoy, 2000; Altinok et al., 2000). Numbers indicate the chronological order. The seismotectonic map of the Sea of Marmara is modified from Yaltirak et al. (2000).***

Two scenarios were investigated during a recent 2002 study conducted by Pacific Consult for the Greater Municipality of Istanbul as part of the Earthquake Risk Assessment. The model assessment indicated that the highest tsunami wave generated is between 4.71 and 5.56 m at the shores of Istanbul. The greatest wave heights are expected to hit the southeastern shores of Istanbul. For the shores along the Project area, tsunami waves were estimated to be 1-2 m high.

The associated implications of sea level rise and storm surges were also taken into account in the engineering design through studies undertaken for ATAS by METU Ocean Engineering Research Centre.

### *6.3.5 Soils and Contaminated Land*

Due to the location in the middle of a large city, most of the Project area is already sealed (roads, pavements, buildings etc) and only few areas have open soil cover. These are mainly located in the parks on the European side, close to the cemetery on the Asian side and alongside roadside verges. These soils are all part of either reclaimed land or civil engineering earthworks. No natural surface soils are known in the Project area.

During a site visit in Autumn 2009 a number of sites were identified where soil contamination by former or present activities may have occurred. The locations of these are shown in Figure 6-6 and Table 6-2 summarizes the results of the field reconnaissance. Photographs from the field visit are presented in Annex J-2.


*Figure 6-6 Location of Potentially Contaminated Land along the Project Route*

*Table 6-2 Summary of Potentially Contaminated Sites along the Project Route*

| No | Name | Distance to the Project centreline | Description |
|---|---|---|---|
| **European side** | | | |
| **1** | **Kazlıçeşme tannery facilities** | Approx. 200 m northwest of km 0 | These facilities were previously outside the settlement area of Istanbul. However, at the end of 1980s as the settlement area widened, tanneries were relocated. The facilities included various tannery activities (including leather painting, leather processing involving heavy metals) and the area did not have a licence or infrastructure. Regarding topography, the area is located at a higher elevation than the Project. Based on the historical use of the area, it is thought that heavy metal contamination is likely to be present at the area and that heavy metals may reach to the sea via groundwater. |
| **2** | **Görürsan Makine Sanayi** | Approx. 200 m north of km 0+200 | Görürsan Machine Industry is the only warp knitting beam producer in Turkey (http://www.gorursan.com/Hakkimizda_eng.php). The company also produces beam carriers, batching trucks, winding systems and other products. The company was established in |

| No | Name | Distance to the Project centreline | Description |
|---|---|---|---|
| | | | 1940 with a small workshop. In the 1980s, the company focused on producing beams for the world's leading weaving and warping machine manufacturers. The company exports products to Egypt, S.Arabia, Syria and S.Africa. Contamination typical of metal-working industry (such as chlorinated hydrocarbons) cannot be excluded. |
| 3 | **Old Gas Works** | Approx. 10 m north of section km 0+700 to 1+200 | Based on aerial photographs from 1940, gas was generated using coal at this site. Currently, the site is used by IETT (Istanbul Elektrik, Tramvay ve Tünel İşletmeleri Genel Müdürlüğü-General Directorate of Istanbul Electricity, Tram and Tunnel Facilities) for the storage of old, used buses. The area borders to the Theodosian Wall in the northwest. |
| 4 | **Railway Maintenance Area** | Approx. 10 m north of section km 1+200 to 1+400 | This area was used by TCDD (State Railways) from 1960 for the maintenance of local trains. The facility was closed some time ago (the date is not known) and the site is currently abandoned. It is possible that hazardous waste and materials were stored at this area. It was not possible to enter the site but based on internet aerial photographs, it is thought that hangar and large maintenance workshops are present in the area. Reportedly, this area has been transferred to TOKI (Başbakanlık Toplu Konut Dairesi Başkanlığı-Prime Ministry Directorate of Housing Department) for housing development. Part of the area facing the sea is on the embankment area. |
| 5 | **Petrol Ofisi (PO) fuel tank(s)** | South of road at km 4+700 | It is likely that there are one or two gas tanks used to fill vehicles at the Water Products Market Directorate at Yenikapi Pier. This type of storage is not regulated as strictly as gas stations and if tanks are present there is a high risk of contamination caused by leaks and spills. |
| 6 | **Petrol Ofisi (PO) Gasoline station** | Adjacent and on the road at km 5+800 | PO is a national Turkish company with thousands of retail stores. The establishment date of this station is unknown. The gas station is not in operation since approximately one year, only the shop is operated. |
| **Asian side** | | | |
| 7 | **Haydarpasa Port** | Approx. 100 m south of ventilation shaft (km 9+500) | It is likely that there is a risk of contamination at the connection point of the port and the railways as a result of train maintenance activities, storage of hazardous materials, etc. |
| 8 | **Gasoline stations** | Close to Eyüp Aksoy Interchange | There are 4 gasoline stations adjacent to the route. Three of them are located close to the tunnel entrance. These are all operated by national Turkish companies. The establishment date of these stations is unknown. As noted above there is a risk of ground contamination from leaks and spills. |

| No | Name | Distance to the Project centreline | Description |
|---|---|---|---|
| 9 | **Cement mix** | Cevreyolu Interchange | There are two cement facilities (Lafarge and Nuh Cimento) south of the route. These facilities have temporary permits and for the Marmaray construction. Large amounts of cement materials are transferred and handled at these sites. Soils may be contaminated by deposition of dust and cement auxiliary materials. |
| 10 | **Automotive industry area** | Close to Kosuyolu Interchange | The area includes many automobile repair shops. These are privately owned by small artisans. It is likely that the oils, hazardous materials, etc. are not handled according to environmental standards and some wastes may be dumped to sewers. |

## 6.4 *ASSESSMENT OF IMPACTS*

### 6.4.1 *Impacts on Geological Features and Land Stability*

Excavation works have the potential to affect geological sites and other features of importance to science and to cause land instability. The nature of the areas to be affected by the Project (mainly reclaimed or previously developed land or strata beneath the seabed of the Bosphorus) means that there is low likelihood of encountering any features of importance. The works are not expected to cause any risk of land instability.

### 6.4.2 *Impacts related to Geology and Seismic Risk*

In the event of earthquakes or tsunamis during construction and operation significant impacts on the environment as well as on the community and workers' health and safety may arise following accidents, flooding, spills, fire etc. related to the seismic incident. The Lenders Technical Adviser has evaluated the seismic design and risk assessment and acknowledges ATAŞ's approach as pragmatic and in line with the procedures followed on the Marmaray tunnel. Further work is now being undertaken to ensure suitable international design standards are adopted for the construction phase and long term operation. This will ensure that residual risks are as low as reasonably practicable.

### 6.4.3 *Impacts on Soils*

#### 6.4.3.1 *Impacts during Construction*

If any construction was to take place on soils used for productive purposes (e.g. agriculture) this could result physical damage through compaction. The open land affected by the Project is, however, mainly public open space or in transportation or commercial use and no adverse impacts are therefore expected to occur.

There will be areas where soils will be permanently covered by the new Project structures which will lead to a permanent loss of access to the soil resource. Approximately 91,000 m$^2$ of open ground with anthropogenic soils will be covered by the new road. Since these soils are not natural soils this impact is not considered to be significant.

Temporary use of land for construction can, if not properly managed and operated, lead to significant impact on soil quality by compaction and accidental spills of liquid cement, fuel oils, lubricants, *etc*. Excavation and temporary storage of soils can also damage their quality prior to re-use. In particular, inadequate care in segregating topsoil from subsoil, storage in excessively high stockpiles and movement of heavy machinery over soils can damage soil structure by compaction and runoff from stockpiles and cut and fill areas may result in soil erosion. All these impacts could have a minor impact by hindering restoration of temporary sites once construction is complete.

#### *6.4.3.2 Impacts during Operation*

During operation soils may become contaminated with road run-off pollutants including PAH (Polycyclic Aromatic Hydrocarbons) and metals. These compounds arise from spills, corrosion, wear of tyres and brake linings, and general wear of the car. The Project is designed with a closed drainage system in which road run-off will be collected at the lowest points in underpasses and the tunnel, and discharged in compliance with the local legislation. Normal road run-off should not therefore have any significant impact on soils.

There may also be risks of soil contamination occurring as a result of spills of fuel or hazardous loads during accidents and discharge of contaminated firefighting water.

### ***6.4.4 Risks associated with Contaminated Land***

The construction of the Project will take place on lands that may have been or are currently used for purposes that could give rise to contamination including the sites identified in Table 6-2. The infill in reclaimed areas from the 1940s and 60s may also contain contamination. If contaminated soils are disturbed they may present risks to workers, neighbouring land uses or the aquatic environment.

## 6.5 *MITIGATION MEASURES*

The Project will be designed, constructed and operated in accordance with good international standards for protection against seismic activity and flooding and as a result impacts should be as low as technically and financially feasible.

The contractors will be required to adopt good construction site practice for protection of soils and to follow IFC EHS Guidelines on Construction Materials Extraction and the IFC EHS Guidelines for Toll Roads. Specific measures for protection of soils and managing risks associated with contamination will include:

- Provision for the protection of newly exposed soil surfaces from rainfall erosion.
- Topsoil, overburden, and low-quality materials will be properly removed, stockpiled near the site, and preserved for rehabilitation
- Careful control of the use of cement and wet concrete in or close to any exposed areas.
- Hazardous and non- hazardous waste management plans will be developed and implemented during construction.
- Impacts associated with specific chemical and / or physical properties of extracted materials will be considered during the design phase.
- Some parts of the Project only comprise replacement of the road surface. In these cases, the old road surface material will be re-used in paving where practicable, or stockpiled for other uses. Old asphalt may contain tar and polycyclic aromatic hydrocarbons and may require management as a hazardous waste.
- Fuels, oils and chemicals will be stored on an impervious base protected by a bund and drip trays will be used for fuelling mobile equipment. Any spillages from handling with fuel and liquids will be immediately contained on site and the contaminated soil removed from the site for suitable treatment and disposal.
- Procedures will be set up for identifying and dealing with contaminated materials when encountered during constriction, including treatment and disposal of contaminated soils. Contaminated material will be remediated or disposed of in an appropriately licensed disposal site.

- Spoil and other surplus material arising from the works which is classed as 'acceptable fill' shall, wherever practicable, be recovered and used in the construction works. Relevant authorities shall be consulted regarding this on a site by site basis to ensure the re-use of waste materials is acceptable. Surplus material will be made available to third parties for reuse on local development projects if it can not be utilised on site.

The construction mitigation measures listed in Chapter 10 (Biodiversity) and Chapter 7 (The Water Environment) are also applicable to this section.

Operation of a closed drainage system and establishment of emergency response plans to be implemented in the event of spills, fire etc should prevent significant impacts on soils during operation.

# 7 THE WATER ENVIRONMENT

## 7.1 SCOPE

This chapter presents an assessment of the potential impact of the Project on groundwater, inland surface waters and the sea. The following issues are addressed and mitigation measures are described:

- potential impacts on the hydrology or quality of the water environment from physical intervention and intentional and accidental discharges to water during construction;

- potential impacts on the water environment during operation of the approach roads and tunnel.

The Project structures will be located either above ground and set back from the coast or well below the sea bed. The tunnel will be constructed from access points set back from the coast. The Project is therefore considered unlikely to have any direct effect on the marine environment.

## 7.2 INFORMATION SOURCES AND APPROACH

The assessment is based on a desk study carried out using the following information sources:

- Istanbul Regional Plan Report, 2009;
- Istanbul Water Supply, Sewerage and Drainage, Sewage Treatment and Disposal Master Plan, Final Report, Volume 3, Part A, Wastewater Infrastructure, 1999;
- a report of 12 soil boring log profiles including groundwater table measurements, undertaken by OYO International Cooperation in July 2006.

The team also undertook field visits to the route of the approach roads to confirm the locations and condition of surface watercourses along the route.

## 7.3 EXISTING ENVIRONMENT

### 7.3.1 *Surface Water*

Information on surface water resources in the region is presented in Figure 7-1 and Figure 7-2.

The main water body located in the project area is the Marmara Sea located between 30 and 200 m from the road on the European side and approx. 200 m from the ventilation shaft on the Asian side. The coastal waters of the Marmara Sea adjacent to Kennedy Caddesi are important for recreational fishing and amenity and these interests could be adversely affected by pollution.

The project area on the European side is not located in a specific catchment area of a larger river and the area drains directly into the Marmara Sea. No rivers or other watercourses are crossed by the road on the European side.

The Project area on the Asian side is located within the catchment system of the Kurbagali Creek which flows from east of Istanbul to the Marmara Sea.

The Project is not located within the watershed or protection zone of any of the seven major drinking water reservoirs supplying the city of Istanbul.

***Figure 7-1*** ***Istanbul Surface Water Resources Map (Source: Istanbul Province Environmental Status Report, 2007)***

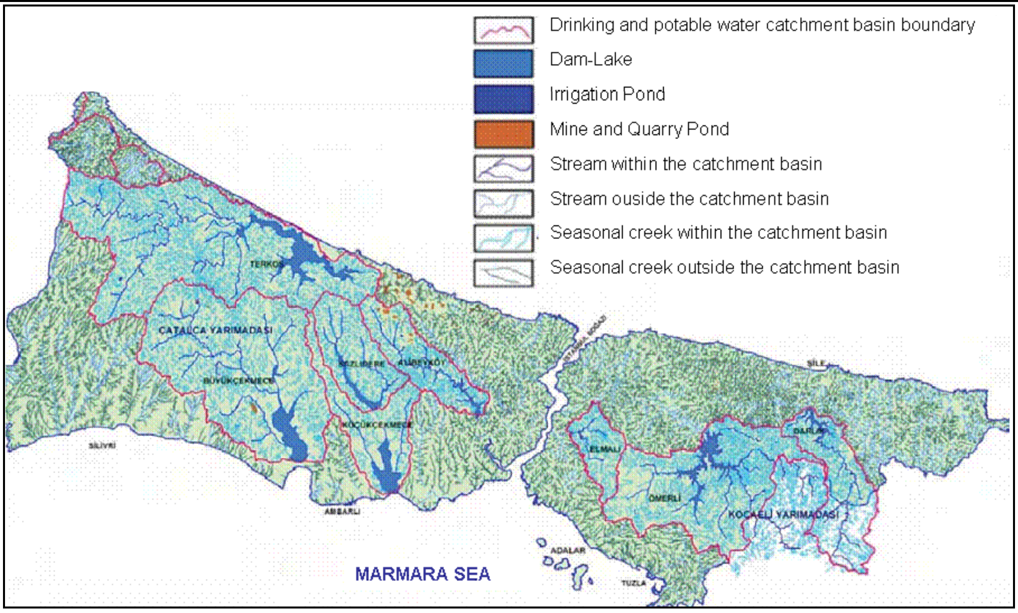
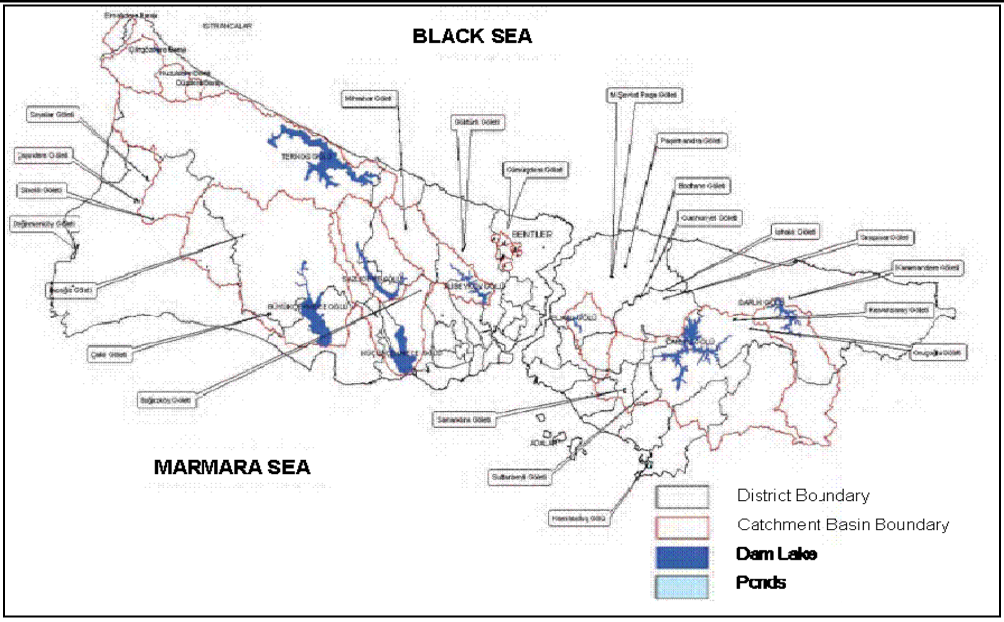


*Figure 7-2 Istanbul Lakes and Ponds Map (Source: Istanbul Province Environmental Status Report, 2007)*




### 7.3.2 *Kurbagali Creek (Kurbağalı Dere)*

Kurbagali Creek flows on the Asian side of Istanbul from east to west and discharges into the Marmara Sea. The creek is almost 40 kilometres long and one of the largest surface waters on the Asian side of the city. It has its source in Küçükbakkalköy in the foothills of Kayışdağı and reaches the Marmara Sea in Kadıköy after receiving water from Mimi Creek and Küçükçamlıca. The total area of the watershed of Kurbagali Creek is 4,496 hectares.

Kurbagali Creek crosses the D100 at Göztepe Intersection as shown in Figure 7-3.

*Figure 7.3 Kurbagali Creek adjacent to the Project*

It passes in a deep open channel beneath the main road and slip roads. Immediately north of Göztepe the creek is culverted beneath developed land. To the south a Project side road will cross the creek via an overpass at km 14+500. The creek then continues above ground in a westerly direction along the southern side of the approach road at a distance of between 30 m (at km 14+600) and 200 m (at km 13+200). At km 12+800 the creek turns south away from the Project road.

Kurbagali Creek is highly affected by the urban environment since it is partly culverted and canalised and the water is heavily contaminated by upstream run-off and disposal of wastes in the bed. It is not known to be used for any abstraction or other beneficial purposes downstream of Göztepe or to provide habitat for any aquatic fauna or flora of particular interest.

### *7.3.3 Flood Risk*

No records on flooding of the Kurbagali Creek are available. However, a comprehensive study of flood risk is presently being undertaken by the Istanbul Municipality for the whole city in the light of a severe flood event in September 2009 in the west of the city when there were several deaths. Reportedly, the severe consequences of this flood were the result of development of residential dwellings in the floodplain of the respective river. The risk of flooding from Kurbagali Creek is considered to be low given its small scale and its position in a deep channel (approx. 2 m below road level). The creek is located more than 3 km from the tunnel entrance and there is no risk of flooding of the tunnel by the creek.

The risk of flooding from the sea due to tsunamis caused by offshore seismic activity is dealt with in Chapter 6.

### 7.3.4 *Groundwater*

The European approach road is located on land at between 2 and 7 m asl (above sea level) in an area reclaimed from the sea since the 1940s. It is underlain by a shallow groundwater table and the hydrogeological situation is not natural. According to soil borings, groundwater was encountered between 11.30 m bgl (below ground level) and 2.5 m bgl. Groundwater levels vary widely and are not regularly distributed due to the varying nature of the artificial fill. Given the proximity of the sea the groundwater is assumed to be saline.

The Asian approach road runs at between 13 m asl and 52 m asl. No information on groundwater is currently available but given the elevation and that groundwater level is likely to be closely linked to the water level of the adjacent sea, it is considered unlikely that the approach road structures will reach below the groundwater table. Tunnel structures such as the NATM and cut and cover sections are likely to be in contact with groundwater.

No sensitive uses of groundwater close to the Project area are known as the water demand of Istanbul is almost entirely covered by surface water resources.

## 7.4 *ASSESSMENT AND MITIGATION OF IMPACTS DURING CONSTRUCTION*

### 7.4.1 *Introduction*

Large construction sites, if not properly managed and operated, can lead to significant impact on surface or groundwater. On the European side, the approach road construction works will be located close to the sea at a distance of 30 m at the closest point. There are no inland surface watercourses in the vicinity of the works. On the Asian approach road construction will involve the crossing of the Kurbagali Creek. Almost all subsurface works associated with major structures on the European side and the tunnel will be carried out beneath the groundwater table.

The main potential sources of impact from construction activities will be discharge of effluent from the TBM slurry treatment plant, discharges from dewatering of deep excavations, discharge of site run-off potentially contaminated with silt and hazardous materials, discharges at stream crossings, sewage disposal, wheel washing, accidental releases from work sites, and release of specialist chemicals used in tunnelling and grouting. These are discussed below and proposed mitigation is described.

### 7.4.2 *Slurry Treatment Plant*

Spoil from the tunnel boring machine will be removed from the tunnel as slurry mixed with a bentonite added at the cutter head to prevent tunnel collapse. Various chemicals may be added to protect and lubricate the TBM and to stabilise the grout used to seal the tunnel lining segments, depending on the conditions encountered along the route. The exact chemicals to be used will depend on the selected TBM but they will be selected to be of no or low hazard to the water environment[1].

The slurry will be conveyed to a holding tank and slurry treatment plant located near the access point for the TBM at the Asian ventilation shaft. The slurry treatment plant will use cyclones and centrifuges to separate the spoil and extract the bentonite, chemicals and water for recycling back into the process. Biodegradable flocculant chemicals made from modified starches will be used in the centrifuges to aid separation.

The majority of the slurry materials separated out from the spoil will be recycled back to the TBM but there may be small volumes of residual effluent requiring disposal. A permit for discharge of this effluent either to surface water or sewers under the Water Pollution Control Regulation 2004 No. 25687, will be obtained and all discharges will be made in accordance with the permit conditions and in accordance with the requirements of IFC General EHS Guidelines to protect public health and safety and conserve water resources.

ATAS will seek to use less environmentally harmful materials as far as possible. All hazardous materials used in slurry treatment will be stored in a secure, bunded area and used under careful supervision to minimise any risk of accidental releases into the environment.

### 7.4.3 *Risks to Groundwater*

At almost all locations with sub surface structures on the European side and along the tunnel route the base of the excavations will extend below groundwater level, reaching 10 m below in one location. To reduce the amount of groundwater entering these excavations retaining walls will be

[1] Information has been provided on chemicals used by the supplier CONDAT. Materials Safety Data Sheets indicate that they typically fall into classes WGK0 (= not hazardous) and WGK1 (= slightly hazardous). WGK is a German classification of the physical, chemical and biological characteristics of chemicals according to their hazard to water. Some chemicals are biodegradable but other are mineral and do not biodegrade. One substance was classified as irritating to skin.

extended approximately 30% deeper into the ground than the actual depth of the excavation.

Operation of plant and equipment within the excavated areas will present risks of pollution of groundwater from spills and leaks. Groundwater is not used for abstraction in any part of the Project area but it is understood to be in hydraulic continuity with coastal water and contamination of groundwater could lead to discharge of pollution into the sea. The potential for adverse impact is considered to be minor but to minimise this, the following measures will be taken to reduce the risk of spills and leaks:

- no fuelling of vehicles or equipment will take place within excavated areas;
- no hazardous materials will be stored in excavated areas and all handling of hazardous materials will be under special supervision;
- drainage collected in excavated areas will be collected and removed for off-site disposal together with effluent from dewatering (see below).

### 7.4.4 *Dewatering*

Dewatering may be needed to remove groundwater entering excavations for underpasses and the tunnel. This will be pumped out and treated by settlement prior to discharge to the surface drainage system. Treatment will reduce sediment concentrations to meet the standard set out in the IFC EHS Guidelines for Construction Materials Extraction which require total suspended solids (TSS) prevention and control to achieve concentrations of less than 50 $mg^*l^{-1}$ at the point of discharge. A permit for discharge of any dewatering effluent either to surface water or sewers under the Water Pollution Control Regulation 2004 No. 25687, will be obtained and all discharges will be made in accordance with the permit conditions.

The construction of retaining walls extending below the works will reduce the level of ingress of groundwater and if excavation in periods of heavy rainfall cannot be avoided the length of excavations will be kept as short as possible.

### 7.4.5 *Discharge of General Site Run-off*

Rainfall run-off from construction sites can contain large quantities of sediments from excavations, exposed ground, stockpiles of soil and construction materials, and dirt from plant, vehicles and site roads. If plant and equipment and site roads are washed down during site cleaning or dusty areas are dampened to reduce dust generation this can also result in release of sediments. All these sources can impact on nearby surface waters causing increased suspended solids and increased bottom siltation with adverse effects on aquatic life and amenity.

Additional risks to water quality may arise if materials used on site such as fuels, oils, cement and chemicals, sewage or solid wastes are allowed to enter surface run-off either intentionally or as a result of spills and leaks.

Any discharge of surface run-off into surface waters would have the potential to impact on either the Marmara Sea or Kurbagali Creek. The Sea of Marmara is important for its coastal ecology, recreational fishing and amenity but the creek is not known to be a sensitive receptor regarding any downstream use. To minimise any risk of adverse effects on the Sea of Marmara from discharges or contaminated run-off the construction contractor will be required to undertake the following measures.

- Drainage from excavations will be collected, and treated to remove contaminants prior to discharge in accordance with required permits.
- Perimeter drains will be constructed around all working areas to collect potentially contaminated run-off and direct it to a system of settlement tanks before discharge in accordance with required permits.
- Channels, bunds and sandbag barriers will be provided on site to direct run-off to the collection system.
- There will be no direct discharge of contaminated run-off from work sites to the Marmara Sea or Kurbagali Creek.
- Run-off from construction sites will be discharged to the existing road drainage system unless this is not feasible.
- All exposed earth will be surfaced or vegetated as soon as possible after works have been completed to minimise erosion.
- Works will be programmed to minimise surface excavation works during the rainy season.
- A special plan will be devised for management of the site during periods of heavy rainfall. High sediment generating activities such as road paving will be avoided and exposed surfaces and stored materials covered if necessary to reduce erosion of sediments into surface waters.
- Spoil and soil storage areas and open stores of construction materials will be designed and managed to control loss of sediments into run-off by minimising the length and angle of slopes.
- The size and duration of exposure of areas of open ground will be kept to the minimum needed for the works.

- Trafficked areas will be covered with coarse stone ballast to reduce disturbance of soils.
- Sweeping rather than washing will be used to keep roads and other surfaces clear of dust.
- Construction equipment will be cleaned away from surface waters and in areas connected to the sewerage system.
- Biodegradable cleaning agents will be used for removal of asphalt residues from road laying plant.
- Suitably sized impervious bunds or other containment will be installed where hazardous materials are handled (e.g. fuel stores and loading areas, concrete mixing, hazardous material stores) to prevent hazardous materials entering the site drainage.
- All existing manholes will be covered and temporarily sealed to prevent construction materials entering the drainage system.
- All surface water drains within the site will be kept clear and clean at all times.
- All facilities and structures will be regularly inspected and maintained to ensure proper and efficient operation at all times, and especially after heavy rainfall. Sediment deposits will be regularly removed and disposed of at either by spreading on site (if uncontaminated) or at a suitably licensed facility.

With these measures in place there will be no significant risk of adverse impacts on water quality in the Sea of Marmara and Kurbagali Creek.

### *7.4.6 Stream Crossings*

One water course, Kurbagali Creek, will be crossed by a structure carrying a slip road at Göztepe Interchange over the creek. Installation of the new structure may cause disturbance of the bed of the channel releasing sediments downstream. The stream is polluted and contaminants may be mobilised from disturbed sediments into the watercourse. It is noted that this is likely to happen already during periods of high rainfall.

As noted above the watercourse is not known to be used for any beneficial purposes or to be of any interest for its fauna or flora. The impact of stream disturbance is therefore expected to be negligible, nevertheless precautions will be taken to minimise the effect of the works by:

- carrying out the works from the banks above the channel and avoiding direct intervention in the watercourse unless the existing bank reinforcement needs to be replaced;
- undertaking the works during periods of low flow.

### *7.4.7 Disposal of Sewage from Construction Workforce*

All sewage will be collected in sanitary facilities located in site offices, at workcamps and at portable WCs. This will either be collected onsite and transported by tanker for disposal at the local sewage treatment works or discharged direct to sewer in accordance with a permit obtained under the Water Pollution Control Regulation 2004 No. 25687. There will be no direct discharge to surface waters and no impact on the environment.

### *7.4.8 Wheel Washing*

To minimise dust and dirt on neighbouring roads the construction contractor will be required to install wheelwashing equipment for all vehicles leaving the site. The effluent from wheel washing will be collected and subjected to settlement to reduce suspended solids prior to recycling of the washwater as far as possible, and any surplus will be discharged into the existing road drainage system. Collected soil will be removed for disposal at a suitable licensed facility at least weekly.

### *7.4.9 Accidental Spills and Other Discharges*

Cement, due to its high alkalinity and corrosive nature, is highly polluting and discharges of liquid cement and washings can cause pollution and have been know to cause major fish kills. Use of cement and wet concrete in or close to any watercourse will be carefully controlled and all washing wasters from equipment used to mix or transport cement and concrete will be collected and recycled as far as possible and any residues disposed off-site at a suitably licensed facility.

The accidental spillage of oils and hydraulic fluids can also have significant consequences for inland and coastal water quality and fisheries.

To minimise risks of accidental pollution:

- All fuel stored on site will be kept in appropriately labelled drums or bulk tanks located in a designated place away from any surface waters, open drains or manholes unless these are connected to an oil interceptor.

- Fuel stores and stores of other harmful substances will be sited on a sealed base within a bund of a capacity equal to 100% of the storage capacity of the largest tank.
- Refuelling will take place well away from any surface water in areas with impervious bunding or other containment.
- Spill Response Kits including absorbent materials suitable for the materials to be handled on site, will be held at secure, clearly signposted locations, instructions will be provided with the kits and personnel will be trained in their use.
- Any spillages will be immediately contained on site and all contaminated materials including soils will be removed from the site for suitable treatment and disposal.
- All staff and subcontractors will be required to report any incidents and these will be subject to investigation and remedial and preventive actions will be taken.

Other sources of contamination that could arise during construction include release of bitumen compounds used in laying the wearing course of the road, scavenger and specialist chemicals used in tunnelling and waterproofing of structures. The contractor will be required to prevent any discharge of these materials to the environment and all handling of these materials will be carried under strict supervision.

### *7.4.10 Sub-Sea Grouting*

If unstable ground conditions are encountered along the route of the tunnel special grouting will be applied to these sections to reinforce the ground. Grouting will also be applied where rock and soft ground meet beneath the sea. This will be done from the tunnel and there will be no risk of chemicals used in grouting entering the sea or inland surface waters. All chemicals will be contained and handled to avoid risk of contaminating water within the tunnel.

## *7.5 ASSESSMENT AND MITIGATION OF IMPACTS DURING OPERATION*

The principal risk to the water environment during operation will be from discharge of contaminated road drainage to inland waters, groundwater or the sea. Road drainage can contain oily residues, particles from tyre and brake abrasion, particles from vehicle emissions and cleaning materials used during maintenance (e.g. during washing of the tunnel). More significant discharges may result form accidental spills of fuel or hazardous loads carried by vehicles.

A dedicated system will collect all road and tunnel drainage at sumps located at the low points along the route (at underpasses and in the tunnel) and carry this for discharge to the municipal stormwater sewers. The drainage system will be designed to accommodate a storm with a return period of 50 years which will allow for containment of major spills. Where road drainage is contaminated by spills this will be separately collected and subjected to appropriate treatment prior to disposal in an appropriately licensed manner.

The scale and nature of the proposed scheme mean that the change in area of impervious surfaces is relatively small and will not significantly increase runoff from the existing road sections during operations.

Structures such as bridges and culverts can obstruct and cause interference with watercourses at road crossing points. In the Project area there is only one stream crossing at Kurbagali Creek. Construction  or operation of the Project will not interfere with the bed of the creek and it will have no effect on the flow or water quality of the creek.

Subsurface structures may also interfere with the flow of groundwater. All tunnel and underpass sections will be constructed in a watertight manner so that groundwater will not infiltrate into them. Groundwater is therefore expected to divert around structures. This may cause localised changes in groundwater levels and flow but as there are no uses of groundwater in the area this will cause no adverse impact. Discharge of groundwater into the adjacent coastal waters may alter slightly but this is not predicted to have any adverse effect on the marine environment.

# 8 *AIR QUALITY*

## 8.1 *INTRODUCTION*

This chapter presents the assessment of the impact of air emissions caused by the Project on air quality. Emissions from combustion of fuel in vehicles using the approach roads will disperse in the surrounding air causing increases in the concentrations of air pollutants which can harm people and other sensitive receptors. Emissions from vehicles in the tunnel will be collected by the ventilation system and emitted as point sources via the ventilation shafts at each end [(1)].

Development of the tunnel will also cause changes in the flows of traffic on other roads connecting to the approach roads and elsewhere around the city, with increases in flows on some and decreases on others. These changes will lead to increases and decreases in air pollution around these roads.

The principal pollutants from road traffic are:

- $NO_x$– nitrogen oxides including $NO_2$ - nitrogen dioxide and NO – nitric oxide;
- PM10 [(2)] – fine particulate matter including soot/black carbon and particles from abrasion of brakes, wheel rubber and the road surface;
- CO – Carbon monoxide;
- HC – unburnt hydrocarbons generated through combustion processes and fugitive fuel evaporation, including benzene, a known carcinogen;
- $CO_2$ - carbon dioxide.

The first four are of concern because they may cause adverse effects on human health, crops and natural ecosystems in the local environment around roads. Carbon dioxide is important because it is a greenhouse gas and increasing emissions can contribute to climate change.

[1] There will also be a small amount of emissions released at the tunnel entrances but this will be much smaller and has not been separately assessed.

[2] $PM_{10}$ stands for particulate matter with size below 10 µm which, with respect to human health, is considered the relevant portion of dust.

The assessment of impacts on local air quality from the Project focuses on $NO_2$ and PM10, as if these pollutants do not cause a significant impact on air quality it is likely that levels of CO and unburnt HCs will also be acceptable. Where significant impacts are identified for $NO_2$ and PM10, mitigation measures for these pollutants will also address impacts from other traffic emissions if they arise.

Emissions of these pollutants and of $CO_2$ are also considered at a city-wide level as contributors to regional air pollution and climate change.

Sulphur dioxide ($SO_2$) and lead used to be significant components of traffic emissions but are generally not a problem today since $SO_2$ and lead emissions from modern traffic are very low. They are not therefore considered here.

In addition to effects of traffic on air quality during operation of the Project, the assessment also considers short term effects during construction. Adverse effects can be caused by emissions from construction vehicles carrying materials and spoil to and from the site and construction equipment (earthmovers, etc), but also from activities generating dust (earthmoving, storage of dusty materials, vehicles moving over dusty surfaces). As well as affecting health dust can lead to unsightly and potentially harmful deposits on property, vegetation, etc.

The remainder of this chapter is structured as follows:

- Section 8.2 discusses the methods and data sources used to assess impacts from operation of the scheme;
- Section 8.3 describes the baseline situation for the year 2009;
- Section 8.4 presents the results of air dispersion modelling for the current traffic flows;
- Section 8.5 presents the modelling results for the future situation with and without the Project;
- Section 8.6 discusses the significance of impacts on local air quality around the Project approach roads from operation of the Project;
- Section 8.7 considers wider effects on air quality around the city including impacts on greenhouse gas emissions;
- Section 8.8 presents the measure which ATAS proposes to take to minimise the risk of significant impacts on air quality during operation of the tunnel;

- Section 8.9 discusses short term impacts during construction and presents the measures that will be taken to mitigate impacts of construction-related air pollution.

## 8.2 *METHODOLOGY AND INFORMATION SOURCES*

In order to assess the impacts of the Project on local air quality around roads, the steps outlined in Section 8.2.1 to 8.2.6 were followed. The approach to assessment of impacts on regional air quality is described in Section 8.7 and for construction impacts in Section 8.9.

### 8.2.1 *Establishing the Baseline*

Existing information on existing air quality was collected from air monitoring stations operated by IMM (Istanbul Buyuksehir Belediyesi IBB) situated near the project area and new measurements were also taken for the assessment. Together these data were used to establish the baseline for predicting impacts of the Project. The results are presented in Section 8.3.

### 8.2.2 *Calculating Present and Future Traffic Emissions*

Information on traffic flows was obtained from the transport studies undertaken by Jacobs (Jacobs 2010) and used to estimate the level of emissions on the approach roads and from the ventilation shafts, and the level of emissions elsewhere on the road network, today and in the future with and without the Project. The forecasts for the future took into account the effect on traffic of other changes in the transport system in Istanbul which are either underway or committed, for example the Marmaray Metro Tunnel and privatisation of the bridges, and also improvements in the emissions characteristics of the vehicle fleet over time as fuels and engine technology improve. Further details of these calculations are provided below.

***Emission Parameters***

The quantity of pollutant emissions by vehicles depends on a variety of factors; i.e.:

Single vehicle:

- Type and power of engine
- Date of construction
- Type and composition of fuel
- Efficiency of combustion (e.g. age, wear)
- Presence of emission control equipment (i.e. catalyser)
- Actual speed of the vehicle

Overall traffic:

- Traffic flow (number of vehicles per hour or day)

- Composition of vehicle types (e.g. abundance of trucks, average age and actual performance of engine types)
- Traffic flow characteristics on a specific road section (average speed, free flow, or congested traffic)
- Road characteristics (i.e. incline).

Factors taken into consideration for the ESIA are as follows:

- Overall traffic data for the current situation (2009) were taken from the traffic study undertaken by Jacobs in 2010 (average number of vehicles per hour or day and peak and interpeak hourly flows)
- The vehicle fleet on the subject roads was assumed to comprise 10% heavy vehicles (of more than 3.5 tons), 40% of the passenger cars are fuelled with diesel.
- This is assumed to remain the same in the future
- Air emissions in grams per vehicle per km for today and 2023 were taken from the EMEP/EEA Air Pollutant Emission Inventory Guidebook (1), Part B: Sectoral Guidance, Chapter 1.A.3.b on Road Transport published by the European Environment Agency (EMEP/EEA 2009). This source accounts for the effect of changes in fuels and engine technology on emission levels in future years. For estimating the age composition of the vehicle fleet in Istanbul, it was assumed that vehicles on average are 5 years older than in Western European countries
- Driving speed on the major roads was set to 80 km/h for passenger cars and trucks (this is a conservative approach for trucks which at some sections might drive 10-20 km/h slower)
- Slope or decline of the roads up to about 2% have not been taken into consideration given an only small effect on emissions in this case (this is important only for the tunnel).

These assumptions are generally considered to lead to over-prediction of traffic emissions and therefore to provide a conservative assessment of the impact of the Project.

### 8.2.3 *Modelling the Effect of Traffic on Air Quality*

An atmospheric dispersion model was used to calculate the effect of traffic emissions on air quality around the approach roads and ventilation shafts. Further details of the model are provided below. The model was set up, verified, and validated in conformance with the German guideline on atmospheric particle models - VDI 3945/3 (2).

***Air Modelling:***

The air dispersion modelling was carried out using standard software, AUSTALView (Version 6.3), which employs the AUSTAL2000 dispersion model developed on behalf of the German Environment Agency and used as the official reference model for the German Instruction on Air Quality Control (TA Luft). In Germany it is mandatory to use this model for air emissions from point sources such as the ventilation shafts and it can also be used for line sources such as roads.

Austal is a Lagrangian particle models, an advanced model which considers local topography

[1] http://www.eea.europa.eu/publications/emep-eea-emission-inventory-guidebook-2009

[2] VDI – Society of German Engineers; the VDI publishes technical guidelines and norms comparable to ISO standards

and meteorological situations in more detail than the older Gaussian models. Comprehensive meteorological parameters are used in form of a dispersion class statistics utilizing the parameters wind direction, wind speed, and atmospheric stability. Thus, the dispersion of substances follows the wind streams modulated by topography. This might be relevant in a complex terrain like it is found along the project scheme. In addition, the model allows accounting for high abundance of calm wind situations.

Emission sources can be defined as point, line, area, or volume source. The results of the dispersion calculation are substance-specific quantities in accordance with the EU directives.

The modelling in this ESIA was performed by means of the AUSTALView software (1) which utilizes the AUSTAL2000 calculation model. The mesh size for the calculations was 50m; mesh size of 25m revealed no significant improvement of the resulting concentration contour lines.

***Meteorological Parameters for Modelling***

Meteorological data representative for the project area were fed into the dispersion model by means of a three-dimensional statistics in the special format required by the software (2).

Istanbul-Atatürk was used as reference meteorological station due to the availability of the meteorological parameters required from the dispersion model. Details are provided in the Annex K. For modelling, wind data from 2001 to 2009 were taken.

The statistics of the Atatürk station were transposed to the local area of interest by a 3-dimensional wind field simulation. This means that the statistical data of the station were modulated via the region's topography. By this approach the station's statistics can be adopted and are considered representative for the site area (3) .

***Estimated Accuracy of Modelling Results***

The accuracy of modelling results is about 20-25% for the annual mean concentrations and up to 50-60% for the 1-hour maximum of the year (cf. Annex K). This is in conformance with the requirements of EU Air Quality Directive 2008/50/EC.

Three scenarios were modelled and the results are presented in Sections 8.4 and 8.5:

- "2009": Current situation
- "2023 with-Project": Year 2023 with implementation of the Project
- "2023 without-Project": Year 2023 without the Project being implemented (but including other committed changes in the transport system).

[1] Version 6.3 (February 2010) by Lakes Environmental (http://www.weblakes.com)

[2] This data format represents the relative probability of all possible combinations of wind direction (36 wind direction classes), wind speed (9 classes) and stability of the atmosphere (six stability classes ranging from very stable to very unstable). In optimum situation the statistics comprises these data for each hour of a year.

(3) However, various assumptions had to be made which influence the accuracy of the modelling results, which is estimated to be around 20%.

2023 was chosen as this is the year in which the traffic forecasts suggest the tunnel will reach its capacity of 130,000 vehicles per day (1) .

### 8.2.4 *Determining the Magnitude and Evaluating the Significance of Impact*

The magnitude of impact (see Section 1.3.5 in Chapter 1) was determined by using the model results to calculate the difference in concentrations of $NO_2$ and PM10 with and without the Project in 2023 at various distances from the road. In the absence of data enabling the future development of underlying background air quality in Istanbul away from roads to be predicted, background concentrations were assumed to stay at the same level as today (2) The difference in concentrations with and without the Project could therefore be calculated from the difference in the modelled contribution of traffic to ambient air quality (where ambient air quality equals the underlying background plus the contribution of local traffic).

The significance of these predicted changes in air quality was then evaluated by considering the extent to which the Project contributed to the possibility that air quality would exceed Turkish and international air quality standards and if so, how many residents or other sensitive receptors might be affected.

*Air Quality Standards*

Relevant air quality standards are set under Turkish law and in various international standards and guidelines. As Turkey is a candidate for accession to the EU, the EU Council Directive 2008/50/EC on ambient air quality is considered to be the most useful and relevant reference. This sets strict standards for air quality which are generally equivalent to IFC and WHO targets and to Republic of Turkey legal standards which are due to come into force by the early years of operation of the Project (see Annex C).

EU air quality standards for $NO_2$ and PM10 are established for various averaging periods from 1 hour to 1 year. Standards for annual average concentrations are designed to protect health from the cumulative effects of low level exposure to air pollution over the long term , whilst daily and hourly averages are designed to avoid acute effects caused by short term exposure to high levels of pollution.

(1) A recent forecast by Jacobs suggests that this level of traffic may not actually be reached until slightly later but this does not influence the main conclusions from the assessment.

(2) In practice emissions are likely to be reduced as a result of improvements in technology affecting sources such as vehicles, power generation, household heating, etc, but to be increased as a result growth in population, traffic and other activities. The assumption that background air quality will remain the same as today therefore seems reasonable. See also discussion re short term PM10 assessment later in this section.

The relevant EU standards for protection of human health [1] are presented in Table 8-1. Equivalent Turkish standards are also noted.

*Table 8-1* *EU[1] and Turkish[2] Ambient Air Quality Standards*

| Substance | Concentration in µg/m³ | | |
|---|---|---|---|
| | **1-hour Average** | **24-hour Average** | **Annual Average** |
| $NO_2$ | 200<br>May be exceeded 18 times per year<br><br>Turkish standard from 2014 = 300 from 2024 = 200 | - | 40<br><br>Turkish standard from 2014 = 60 from 2024 = 40 |
| PM10 | - | 50<br>May be exceeded 35 times per year<br><br>Turkish standard from 2014 = 100 from 2019 = 50 | 40[3]<br><br>Turkish standard from 2014 = 60 from 2019 = 40 |

(1) EU Council Directive 2008/50/EC
(2) Turkish standards as per AQEMR (Annexes I and IA) – see ESIA Annex C.
(3) IFC and WHO guideline values set the strictest standards for PM10 at 20 µg/m³. In an urban location such as Istanbul with a degraded airshed the EU limit value is considered to be more appropriate. IFC Interim targets range from 70 to 30.

It will be noted that the 1-hour EU standard for $NO_2$ and the 24-hour EU standard for PM10 can both be exceeded on a specific number of occasions in any one year. This provision is included in the Directive to allow for the fact that short term air quality can vary very considerably depending on the level of emissions at any point in time and the accompanying meteorological conditions. Occasional exceedances are accepted as inevitable without causing an unacceptable impact on health [2].

The impact of the Project on attainment of these standards was assessed using a different approach for long and short term values.

(1) The Directive also includes standards for protection of natural vegetation and ecosystems but these are not considered to be relevant in Istanbul.

(2) Although in theory, Turkish law is stricter as exceedances are not allowed, the EU standards are taken as the basis for the assessment as they are widely acknowledged as effective standards for protection of air quality.

*Predicting Magnitude of Long Term Impacts*

As will be discussed in Section 8.3, air quality in Istanbul is generally quite poor. Turkish and international standards for annual average concentrations are already often exceeded and this situation is likely to continue into the future. It is not therefore helpful to evaluate the significance of long term impacts by comparing air quality with the Project against standards as they are likely to be breached whether or not the Project is implemented. An alternative approach is therefore adopted which follows the IFC General EHS Guidelines. These require that "[Project] *emissions do not contribute a significant portion to the attainment of relevant ambient air quality guidelines or standards."* As a general rule, the Guidelines suggest that a significant impact would occur if a Project contributed 25 percent of the applicable air quality standards in an undegraded airshed (i.e. where air quality is good) but a lower fraction where the airshed is already degraded. As air quality in Istanbul is degraded a lower threshold of 10% (1) was therefore adopted.

*Predicting Magnitude of Short Term Impacts*

For short term concentrations the difference in the contribution of traffic to concentrations with and without the Project does not pose a meaningful parameter for evaluation. The key question for the short-term is whether and to what extent the Project affects the number of exceedances of the standard and if so, over what area the number of exceedances in a year is greater than is allowed by the EU Directive (18 exceedances for 1-hour average NO2 and 35 exceedances for 24-hour PM10).

For $NO_2$, where the short term standard is based on 1-hour average concentrations, the model was used to predict the concentrations for all hours in a typical year and then to determine the concentration above which only the permitted number of exceedances (18) was predicted. As the short term contributions will be added to the underlying background level the underlying annual average concentration was added to the short term concentration to estimate the total concentration from traffic and other sources. In practice this is the same as reducing the standard by the underlying background concentration and for $NO_2$ this value is used as the threshold for a significant impact from traffic-related concentrations.

For PM10 the same approach was not feasible as the available meteorological data did not allow calculation of 24-hour averages. Instead the model was used to predict the same parameter as for $NO_2$ (i.e. the 1-hour average

(1) The guidelines do not define what is meant by "a lower fraction" but 10% was selected as a figure which is substantially lower than 25%.

exceeded 18 time per year) and this was compared with the standard for 24-hour average concentration with 35 exceedances. This provides a very conservative assessment of the potential for significant impact.

The allowance for the underlying background concentration of PM10 also had to be addressed differently as the underlying background was estimated to be greater than the short term standard (see Section 8.3). Subtracting this from the standard would therefore give a negative value. To overcome this an optimistic assumption was made that the background concentration of PM10 would reduce by half between now and 2023. This value was then subtracted from the short term standard to define the threshold for significant impact from traffic of PM10. If the assumed improvement does not occur the relative effect of traffic on air quality will be lower than predicted using this approach and this approach therefore adds further conservatism to the assessment.

*Evaluating Significance of Predicted Impacts*

The significance of predicted impacts was evaluated by determining the locations where the thresholds discussed above were exceeded, i.e. where:

- the Project contributed more than 10% to attainment of the relevant long term standard for $NO_2$ or PM10 based on the difference between with-Project and without-Project modelling results; or
- the traffic contribution exceeded the short term standard minus background concentration, in the with Project situation;

and then estimating the numbers of people resident in those areas and identifying any other sensitive receptors such as hospitals or schools. The valuation matrix is presented in Table 8-2.

*Table 8-2 Evaluation of Significance*

| Magnitude: Based on the difference in contribution of traffic to ambient concentrations with and without the Project | | | | | Sensitivity | | |
|---|---|---|---|---|---|---|---|
| | | | | | **Low** | **Medium** | **High** |
| | | **Long term standard $NO_2$ & PM10** | **Short term standard** | | **<100 people** | **100-1000 people** | **>1000 people** |
| | | | **$NO_2$(1)** | **PM10(2)** | | | |
| **Magnitude** | **Small** | **10-25%** | **150** | **30** | Not sign. | Minor | Moderate |
| | **Medium** | **25-50%** | **175** | **40** | Minor | Moderate | Major |
| | **Large** | **>50%** | **200** | **50** | Moderate | Major | Critical |

(1) 1 hour with 18 exceedances
(2) 24 hour average with 35 exceedances

### 8.2.5 *Mitigation*

Where an impact was evaluated as being of more than minor significance consideration was given to the scope for measures to mitigate impacts on local air quality.

## 8.3 BASELINE SITUATION IN 2009

The Project corridor is situated in a densely urbanized area which includes many sources of air emissions including traffic on regional and urban highways and minor roads, electricity generation, industries, households, airplanes, ships, trains and natural sources (e.g. dust caused by wind erosion). Long distance transportation of airborne pollution from outside the city is also a well known cause of temporary impacts.

### 8.3.1 *Current Air Quality*

For characterization of the current ambient air quality in the project area, data on $NO_2$ and PM10 concentrations has been obtained from two sources.

- Results from monitoring of $NO_2$ and PM10 by Istanbul Metropolitan Municipality (IBB) at three ambient air quality measuring stations in 2009 (1) :

(1) Source: http://www.havaizleme.gov.tr

- at Istanbul-Aksaray: situated on the European side on Ataturk Bulvari in the centre of the historic peninsula about 1½ km north of the European approach road;

- at Istanbul-Kadikoy: situated on the Asian side about 1 km south of D100 in a residential area with major roads;

- at Istanbul-Uskudar: situated on the Asian side about 1 km north of the D100 in a mixed urban area.

The stations are all in locations where evidence of air pollution is expected; there is no monitoring station operated in the Istanbul region for the determination of underlying background concentrations.

- Sampling of air quality in the vicinity of the Project undertaken by the ESIA team in 2010:

  - passive sampling for $NO_2$ undertaken between November 2009 and February 2010 at 27 locations along the Project alignment (Stations 1-27);

  - active spot sampling for short term concentrations of $NO_2$ and PM10 in March and June 2010 at four locations near the tunnel entrances (Stations 101-104).

The sampling locations are all shown in Figure 8-1.

Details of the sampling methods used for the ESIA measurements and full details of the results (including data for other air pollutants) are presented in Annex K.

A summary of the findings is presented in Table 8-3.

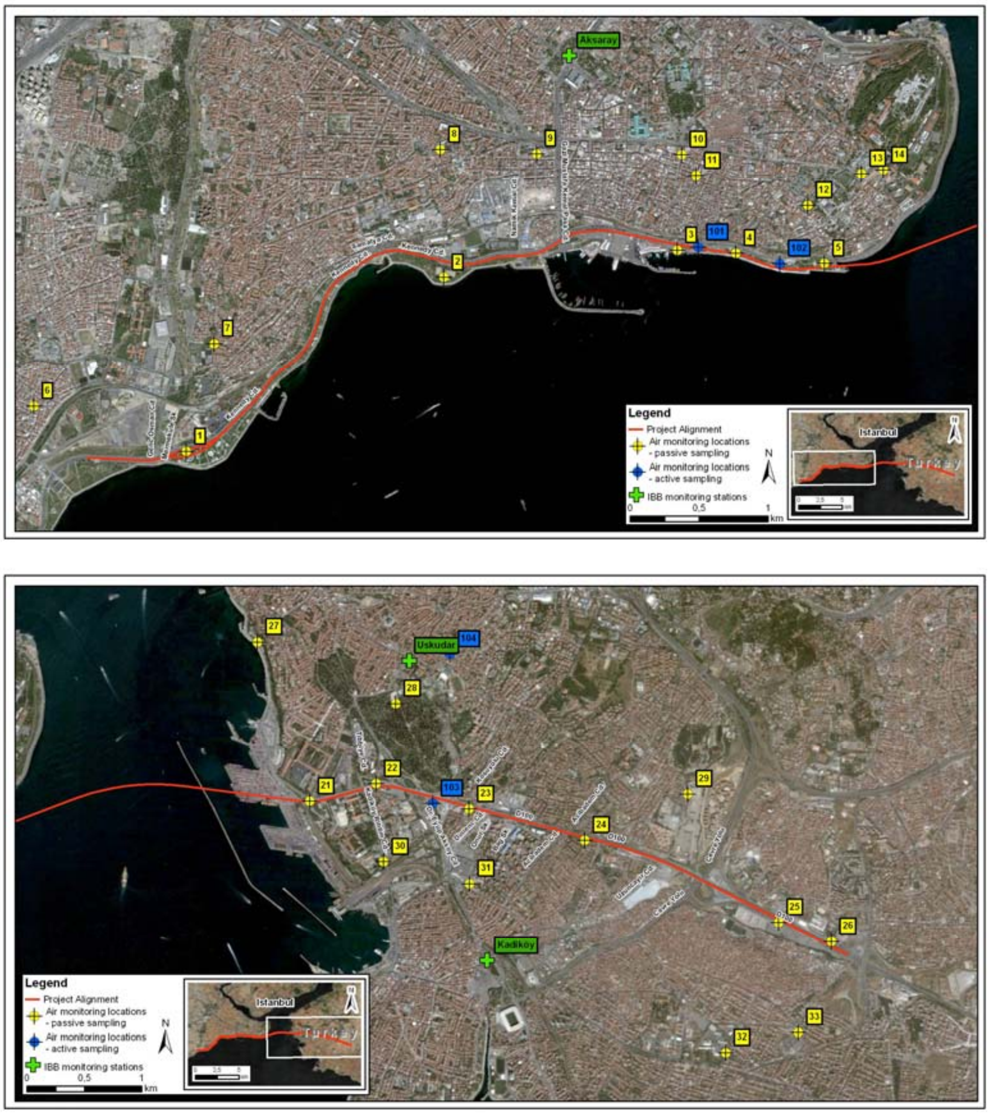



*Figure 8-1 Ambient Air Sampling Locations and Municipal Monitoring Stations*

*Table 8-3 Ambient Air Quality in 2009-2010 (μg/m³)*

| Location | $NO_2$ (μg/m³) | | | PM10 (μg/m³) | |
|---|---|---|---|---|---|
| | **Maximum 1-hour average(3)** | **95 percentile of 1-hour averages(3)** | **Annual average** | **Maximum 24-hour average** | **Annual average** |
| **EU Standard** | **200** | **200** | **40** | **50** | **40** |
| **Europe** | | | | | |
| Aksaray (1½ km north) | 1060 | | 106 | 204 | 45 |
| Urban area ½ - 1 km north (Stations 6-14)(1) | | | 54-78 (ave. 66) | | |
| Kennedy Cd European Approach (Stations 1-5) (1) | | | 60-68 (ave. 62) | | |
| European tunnel entrance (Stations 101-102)(2) | 161-165 | 88-98 | 33 | 110-118 | 63-74 |
| **Asia** | | | | | |
| Kadikoy (1 km south) | 446 | | 54 | 209 | 42 |
| Uskudar (1 km north) | | | | 150 | 37 |
| Urban area 1 – 1½ km to north (Stations 27-29) (1) | | | 58-71 (ave. 66) | | |
| Urban area to north (Station 104) (2) | 197 | 108 | 45 | 99 | 65 |
| Urban area 1 – 1½ km to south (Stations 30-33) (1) | | | 58-100 (ave. 71) | | |
| D100 Asian Approach (Stations 21-26) (1) | | | 71-103 (ave. 89) | | |
| Asian tunnel entrance (Station 103) (2) | 140 | 87 | 39 | 109 | 65 |

(1) The 3 monthly average passive sampling measurements are taken to be representative of the annual average concentration. These covered the winter period and the annual average may be overestimated given the increased level of domestic emissions and poorer dispersion characteristics in winter.
(2) The average of 12 24-hour average PM10 values measured between March and June is taken to be representative of the annual average PM10 concentration. Comparison of all the active sampling measurements (Stations 101-104) with the standards must be taken as indicative only as the samples were discontinuous and over a limited period
(3) These are the highest short term values recorded during the measurement period. In theory these should not be compared with the EU standard which allows for up to 18 exceedances in any one year for NO2 and 35 for PM10, but for our purposes here the comparison is still useful. In general it will over-estimate the exceedance of the standard. The 95 percentile values for $NO_2$ reported in the next column provides a more valid comparison with the standard and is referenced in Turkish standards, but the sampling period was insufficient to obtain a true value for 18 exceedances.

Comparing the measured values with the standards shown at the top of Table 8-3 it can be seen that:

- annual average concentrations of $NO_2$ almost all exceed the standard (40 µg/m$^3$), ranging from 33 to 106 µg/m$^3$; the standard was met only at the tunnel entrance locations which are both in areas with lower traffic;

- short term (1-hour average) $NO_2$ concentrations are much higher than the standard (200 µg/m$^3$) at Aksaray and Kadikoy; these stations are located close to very high traffic but the measurements taken for the ESIA indicate that the standard is generally met closer to the route where maximum concentrations were 140-197 µg/m$^3$;

- with one exception (annual average PM10 at Uskudar), both 24 hour and annual average values for PM10 exceeded the standards, often by a considerable margin.

From the data it is evident that levels of air pollution in Istanbul are generally poor and typical of a large city with heavy traffic. Air quality frequently fails to meet both future Turkish and current international standards.

More detailed inspection of the data (see Annex K) indicates that the lowest $NO_2$ concentrations occur at Stations 12 to 14 (south of Topkapi Palace) which are least affected by traffic. At these stations the annual average is about 54 µg/m$^3$, compared to an average of 66 µg/m$^3$ across the historic peninsula. On the Asian side a similar effect is seen with concentrations at Stations 28, 30 and 33 being about 58 µg/m$^3$ compared to the averages north and south of the D100 of 66 and 71 µg/m$^3$.

Based on these data a figure of 50 µg/m$^3$ has been used as representing the underlying background concentration of $NO_2$ in areas unaffected by local traffic.

A similar analysis for PM10 suggests that the underlying background concentration of PM10 is about 40 µg/m$^3$.

In future, an improvement in air quality can be expected to occur with steadily improving of vehicle engine technology and operation of exhaust emission control equipment and emissions from domestic heating and cooking and from industry should be reduced with replacement of old inefficient equipment and improved emission controls. However, against these the continuing growth of Istanbul's population, traffic and economic activity is likely to work in the opposite direction. These background levels are therefore assumed to persist into the future.

## 8.4 *EFFECTS OF EXISTING TRAFFIC ON BASELINE AIR QUALITY IN 2009-10*

Atmospheric dispersion modelling of current road traffic emissions has been carried out in order to estimate the contribution traffic makes to existing ambient air quality (ground level concentrations) and to verify the estimates of underlying background concentrations made from measurement data.

On the European side, the annual average daily traffic (AADT) at Kennedy Caddesi in 2009 is of the order of 90,000 vehicles/day between Kazliçesme (Genç Osman Cd), Yenikapi and Mustafa Kemal Cd, and 40,000 vehicles/day further along the coastline beyond Aksakal Caddesi. Traffic flows on major connecting roads are about 60,000 vehicles/day at Yenikapi and 30,000 vehicles/day at Kazliçesme and Aksakal Cd (1) .

The AADT on the D100 on the Asian side ranges from about 70,000 vehicles/day at Dr. Eyup Aksoy Cd to 130,000 vehicles/day at Göztepe interchange at the end of the scheme. Traffic flows on the connecting roads are roughly 30,000 vehicles/day on the D100 between the harbour and Eyup Aksoy interchange, 40,000 vehicles/day at Dr. Eyup Aksoy Cd, 90,000 vehicles/day at Cevre Yolu, and 25,000 vehicles/day at Libadiye Cd at Göztepe Interchange.

### 8.4.1 *Illustrative Modelling Results for 2009 Traffic at selected Cross Sections*

The detailed results of the modelling are presented in Annex K and illustrative findings are presented and discussed below. The discussion focuses on $NO_2$ as predictions for this pollutant are most relevant for considering impacts in the future but comparative data are also provided for PM10.

Figures 8-2 and 8-3 show the contribution of traffic to ambient ground level concentrations of $NO_2$ for the sections around Yenikapi on the European side and Cevre Yolu Interchange on the Asian side. Both figures show

(1) Traffic figures provided in this and later sections are rounded to the nearest two significant figures for convenience. Detailed figures are presented in Annex K.

concentration contours for annual average $NO_2$ from traffic on the approach roads and main connecting roads.

Table 8-4 presents calculated concentrations for $NO_2$ and PM10 at 25m, 50m, 100m, 200m, and 400m from the centreline of Kennedy Cd. at km 2+100. Although these concentration levels are influenced to some extent by the effect of local topography and building structures on dispersion, as expected concentrations decrease with increasing distance from the road. At 400 m the annual average has dropped by more than 90% and the 1-hour average (taking into account 18 exceedances) has dropped by approximately 75%. PM10 concentrations reduce more quickly with distance dropping by more than 95% for the annual average and about 85% for the 1-hour average at 400 metres.

*Table 8-4* ***Contribution of Traffic to Ambient Air Quality on Kennedy Cd (km 2+100) with Traffic Flow of 90,000 vehicles/day in 2009***

| Distance from centre line (metres) | NO2 | | PM10 | |
|---|---|---|---|---|
| | Annual average | 1-hour average (19th highest value) | Annual average | 1-hour average (19th highest value) |
| **25** | 32.0 | 215 | 7.8 | 46 |
| **50** | 8.6 | 101 | 1.9 | 17 |
| **100** | 4.7 | 79 | 0.9 | 12 |
| **200** | 2.5 | 61 | 0.5 | 9 |
| **400** | 1.4 | 52 | 0.3 | 6 |

Based on the measurement results from Table 8-3 the data in Table 8-4, and taking into account the distances of sampling locations from the road and traffic flow at the relevant location, the underlying background concentration of $NO_2$ without Project traffic can be estimated and compared with the values reported in *Section 8.3.1*. The sampling locations are located between 30 m and 50 m from the road, and the predicted contributions to ambient concentrations from traffic at these distances are 10 to 30 µg/m³ for Kennedy Caddesi (European side) and 30 to 45 µg/m³ for D100 (Asian side) with 2009 traffic flows.

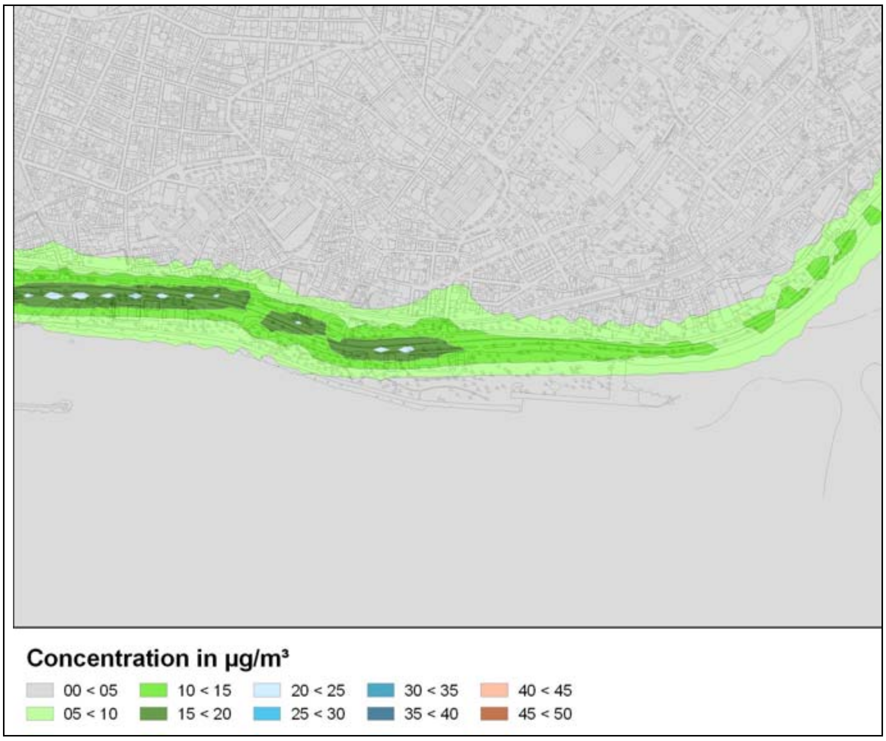



*Figure 8-2 Contribution from Traffic to annual average concentration of $NO_2$ on Kennedy Cd near Yenikapi in 2009*

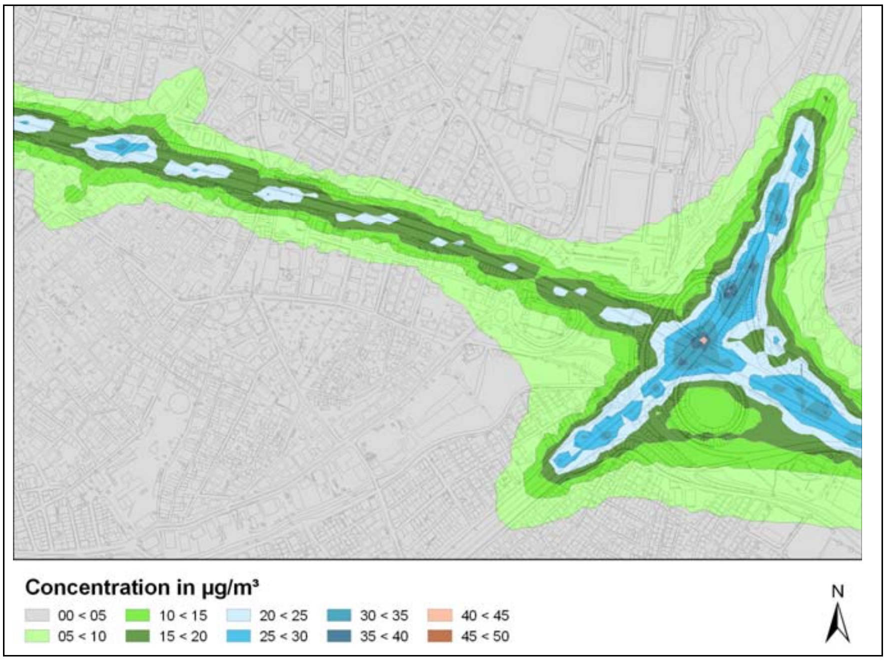


*Figure 8-3* ***Contribution from traffic to annual average concentration of $NO_2$ on D100 near Cevre Yolu Interchange in 2009***

Based on this, the underlying background concentration of $NO_2$ for Kennedy Caddesi is estimated to be 56±10 µg/m³ and for the D100 is 52±12 µg/m³. These values compare well with the measured background concentrations of 54 and 58 µg/m³ presented in Section 8.4.2.2 indicating that the modelling results are reasonably reliable [1]0. They support the application of a background concentration for $NO_2$ of about 50 µg/m³ to the study area as a whole.

A similar analysis for PM10 supports the selection of 40 µg/m³ as a study area background level for PM10 as proposed in Section 8.3.1.

## 8.5 IMPACTS OF THE PROJECT ON LOCAL AIR QUALITY

### 8.5.1 Introduction

In order to predict the impact of the Project on air quality, dispersion modelling was carried out for the Project with the tunnel operating at its maximum flow of 130,000 vehicles per day and the results compared with the situation in 2023 without the Project. 2023 has been selected as the forecast year as the traffic forecasts indicate that tunnel capacity will be reached at around this time [(2)] . Between the opening year of the tunnel, which is expected to be 2015, and 2023 total traffic through the tunnel is forecast to grow from 80,000 to 130,000 vehicles/day.

Emissions sources include vehicles moving along the approach roads and the main connecting roads, and the ventilation shafts. As discussed in Section 8.2, it is assumed that the emissions characteristics of vehicles in Istanbul will improve with changing fuel and engine technology. This is assumed to occur

(1) Fluctuations in various emissions sources (other local traffic, shipping, household, power sector, industrial and commercial emissions) and variations in local meteorological conditions will influence the background level at any particular location and time and these fluctuations limit the ability to validate the modelled results for 2009 against the baseline measurements. The calculation method has however undergone comprehensive validation during its development and implementation.

(2) It should be noted that the new traffic base case which has been developed since completion of this analysis indicates that this level of traffic flow through the tunnel will not be reached until slightly later. This is not however, considered to affect the general conclusions of the assessment.

at a rate some 5 years slower than in the EU vehicle fleet. The effect of other planned changes in Istanbul's transport system between now and 2023 is taken into account in both with and without Project scenarios.

### 8.5.2 *Traffic Flows*

Data on traffic flows at key points is presented in Table 8-5 for 2009 and the two future scenarios. It should be noted that along the approach roads, tunnel traffic (130,000 vehicles per day) will mix with other traffic that will not use the tunnel resulting in higher traffic flows on Kennedy Caddesi and D100 for the future situation than the 130,000 vehicles/day tunnel flow.

From Table 8-5 it can be seen that:

- traffic on the existing roads along the Project route is forecast to increase by at least 50% and in some sections by 100% or more between 2009 and 2023 without the tunnel;
- with the tunnel traffic flow on the widened approach roads will increase by a further 70 to 80% on the European side and 30-60% on the Asian side;
- operation of the tunnel will reduce traffic around the eastern coast of the historic peninsula by about 20%;
- traffic flows will decrease on most connecting roads (*eg* Genç Osman Caddesi, Mustafa Kemal, Aksakal, Eyup Aksoy and Cevre Yolu) but there will be a minor increase on Libadiye Caddesi at the eastern end of the route.

*Table 8-5 2009 and 2023 AADT Traffic ('000 vehicles/day)*

| **Location** | **Annual Average Daily Traffic ('000 vehicles/day); rounded** | | |
|---|---|---|---|
| | **2009 scenario** | **2023 scenario without Project** | **2023 scenario with Project** |
| **EUROPEAN SIDE** | | | |
| **Approach Road** | | | |
| Kennedy Cd (Kazliçesme to Mustafa Kemal Cd (Yenikapi)) | 90 | 130 | 220 |
| Kennedy Cd (Mustafa Kemal Cd to Aksakal Cd/toll gate) | 64 | 130 | 240 |
| Kennedy Cd (beyond Aksakal Cd (east of the Project)) | 41 | 105 | 86 |
| **Connecting Roads** | | | |
| Genç Osman Cd (Kazliçesme) | 29 | 49 | 38 |
| Mustafa Kemal Cd | 56 | 96 | 85 |
| Aksakal Cd | 24 | 43 | 41 |
| **ASIAN SIDE** | | | |
| **Approach Road** | | | |
| D100 (Eyup Aksoy Interchange to Cevre Yolu Interchange) | 70 | 140 | 220 |
| D100 (Cevre Yolu Interchange to Göztepe Interchange) | 130 | 220 | 280 |
| **Connecting Roads** | | | |
| Dr. Eyup Aksoy Cd | 40 | 110 | 94 |
| Cevre Yolu | 90 | 140 | 130 |
| Libadiye Cd | 25 | 100 | 110 |

*Source: Compiled from Jacobs 2010 model runs. All data are rounded to two significant figures for convenience..*

### 8.5.3 *Emissions from Ventilation Shafts*

The ventilation shafts were included in the modelling as point sources. Details of the shaft designs and emissions are presented in Table 8-6. A 5% road gradient is taken into account in the tunnel in calculating the level of vehicle emissions (emissions will be elevated compared to a no-gradient section). Trucks will be prohibited from the tunnel and are not include in the estimate of tunnel-related emissions.

*Table 8-6 Shaft design and emission data for an AADT of 130,000 vehicles/day*

| | European side | Asian side |
|---|---|---|
| Shaft height/shaft opening diameter | 5 m / 5 m | 5 m / 5 m |
| Ventilated rate | 160 $m^3/s$ | 180 $m^3/s$ |
| $NO_x$ emission rate | 9.2 kg/hr | 9.2 kg/hr |
| Maximum NOx emission concentration | 16 $mg/m^3$ | |
| PM10 emissions | 0.33 kg/hr | 0.33 kg/hr |
| Maximum PM10 emission concentration | 0.6 $mg/m^3$ | |

In addition to including the ventilation shafts as sources in the air quality modelling it is also relevant to consider whether they comply with emission limit values for point sources. There are no directly relevant limit values for ventilation but emission limit values set for industrial point sources provide a useful reference point. Relevant industrial emission limits are 50 $mg/m^3$ for NOx and 5 $mg/m^3$ for PM10. The maximum emission concentrations reported in Table 8-6 are well below these limit values.

### 8.5.4 *Impacts on Local Air Quality in 2023*

The impact of traffic emissions and emissions from the ventilation shafts on air quality around the approach and connecting roads was modelled as described in Section 8.2 and in the same way as for 2009 (see Section 8.4). The detailed results of the modelling are presented in Annex K. In this chapter, illustrative findings are presented and discussed.

*Nitrogen Dioxide ($NO_2$)*

Table 8-7 presents $NO_2$ concentrations at increasing distance from the road at two illustrative locations, Kennedy Cd at km 2+100 and the D-100 near Dogus University at km 12+400). These values can be compared with the data for 2009 in Table 8-3.

In addition to showing the contribution of traffic to average annual concentrations with and without the Project the difference between these values is shown for comparison with the 10% threshold for significant impact.

Where predicted values exceed the thresholds for significant impact these are highlighted in **bold**.

*Table 8.7 Calculated contribution of traffic-related emissions to concentrations of $NO_2$ at illustrative locations*

| Distance from centre line (metres) | NO2 Annual Average µg/m³ | | | $NO_2$ 1-hour average (19th highest value) µg/m³ | |
|---|---|---|---|---|---|
| | **With Project** | **Without Project** | **Difference** | **With Project** | **Without Project** |
| **Kennedy Cd at km 2+100** | | | | | |
| **25** | 32.2 | 21.3 | **10.9** | **214** | 149 |
| **50** | 9.0 | 5.8 | 3.2 | 110 | 67 |
| **100** | 4.9 | 3.2 | 1.7 | 82 | 49 |
| **200** | 2.7 | 1.8 | 0.9 | 76 | 47 |
| **400** | 1.5 | 1.0 | 0.5 | 63 | 47 |
| **D100 at km 12+400** | | | | | |
| **25** | 29.3 | 18.9 | **10.4** | **196** | 140 |
| **50** | 16.7 | 10.7 | **6.0** | **159** | 114 |
| **100** | 7.1 | 4.8 | 2.3 | 94 | 68 |
| **200** | 3.9 | 2.7 | 1.2 | 69 | 59 |
| **400** | 2.5 | 1.8 | 0.7 | 58 | 51 |
| **Threshold for significant impact** | | | **4(1)** | **150(2)** | |

(1) Threshold for significant long term impact is 10% of annual average standard (10% of 40 µg/m³ = 4)
(2) Threshold for significant short term impact is exceedance of 1-hour average standard taking into account 18 exceedances less the background concentration of 50 µg/m³ (200 – 50 µg/m³ = 150)

On the European side it can be seen that the threshold for long term impact (4 µg/m³) is exceeded at 25 metres but is met at the higher distances. Detailed inspection of the model results indicates that the threshold is met on the European side at about 45 metres from the centre line. This is equivalent to about 32 metres from the edge of the 4-lane road (roadside). If there are residents living within this distance at km2+100 they may be exposed to long term $NO_2$ concentrations which exceed the threshold for significant impact.

On the Asian side the long term threshold is exceeded at 25 and 50 metres but met at 75 metres from the centreline. The road is wider here (6 lanes) and this is equivalent to 57 metres from the roadside. If there are residents within this distance at km 12+400 on the Asian side they could therefore be exposed to significant impact.

The threshold for short term concentrations (150 $\mu g/m^3$) is also exceeded at 25 metres on the European side and at 25 and 50 metres on the Asian side. The threshold is met at 35 metres on the European side and 67 metres on the Asian side, that is 22 metres from the roadside in Europe and 49 metres from the roadside in Asia. If there are residents within these distances at km2+100 and km12+400 they may be exposed to significant short term impact.

It should be noted that the data in Table 8-7 are illustrative only and concentrations elsewhere on the route may be higher or lower depending on local topography, buildings and other factors affecting dispersion. The distances at which the thresholds are met will therefore also vary along the route. Predictions for specific locations where there are residential areas near the route and for other sensitive receptors are discussed in Section 8.5.5.

The distribution of impacts around the route is illustrated in Figures 8-4 and 8-5. These show the effect of traffic emissions on annual average $NO_2$ concentrations along two sections of the European and Asian approach roads with the Project. The difference between the with and without Project situation is illustrated in Figures 8-6 and 8-7. Full plots for the whole Project for both annual average and short term concentrations are presented in Annex K.

It can be seen from the difference plots that increases in annual average $NO_2$ on the approach roads occur in a narrow corridor along the route (grey and blue shading). There are reductions in $NO_2$ (green shading) on the connecting roads in these sections. Most other connecting roads also experience reductions in traffic (see Table 8-5) and improvements in traffic related air quality, but there is one exception at Libadiye Caddesi at the eastern end of the Project where there is a small increase in traffic as travellers divert from other routes to access the tunnel.

Figure 8.4 shows the effect of the European ventilation shaft which causes more substantial increases in annual average $NO_2$. Higher concentrations are concentrated mainly within 25 metres focussed towards the south of the shaft reflecting the predominant wind direction. The affected area is over the park and the sea and there will be no receptors present for long periods in this area. A similar effect is observed around the Asian vent shaft but again there are no long term receptors present in the affected area.


*Figure 8-4 Contribution from traffic to annual average $NO_2$ concentration east of Yenikapi (European side) for the with-Project scenario of 2023*

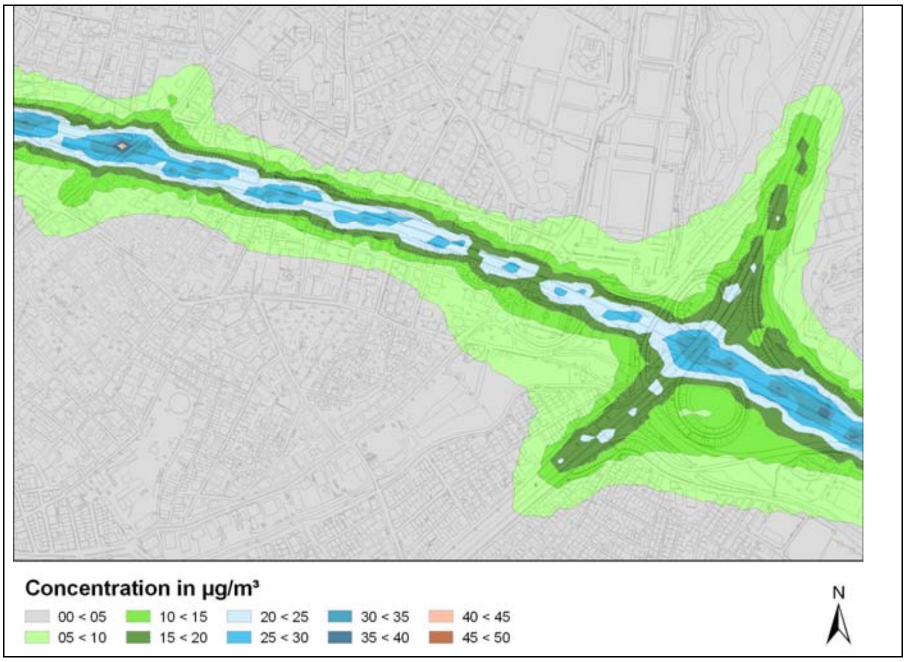



*Figure 8-5 Contribution from traffic to annual average $NO_2$ concentration at D100 near Cevre Yolu Interchange(Asian side) for the with-Project scenario of 2023*

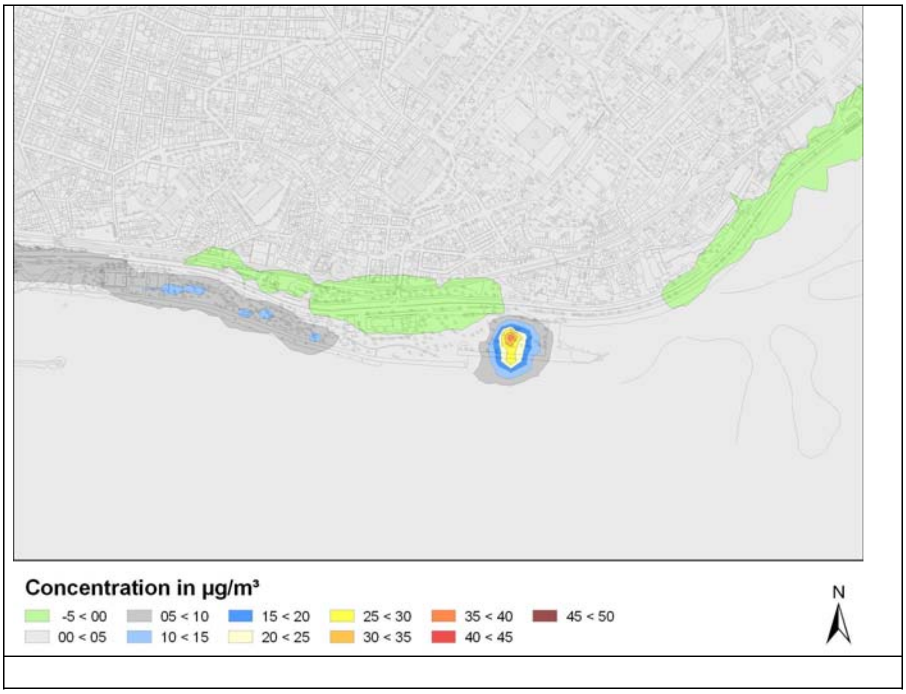



*Figure 8-6* *Difference plot for annual average $NO_2$ between the with-Project and the without-Project scenario in 2023 – east of Yenikapi (European side)*

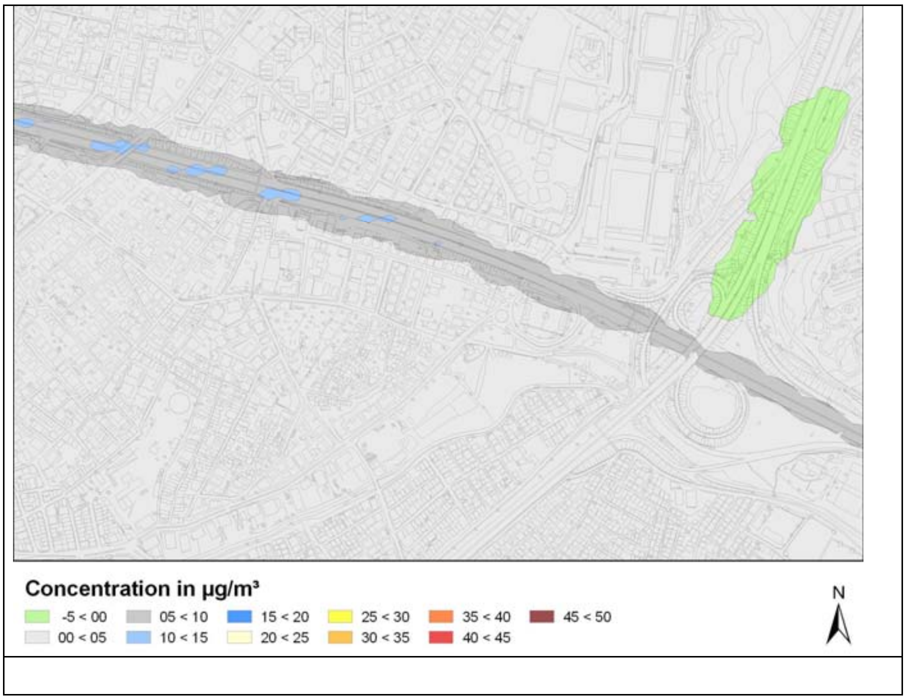



*Figure 8-2* *Difference plot for annual average $NO_2$ between the with-Project and the without-Project scenario in 2023 – near Cevre Yolu Interchange(Asian side)*

*Particulate Matter (PM10)*

Illustrative results for PM10 concentrations at km2+100 and km12+400 are presented in Table 8-8.

***Table 8-8 Calculated contribution of traffic-related emissions to concentrations of PM10 at illustrative locations***

| Distance from centre line (metres) | PM10 Annual Average µg/m³ | | | PM10 1-hour average (19th highest value) µg/m³ (3) | |
|---|---|---|---|---|---|
| | **With Project** | **Without Project** | **Difference** | **With Project** | **Without Project** |
| **Kennedy Cd at km 2+100** | | | | | |
| **25** | 10.4 | 6.8 | 3.6 | <u>59</u> | <u>38</u> |
| **50** | 2.5 | 1.6 | 0.9 | 23 | 15 |
| **100** | 1.3 | 0.8 | 0.5 | 16 | 10 |
| **200** | 0.6 | 0.4 | 0.2 | 11 | 7 |
| **400** | 0.30 | 0.24 | 0.06 | 9 | 6 |
| **D100 at km 12+400** | | | | | |
| **25** | 9.2 | 5.9 | 3.3 | <u>50</u> | 25 |
| **50** | 5.0 | 3.2 | 1.8 | <u>39</u> | 26 |
| **100** | 1.9 | 1.3 | 0.6 | 18 | 12 |
| **200** | 0.9 | 0.6 | 0.3 | 11 | 9 |
| **400** | 0.5 | 0.4 | 0.1 | 9 | 8 |
| **Threshold for significant impact** | | | 4(1) | 30(2) | |

(1) Threshold for significant long term impact is 10% of annual average standard (10% of 40 µg/m³ = 4µg/m³)
(2) Threshold for significant short term impact is exceedance of the daily average standard taking into account 35 exceedances less the estimated underlying background concentration of 20 µg/m³ (50 – 20 µg/m³ = 30 µg/m³)
(3) As explained in Section 8.2, it was not possible to predict 24-hour average values for PM10 and the 1-hour average is used as a conservative basis for comparison with the short term standard for PM10

It can be seen that from 25 metres distance annual average PM10 values are all below the threshold for significant impact. The threshold only starts to be exceeded at less than 18 metres from the centre line. This is 5 metres from the roadside in Europe and is at the roadside in Asia. There are no receptors at these locations.

For short term concentrations the thresholds are exceeded at 25 metres in Europe and at 25 and 50 metres in Asia. The distances within which the thresholds start to be exceeded are 27 metres from the roadside in Europe and 22 metres in Asia. These distances are similar to but slightly larger than the equivalent figures for $NO_2$ (22 metres and 49 metres). If residents live within these distances at these locations they may experience significant impact.

The variation in traffic-related PM10 concentrations along the route is similar to that illustrated for $NO_2$ in the figures above. Plots of PM10 for the whole route are presented in Annex K.

### 8.5.5 *Predictions for Receptor Locations*

Predictions of long and short term concentrations of $NO_2$ at specific locations where residents live close to the route are presented in Table 8-9 [(1)]. This also presents predictions for concentrations at other sensitive receptor locations such as hospitals and schools. Predictions for residential areas are for the closest buildings to the route; values at homes further away within these areas are likely to be lower.

Where the thresholds for significant impact are exceeded these are highlighted. There are exceedances of the 10% threshold in residential areas but not at any other sensitive receptors. The short term threshold is also exceeded at some residential receptors and at one hospital. The significance of these impacts is discussed in Section 8.6.

(1) Given the similarity between the predicted magnitude of impact for $NO_2$ and PM10 and the conservatism built into the PM10 results, this part of the assessment is based only on discussion of findings for $NO_2$.

*Table 8-9 Impacts on Sensitive Areas ($NO_2$)*

| Location | Receptor | Annual average $NO_2$ (limit value 40 µg/m³) | | 1 - hour average $NO_2$ (19th highest value | Comment |
|---|---|---|---|---|---|
| | | Contribution of traffic to ambient concentration in 2023 with Project | Difference with and without Project (10% threshold: 4 µg/m³) | Contribution of traffic to ambient concentration with Project (threshold 150 µg/m³) | |
| **Europe** | | | | | |
| 1+700 – 2+250 (west) | Residential | 15 | 4 | **150** | Values for closest buildings |
| 2+200 (west) | Armenian Kindergarten and Primary School | 5 | 2 | 90 | |
| 2+400 – 2+600 (north) | Residential | 15 | **6** | **150** | Values for closest buildings |
| 2+750 – 3+350 (north) | Samatya Hospital and Cerahpasa Hospital | 10 | 3 | **160** | Values for closest buildings |
| 3+950 – 4+180 (north) | Residential | 10 | **5** | **170** | Values for closest buildings; the main area is shielded by commercial buildings |
| 4+450 – 5+200 (north) | Residential | 10 | 4 | **170** | Values for closest buildings |
| 4+700 (north) | Bezciyan Armenian Primary School | 10 | 3 | 130 | |

| Location | Receptor | Annual average $NO_2$ (limit value 40 µg/m³) | | 1 - hour average $NO_2$ (19th highest value | Comment |
|---|---|---|---|---|---|
| | | **Contribution of traffic to ambient concentration in 2023 with Project** | **Difference with and without Project (10% threshold: 4 µg/m³)** | **Contribution of traffic to ambient concentration with Project (threshold 150 µg/m³)** | |
| 5+200 – 6+000 (north) | Residential | 10 | Negative | 130 | Improvement in air quality with Project |
| 6+000 – 6+500 (north) | Residential | 10 | Negative | 120 | Improvement in air quality with Project |
| **Asia** | | | | | |
| 9+500 – 10+400 | Military Barracks, University, Hospitals | 10 | 1 | 100 | Except within 25 m of shaft, improvement in air quality with Project |
| 10+800 – 11+050 (north) | Residential | 20 | **5** | **170** | Values for closest buildings |
| 10+850 – 11+100 (south) | Residential | 20 | **7** | **170** | Values for closest buildings |
| 11+050 – 11+150 (north) | Medopol Hospital | 10 | 3 | 90 | |
| 11+400 (south) | Istek Acibadem College | 10 | 3 | 60 | |
| 11+600 – 12+750 (north) | Residential | 15 | **6** | **170** | Values for closest buildings |

| **Location** | **Receptor** | **Annual average $NO_2$ (limit value 40 µg/m³)** Contribution of traffic to ambient concentration in 2023 with Project | **Difference with and without Project (10% threshold: 4 µg/m³)** | **1 - hour average $NO_2$ (19th highest value** Contribution of traffic to ambient concentration with Project (threshold 150 µg/m³) | **Comment** |
|---|---|---|---|---|---|
| 11+700 – 12+750 (south) | Residential | 25 | **7** | **160** | Values for closest buildings |
| 12+250 – 12+350 (south) | Dogus University | 15 | 3 | 130 | |
| 12+900 (south) | Ministry of Environment and Forests | 20 | **5** | **170** | Values for closest buildings |
| 13+000 – 14+500 (south) | Residential | 10 | 2 | 60 | |
| 13+400 – 13+550 (south) | Muratpasa Primary School | 10 | 1 | 70 | |
| 13+650 – 13+750 (north) | Seyh Sami High School | 10 | 2 | 80 | |
| 13+700 – 13+900 (north) | Üsküdar Municipality Cultural Centre | 5 | 1 | 70 | |
| 13+980 – 14+050 (north) | Yildirim Beyazit Primary School | 5 | 1 | 50 | |
| 14+150 – 14+350 (south) | Göztepe Halil Turkkan Primary School | 10 | 2 | 50 | |

## 8.6 *EVALUATION OF SIGNIFICANCE OF IMPACTS ON LOCAL AIR QUALITY*

In order to evaluate the effect on exposure on people living close to the Project, the residential locations potentially affected by exceedance of the $NO_2$ threshold were determined as described in Section 8.5.5.

Table 8-10 presents estimates of the difference in residential area ($m^2$) that will be affected by concentrations greater than the thresholds between the with and without Project situations [(1)]. It then provides an estimate of the number of potentially affected people living within those areas. The estimate of numbers of affected residents is based on the current average population density for the Districts on the European side (about 25,000/$km^2$) and on the Asian side (14,000/$km^2$) of the scheme [(2)].

The affected locations are identified in Table 8-9. In each case a narrow strip of residential land varying in width from zero to at most about 75 metres from the roadside will be affected:

- alongside Kennedy Caddesi in Samatya (km 1+700 - 2+600) and the grounds of Samatya Hospital;
- north of Yenikapi ferry terminal and the eastern end of the coastal park (km 3+950 – 4+180);
- next to the D100 near Medopol Hospital; and
- alongside the D100 up to Uzuncayir interchange.

It should be noted that the concentrations presented in Table 8-9 are for the nearest building to the roadside in each area and that concentrations will be lower at buildings set back further from the road.

The number of inhabitants in Istanbul will increase in the future. Therefore, the data in Table 8-10 could be an under-estimate with a greater population being exposed in future years. However, for the areas located directly adjacent to the scheme with already existing high traffic flows, land is already intensively occupied with little scope for further residential growth. Thus, the data in Table 8-13 are considered to pose a reasonable estimate.

(1) )The affected areas are determined by measuring the areas exceeding the thresholds from the mapping of air quality along the full Project route with and without the Project presented in Annex K and identifying those areas in residential and other sensitive uses. Information on land use is taken from the mapping and aerial photography in Annex I.

(2) Source: http://istanbul.net.tr/istanbul_ilceler.asp

*Table 8-10 Significance of Impacts on Residents*

| | Europe | Asia |
|---|---|---|
| **Long Term Impact** | | |
| Increase in area affected by long term concentrations greater than the threshold (>4 µg/m³) | 8,000m² | 30,000 m² |
| Estimated number of residents affected and resulting sensitivity of receptor group (see Table 8-2) | 200 (Medium Sensitivity) | 420 (Medium Sensitivity) |
| Magnitude of impact (see Table 8-9 and Table 8-2) | 10-25% of standard (Small Magnitude) | 10-25% of standard (Small Magnitude) |
| Significance of impact (see Table 8-2) | Minor Impact | Minor Impact |
| **Short Term Impact** | | |
| Increase in area affected by short term concentrations greater than the threshold (>150 µg/m³) | 3,400 m² | 16,000m² |
| Estimated number of residents affected and resulting sensitivity of receptor group (see Table 8-2) | 85 (Low Sensitivity) | 225 (Medium Sensitivity) |
| Magnitude of impact (see Table 8-9 and Table 8-2) | >200 µg/m³ (Large Magnitude) | >175 µg/m³ (Medium Magnitude) |
| Significance of impact (see Table 8-2) | Moderate impact | Moderate Impact |

Table 8-10 shows that there will be only minor impact from changes in long term air quality but that impacts of moderate significance could result in the short term. These are likely to result from peaks in traffic flows coinciding with poor dispersion conditions. Proposals for mitigating these impacts are discussed in Section 8.8.

## 8.7 *IMPACTS ON CITY-WIDE AIR QUALITY*

The preceding sections have focussed on the impact of traffic on the approach roads to the tunnel (Kennedy Caddesi and the D-100) and direct connecting roads. However, the tunnel will also affect traffic flows and resulting air quality on the wider network as traffic adjusts to the introduction of a new Bosphorus crossing. This effect can be considered at two levels: in relation to individual roads where there are substantial changes in traffic as a result of the project and across the city as a whole.

The effect of the Project on the individual roads can be seen in Figure 8-8 which shows the Project-related change in annual average daily traffic (difference between with and without-Project). A difference of 10,000 vehicles per day would result in a change in the annual average concentration of $NO_2$ of about 3 µg/m$^3$ at a distance of 25 m from the centreline.

Changes below 5,000 vehicles/day are not shown in the figure since they will not have a noticeable effect on the concentrations in the neighbourhood of connecting roads. Traffic on the scheme itself is not included.


AADT difference values are drawn for each driving direction separately
Data source: Jacobs 2010

*Figure 8-8* ***Difference in traffic flow on connecting roads with-Project minus without-Project (AADT - Annual Average Daily Traffic)***

The figure shows neutral or beneficial effects along several roads in Europe (north south roads and Kennedy Caddesi north and east of the tunnel entrance), and on most roads in Asia, with lower traffic flows leading to reductions in $NO_2$ of 3-10 µg/m³ at the reference distance of 25 m on many roads. On the other hand, some east west roads on the European side will experience increases as traffic approaches Yenikapi to join the tunnel approach.

An overall view of the balance between adversely and beneficially affected areas (including the approach roads and other roads) can be achieved by using an index of "weighted road length equivalent" ("$D_e$"). This is a qualitative parameter determined from the Project-related difference in annual average concentration ("$C_{delta}$") for a specific road section of length D:

$$D_e = C_{delta} \times D$$

$C_{delta}$ is calculated at a nominal distance from the centreline of 25 m on each side of the road.

With this approach, for the area shown in Figure 8-8, the index $D_e$ for roads with increased traffic is 503 units (1) and $D_e$ for roads with reduced traffic is minus 708 units. The balance is therefore a net benefit of 205 units . Hence, although the concentration along the scheme increase, the Project leads to an overall a improvement in city wide air quality in the wider area when compared to the without-Project situation.

Across the city as a whole the impact of the Project can be assessed by considering the effect of the new, shorter route across the Bosphorus on the overall number of vehicle kilometres travelled by traffic in Istanbul. Table 8-11 **Error! Reference source not found.**presents estimates of the total vehicle kilometres travelled on the entire Istanbul road network with and without the tunnel (Jacobs 2010). The effect of this on total traffic emissions across the city is calculated assuming that trips throughout the network are similar in both scenarios and that average vehicle specific emissions are not significantly different throughout the network. The figures are approximations but they provide a useful indication of the likely scale of change in total traffic emissions.

(1) 1 unit = 1 km.µg/m³

*Table 8-11* ***Daily and annual savings in air pollutant emissions with operation of the tunnel in 2023***

| | **Daily** | **Annual** |
|---|---|---|
| Vehicle kilometres travelled (Jacobs 2010) | | |
| Without tunnel | 277 million | 100.6 x $10^9$ |
| With tunnel | 276 million | 100.9 x $10^9$ |
| Saving with the tunnel | 1.01 million | 370 million |
| Emissions saving with the tunnel (tonnes) (1) | | |
| CO | 0.89 | 320 |
| $NO_x$ | 0.54 | 200 |
| PM10 | 0.032 | 12 |
| HC | 0.12 | 43 |
| Benzene | 0.005 | 1.9 |
| $CO_2$ | 220 | 81,400 |

(1) Emission factors were taken from EMEP/EEA Air Pollutant Emission Inventory Guidebook, Part B: Sectoral Guidance, Chapter 1.A.3.b on Road Transport published by the European Environment Agency (EMEP/EEA 2009).

In terms of an integrated approach to air pollutant emissions, the operation of the tunnel will result in a small reduction (ca. 0.3-1%) in the total emissions of traffic generated air pollutants in the City of Istanbul. This scale of reduction is unlikely to have a discernible effect on human health but it will support the general reduction in traffic emissions and resulting improvement in air quality which is expected from modernisation of the vehicle fleet, particularly for $NO_x$ and $PM_{10}$.

Two particular issues which have been noted by consultees are the impact of the Project on greenhouse gas emissions and the risk of damage to buildings in historic Istanbul.

### *8.7.1 Greenhouse Gas Emissions*

The calculations presented above show a reduction in total $CO_2$ emissions from traffic in Istanbul of 220 tonnes per day or nearly 82,000 tonnes per year. This can be placed in context by comparison with national emissions. So the reduction comprises approximately 0.03% of Turkey's annual $CO_2$

emissions[1]. Although a very small quantity in relation to overall emissions it will provide a positive impact by contributing towards reducing the risk of climate change.

### 8.7.2 *Impacts on Buildings*

Air pollution can cause damage to buildings by causing acid erosion particularly of stonework and soiling by black soot and smoke. Such effects have most often been linked to high levels of air pollution caused by use of coal and heavy oils in domestic heating and industry. Particularly, high levels of acidic sulphur emissions led to damage of buildings and monuments in the 1960s to 1980s, for example in Rome, Athens and London.

Various studies on how emissions of acid gases such as $SO_2$ and $NO_x$ cause corrosion of materials were conducted in the 1980s. The general result for stone materials was that no direct correlation was found between ambient concentration and corrosion, since multiple additional factors are significant, e.g. humidity, frequency and intensity of rainfall, presence of lichens and/or fungi on the material, composition and porosity of the affected material. Some correlation was found only for metal oxidation.

The concentrations showing effects were quite high, at 5 to 10 times today's air quality standards. Turkish and EU regulations do not stipulate separate standards for protection of building materials since compliance with the standards for protection of human health is considered sufficient to protect building materials.

With introduction of low sulphur coal and oil, the move away from domestic use of coal and improvements in vehicle fuels and engine technology, the current situation has improved markedly. Today the risk of harm to buildings is significantly lower.

However, there are still acid and particulate emissions from use of fuels in homes, industry and traffic today. The levels of air pollution experienced in Istanbul today will be causing some slow and inevitable damage to building facades, but not at the very visible scale seen in the past, and traffic will be only one contributor to these effects.

In the immediate vicinity of the approach roads there will be increases in concentrations of $NO_2$ and PM10 as discussed in Section 8.5. The effect of traffic on concentrations decreases rapidly with distance from the road such

[1] See annual emissions for 2006 from UN Millennium Development Goals Indicators at http://mdgs.un.org/unsd/mdg/SeriesDetail.aspx?srid=749&crid^

that elevated levels are only likely to occur over 50-100m. There are only a small number of historical buildings present within this distance to the north of the European Approach and none on the Asian side and the increase in concentrations is not predicted to be sufficient to cause noticeable damage.

Across the historical peninsula and the wider city the net reduction in overall emissions will reduce the risk of harm to historic buildings.

## *8.8 MITIGATION MEASURES FOR IMPACTS ON AIR QUALITY*

The main risk of significant adverse impacts on air quality will arise at peak commuting times when traffic flows are at their highest, and when these coincide with meteorological conditions which are unfavourable for the dispersion of vehicle emissions.

Meteorological conditions cannot be influenced and it is not within the ability of ATAS to influence the basic emission levels from vehicles. Actual emissions and their resulting effect on air quality can however be influenced by traffic management including measures to avoid stop-start traffic and congestion and to encourage vehicles to travel at optimal speeds for fuel efficiency. The provision of free flow junctions and U-turns along the route to replace the existing signalled intersections will assist in this.

In order to avoid exceedances of short-term limits, speed may be limited to 60 km/h if monitoring indicates that air quality standards are being exceeded. To assist in identifying circumstances when speed restrictions may be required ATAS will monitor ambient air quality at a continuously operating air quality monitoring station to measure ambient air concentrations and determine whether ambient air quality standards are being exceeded. The station will be located on Kennedy Caddesi. If continuous monitoring indicates that ambient concentrations are approaching the limit, variable message signs will be used to slow traffic to reduce emissions. Depending on the measured effect of traffic on air quality, other locations may be selected for monitoring monthly average concentrations.

In addition ATAS will support the reduction of emissions from road traffic by:

- installing speed control displays to notify drivers that they are exceeding the speed limit;
- using the Project's variable message signs to control vehicle speeds to minimise congestion;
- supporting public campaigns on regular vehicle maintenance;
- raising awareness regarding the relationship between driving behaviour and emissions through public information (signs, leaflets *etc*).

Traffic management measures will be the responsibility of the Istanbul Municipality's Traffic Control Centre IBB and ATAS will work with them to design and develop appropriate traffic management.

The predicted exceedance of the long-term standard for $NO_2$ at the ventilation shafts up to 25 m from the centre of each ventilation shaft is not considered to pose a potential health impact since long-term (days/weeks/months) exposure is very unlikely within these areas. The European shaft is between the old road and the toll plaza and the Asian shaft is located on a traffic island, meaning that public use of the land immediately around the shafts is highly unlikely.

In the event that public access was possible planting around the shafts could be used to prevent the public entering the area where air quality standards could be exceeded. Once the Project is in operation, if monitoring indicates that exceedance of air quality standards is occurring in areas where the public may be present the option of increasing the ventilation rate to enhance dispersion will also be considered and adopted if necessary.

## *8.10 AIR QUALITY IMPACTS DURING CONSTRUCTION*

The main sources of air emissions from construction works on the Project will be:

- dust emitted from excavation, earth moving, loading, handling and transportation of spoil;
- emissions of combustion gases from construction machinery and the vehicles.

Construction will be take place in stages along the route as described in Section 2.4 . Each stage will cover a section of about 1.4 km length plus the tunnel sections (cut and cover, shafts, TBM and NATM tunnel). The duration of construction in each section is expected to be 20 to 30 months with works being carried out in parallel in several sections in order to limit the overall construction time.

Construction activities on the European side include the approach road and structure works from km 0 to the toll plaza (km 5.4), and the ventilation shaft, operations and electrical buildings and cut and cover tunnel. On the Asian side, construction works will include the approach road from km 10.8 to km 14.6 plus the cut and cover tunnel and the access and surface works associated with tunnel boring. Emission of dust

Dust can be generated at construction sites by many activities including:

- Excavations;
- Earth moving;
- Loading, handling and storage of materials and waste including spoil;
- On- and off-site transport of dusty materials and movement of vehicles over un-surfaced ground;
- Exposure of surfaces to wind;
- Demolition of structures;
- Crushing and screening of construction materials and debris.

Dust emitted from construction areas has a broad size distribution. Large particles of more than 100 µm diameter are likely to settle within 10 to 20 m of their source. Particles of 30 to 100 µm diameter may travel over 100 m. These fractions constitute the majority of particulate matter emitted from construction activities. Smaller particles below 10 µm (PM10) may also be generated and can remain suspended in air over larger distances. If these small particles are inhaled they can cause adverse impacts on human health. Larger particles are captured by the respiratory system and transported into the throat where they are swallowed. As a result large particles are generally not of concern for health but can cause nuisance by soiling surfaces and vegetation. Research studies have indicated that complaints about deposition of dust typically come from people living within 50 m of construction sites. The frequency of complaints decreases with increasing distance and beyond a distance of about 100 m, nuisance from dust deposition is unlikely.

Standards for protection of human health from PM10 discussed in Section 8.2,. There are no standards for dust deposition in Turkey or in the EU or IFC but for the German Technical Guideline on Air ("TA Luft") stipulates a value of 0.35 grams per square metre per month in order to protect human beings against dust nuisance. This value can be adopted as reference for monitoring dust deposition.

Actual dust emissions depend on the kind of material, the particle size distribution, moisture of the material, as well as the type of activity and nature of handling.

Since it is not possible to eliminate dust emissions from construction sites completely, site management practices must be implemented and maintained to control dust emissions. Dust mitigation measures that will be applied during construction of the project are presented in Section 8.10.2.

### 8.10.1 *Exhaust emissions*

Construction machinery and vehicles use mainly diesel engines and lead to emissions of nitrogen oxides and particulates (see Section 8.1). Most site equipment (bulldozers, diggers, etc) can be considered as similar to medium or heavy duty trucks..

Vehicles are used for transport of materials and equipment on and off site as well as carriage of personnel to and from site using minibuses and cars. Off site transport will include spoil, concrete, road aggregates, asphalt, and pre-fabricated concrete tunnel segments.

Construction related vehicles are assumed to use Kennedy Caddesi and 100 Yil Caddesi on the European side and D100 on the Asian side, and then to connect with the wider main highway network.

For the European part of the scheme it is estimated that about 200,000 $m^3$ of spoil will be removed and about 400,000 $m^3$ of construction and paving materials will be delivered (cf. Section 2.4). On the Asian side, there will be 730,000 $m^3$ of excavated material from the tunnel adds plus about 40,000 $m^3$ of spoil from the approach road. 164,000 $m^3$ of materials for the tunnel and 174,000 $m^3$ for the approach road will also be delivered. An estimate of the truck frequency required to transport these quantities to the site and off-site gives hourly averages of 13 truck movements on the European side [(1)] and 22 movements for the Asian side [(2)]. The actual transportation needs will vary depending on the progress of the construction works.

In addition to these vehicle movements, about 10 to 25 construction machines and on-site vehicles will be present at a construction site at any one time (depending on the size of the site and the nature of activities carried out) although it is unlikely that all will be operating at the same time.

Comparison of these 13 truck movements per hour and the operation of 10-20 machines on-site on the European side with the current traffic flow of about 3,000 to 4,000 vehicles per hour on Kennedy Caddesi shows that the construction activities will contribute less than 1% to the traffic flow on

[1] Transportation of 600,000 $m^3$ with trucks carrying 8 $m^3$ on average requires 75,000 trips. The period for earthworks and construction is 40 months. With 30 days per month and 10 hours per day for transportation activities, an average frequency of 6.3 transports per hour is required. Each trip comprises two movements one from and one to the site.

[2] Similarly for Asia: 1,020,000 $m^3$ means 128,000 trips over the 40 month tunnelling and approach road construction period. Therefore the average frequency of trips to and from the sites is about 22 per hour.

average. The vehicles and equipment will all have diesel engines and contribute more to NOx than petrol vehicles and as a result $NO_x$ emissions may be temporarily and locally increased by 5%. The impact on ambient air quality is considered low and will not be significant.

Similarly on the Asian side, the projected trips of 22 per our plus on-site machines and vehicles will have no significant effect on traffic related air quality on the D100 with its current flow of 5,000 to 6,000 vehicles per hour.

If there are short term peaks in construction traffic, $NO_x$ emissions could become relevant for the sensitive areas identified in Section 8.5.5.

To avoid any risk of adverse effects mitigation measures will be implemented as described in Section 8.10.2 below.

### *8.10.2 Mitigation Measures during Construction*

The Turkish Regulation on Control of Excavated Soil, Construction and Demolition Wastes requires that measures are taken to minimize dust emissions from excavations. ATAŞ will adopt the following measures to control the release of dust and other emissions from constructions:

- Dust generating areas will be controlled by water spraying, particularly under dry weather conditions.
- Stockpiles will be planned and sited to minimise the potential for dust generation taking into account prevailing wind directions and the locations of sensitive receptors. They will be protected against wind erosion (e.g. by wind shield, water spraying in dry periods).
- The drop height of potentially dust generating materials will be kept as low as possible.
- Where practicable, stockpiles will be located away from sensitive receptors.
- If crushing of construction materials or demolition debris is required, crushers will be located away from sensitive receptors.
- On-site speed limits will be applied and enforced for trucks travelling on unpaved surfaces (10 km/h);
- Trucks transporting spoil or other dusty materials off-site will be covered before leaving the site.
- Construction vehicles will not be permitted to keep engines running while waiting to enter the site or waiting on-site.

- Wheel washing facilities will be available and used so that trucks leaving the site do not spread dust onto neighbouring roads.

- Public roads used by site traffic will be swept regularly to prevent accumulation of dirt.

- Construction machines will not be left running in periods between work, or will be throttled down to a minimum.

- Maintenance procedures will be implemented in order to keep equipment in good working condition to minimise exhaust emissions caused by poor performance.

Successful implementation of the above measures will be supported by provision of training for the operators of equipment and truck drivers regarding the air pollution potential of their activities.

Dust levels around construction sites will be monitored using dust deposit gauges. ATAŞ will, as reference, adopt the value of 0.35 grams per square metre per month as stipulated by the German Technical Guideline on Air ("TA Luft") for the protection against dust nuisance. If this level is exceeded at sensitive areas near the construction sites, ATAŞ will take additional measures for dust control including to prevent recurrence during further stages of construction work.

# 9 NOISE AND VIBRATION

## 9.1 INTRODUCTION

One of the most significant impacts caused by traffic is exposure of people living in the vicinity of roads to noise. Sound propagates through the air and may be perceived as noise (*ie* unwanted sound) by a receptor in the vicinity. Surveys in the EU reveal that a great part of the population feels annoyed from noise caused by road traffic [1].

This chapter presents the assessment of the noise impact caused by the Project. During operation of the tunnel, traffic flows will increase on the approach roads causing increased sound emissions and additional noise in the neighbourhood. For the evaluation of the impact of the Project, comprehensive noise modelling was performed for the project scheme comprising the alignment along Kennedy Caddesi, the new road tunnel, and the D100 Istanbul-Ankara State Highway up to Göztepe Interchange).

In the future, the traffic flows will increase not only through operation of the tunnel but also due to general increase of traffic over time. Therefore, the ESIA refers to the future situation without the tunnel as the baseline for defining the impacts of the Project. Additionally, comparison is provided with the current situation to provide context for discussing the changes with implementation of the Project.

Vibration during operation of a road can result from heavy duty vehicles. Since heavy vehicles will not be allowed to use the tunnel, no impacts from operation of the tunnel in regard of heavy vehicles are expected and the issue is not considered further in the ESIA.

In addition to noise during operation, the assessment also considers short term effects during construction. Adverse effects can be caused by noise emissions from construction vehicles carrying materials and spoil to and from the site and construction equipment (earthmovers, etc). Construction activities such as driving piles and operation of heavy construction machines can also result in vibration with potential impacts on the occupiers and possibly the structure of nearby properties.

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[1] Noise exposure and noise stress can cause a variety of diseases in human beings, like e.g. circulatory troubles, hardness of hearing, or nervous system troubles. Recent medical investigations even show correlation of noise impact with cardiac infarction.

The remainder of this chapter is structured as follows:

- Section 9.2 discusses the methods and data sources used to assess impacts from operation of the scheme;
- Section 9.3 summarise relevant standards for evaluation of the significance of changes in environmental noise;
- Section 9.4 describes the baseline situation for the year 2009;
- Section 9.5 provides the results of sound propagation modelling and the assessment of potential impacts;
- Section 9.6 evaluates the Project's impact on environmental noise;
- Section 9.7 presents the measures that will be taken to mitigate impacts and describes residual impacts;
- Section 9.8 discusses short term impacts during construction, describes mitigation measures and discusses the issue of vibration.

## 9.2 *METHODOLOGY AND INFORMATION SOURCES*

### *General*

Sound is a change of air pressure affecting the ear. Sound pressure levels are measured in decibels (dB) which is the logarithm of the ratio of the actual air pressure over a reference air pressure. Human hearing perceives identical sound pressure levels of different frequencies with different strength. For the adaption to human hearing, it is therefore common to use a frequency weighted scale designed so that the level will match the subjectively perceived level. This is commonly done by implementing the so-called A-weighting scheme indicated by the unit dB(A).

Due to the logarithmic nature of the scale the doubling of a source does not result in an impression of doubled loudness. This is reflected in findings of physiological studies where human perception was compared against decibel levels:

- ≤ 3 dB(A) imperceptible increase;
- 3 – 5 dB(A) threshold of perceptibility, minor increase;
- 6 - 9 dB(A) moderate increase;

- ≥ 10 dB(A) significant increase, representing a subjective doubling of loudness.

Since sound pressure levels often vary with time, they are commonly shown as the so-called Equivalent Continuous Sound Pressure Level ($L_{eq}$) which is the energetic average over the observation time. The $L_{eq}$ is the parameter normally used specification of noise standards. In this assessment, all sound pressure levels L are provided as $L_{eq}$ levels. They can also be addressed as $L_d$, $L_e$, $L_n$ in order to indicate the related time period day, evening, or night. The strength of sources is given as sound power levels $L_w$.

For better understanding of various levels, Table 9-1 provides some examples of sources and the associated sound pressure levels.

*Table 9-1 Typical Sound Pressure Levels*

| **Source or Effect** | **Approximate Equivalent Sound Pressure Level in dB(A)** |
|---|---|
| Pain in the ears | 140 |
| Jet take-off (30m) | 140 |
| Hearing damage (short-term exposure) | 120 – 135 |
| Non-comfort, first pain | 120 |
| Jack hammer, Chain saw | 100 – 110 |
| Heavy diesel truck (3 m distance) | 80 – 90 |
| Hearing damage (long-term exposure) | 85 |
| Major road (roadside) | 70 – 80 |
| Busy restaurant | 70 |
| Passenger car (1 m distance) | 65 – 75 |
| Normal conversation | 45 – 60 |
| Whispered conversation | 35 – 45 |
| Breathing | 25 |
| Very quiet room | 20 – 30 |

A difference of 3 dB(A) for the sound pressure level results when the a source is doubled. Hence, a difference of 3 dB(A) is obtained if traffic flow increases from e.g. 50,000 to 100,000 vehicles/day, but the same is also true for an increase from 50 to 100 vehicles/day. Therefore, a decibel difference has always to be discussed together with the absolute level at the same location.

The degree of annoyance caused by exposure to sound will depend on the sound pressure level at the receptor which is affected by distance from the source and duration, but also on the receptor's subjective reaction which can be influenced by several factors:

- the existing noise level in the environment (adaption to noise);
- the type of noise source (road traffic, rail, industry, sports, music, etc);
- the sensitivity of the receptor (*eg* noisy or silent working, teaching, sleeping).

These aspects are taken into consideration as far as possible in defining noise standards as presented in Section 9.3.

The following approach has been taken to assess the impacts of the Project:

- measurements of noise levels have been made in the area of the Project;
- information on traffic flows with and without the Project has been obtained from the transport studies undertaken by Jacobs and these have been used to estimate the level of emissions;
- computer models have been used to calculate the effect of traffic emissions on noise exposure at the locations of sensitive receptors (2). Three scenarios have been modelled:
  - "2009": Current situation
  - "2023 with-Project": Year 2023 with implementation of the Project
  - "2023 without-Project": Year 2023 without the Project being implemented (but including other committed changes in the transport system).

The noise modelling has been carried out using standard software SoundPLAN (Version 7), a noise calculation model that is widely used in EU countries. The calculations were carried out with the NMPB model which is recommended by the European Commission for the assessment of

[2] A receptor is a location where people are present, for example in residential areas near roads, or where there are other environmental features such as sensitive habitats that could e affected by air pollution. For this Project the main concern is residential areas alongside roads.

environmental noise (3). Further details of the computation method are given below.

*Noise Modelling*

**Emission Parameters**

The emission of sound by vehicles depends on a variety of factors:

*Single vehicle:*

- Air drag of the vehicle
- Type of vehicle
- Number and type of tyres
- Actual speed of the vehicle

*Overall traffic:*

- Traffic flow (number of vehicles per hour or day)
- Composition of vehicle types (abundance of trucks)
- Traffic flow characteristics on a specific road section (average speed, free flow, or traffic jam)
- Road characteristics (*eg* type of surface, incline)

*For the modelling, the following factors were taken into consideration:*

- Overall traffic data for 2009 and 2023 with and without the Project were taken from the traffic predictions provided by Jacobs 2010 (number of vehicles per hour and day)
- Number of vehicles was considered separated for "light vehicles" (passenger cars, mini busses, mini trucks) and "heavy vehicles" (heavy duty vehicles, busses, big trucks)
- Peak and inter-peak period flows were considered
- Driving speed on the major roads was set to 80 km/h for passenger cars and trucks; for slip lanes, U-turns, and secondary roads the speed was set to 50 km/h
- Gradient of the road is considered automatically by the model based on the terrain.

*Computation Model*

The EU directive 2002/49/EC refers to the French national computation method 'NMPB-Routes-96' as recommended method. Noise emissions used for the NMPB-model are based on the 'Guide du bruit des transports terrestres, fascicule prévision des niveaux sonores, CETUR 1980'. On August 6, 2003 the European Commission published a Recommendation (2003/613/EC) as additional guidelines for the use of the computation of noise.

Directive 2002/49/EC requires equivalent noise levels L for day time, evening and night time to be long-term noise levels according to ISO 1996-2:1987. They are determined over all day, evening and night periods of a year. The method considers the following parameters:

- Vehicle types: "light vehicles" and "heavy vehicles"
- Average vehicle speed
- Number of vehicles as Annual Average Daily Traffic (AADT) and in the reference

[3] Directive 200/49/EC relating to the assessment and management of environmental noise

period (day, evening, night)

- Traffic flow type in order to account for pulsated or continuous traffic motion.
- Gradient of the road
- Road surface with a reference pavement with "smooth asphalt, concrete or mastic'
- Ground effect in order to consider reflecting ground (e.g. paved area, densely built-up areas) or absorbent ground (e.g. grassland, park, garden, woodland)
- Reflections on vertical obstacles

The noise contours obtained with the modelling and presented in the ESIA refer to a receptor height of 2 m unless otherwise stated.

The significance of predicted changes in environmental noise with and without the Project is evaluated by comparison with Turkish noise limit values and international guidelines proposed by the IFC in its General Environmental and Health & Safety Guidelines (4) as summarised in Annex C.

These standards are designed to protect human beings against adverse effects of exposure to noise. A significant impact is identified where a standard may be exceeded. In these cases measures to mitigate the impact are identified in Section 9.7.

The assessment has been based on a number of assumptions:

- Actual traffic flows in the future may differ from the predicted, but the figures used are the best available.
- Changes in the road network elsewhere in the city and traffic management measures may lead to a different pattern of traffic movements than that assumed for the study. The traffic forecasts do take into account changes in the transport system which are already planned, for example the effects of the Marmaray tunnel and privatisation of the bridges.
- Noise emission levels from vehicles and tyres are assumed to remain the same as today.
- The road surfaces described for the Project are assumed to correspond with the NMPB standard road surface ('smooth asphalt, concrete or mastic').

4 IFC - General EHS Guidelines (IFC 2007)

The assumption relating to vehicle and road surface characteristics is considered to provide a conservative assessment of the impact from individual vehicles. Further details on the parameters used for the assessment in the ESIA are described in Annex L.

## 9.3 NATIONAL AND INTERNATIONAL ENVIRONMENTAL NOISE STANDARDS AND GUIDELINES

The significance of predicted changes in environmental noise is evaluated by reference to Turkish and international noise standards as presented in Table 9-2 and Table 9-3.

### 9.3.1 *Turkish Regulations (for further details see Annex C)*

Environmental noise is regulated by the Regulation on the Assessment and Management of Environmental Noise - CGDYY (Official Gazette Date and Number: 07.03.2008/26809). The regulation stipulates noise standards for areas of specific sensitivity with respect to noise exposure on human beings: residential areas, schools, industrial sites. Limits are defined for noise exposure during daytime, evening hours, and night time.

Noise limits applicable to roads are provided in Annex 8, Table 1 of the above regulation. They are summarised in Table 9-2 below. The regulation specifies separate noise limits for new alignments and upgrading of existing roads. Limits for new alignments are more stringent since they can be planned in a way that the limits are met. The less stringent limits for existing roads take into consideration that these roads are restricted to the existing alignment.

The Project involves mainly upgrading of existing roads and the noise standards for existing roads are therefore applied in the ESIA.

### 9.3.2 *IFC noise standards*

Reference is also made to international standards on environmental noise published in the IFC General EHS Guidelines [5]. These standards differentiate between two principal receptor categories: residential and industrial. The standards are provided in Table 9-3.

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5 There are no EU-wide noise standards (noise limit values are Member State-specific).

### *9.3.3 Construction Noise*

Limits for noise caused by activities at construction sites are set out in Annex 8, Table 5 of the Regulations and are summarised in Table 9-4. The regulation requires that construction activities shall not be carried out inside or close to residential areas during evening and night time. However, where a project is of public benefit, partial exemption is possible under certain circumstances. Urban main road construction is considered to be of public benefit and where construction activities will interrupt traffic during the daytime, activity can be shifted to the evening or night time provided that levels of 5 dB(A) less than the daytime limits are met during evening and 10 dB(A) less at night time. Additionally, a permit has to be granted by the relevant authority taking into account the opinion of the Provincial Directorate of Environment and Forestry.

The Regulation on Control of Excavated Soil, Construction and Demolition Wastes (Official Gazette Date/Number: 18.03.2004/25406) also requires those carrying out excavations to take measures to minimise noise.

*Table 9-2 Turkish Environmental Noise Limits*

| Land Use Type (Receptor) | Noise Standard (dB(A)) | | |
|---|---|---|---|
| | **Daytime (07:00-19:00)** | **Evening (19:00-22:00)** | **Night Time (22:00-07:00)** |
| **Upgrading of Existing Roads** | | | |
| Industrial area (heavy industries) | 72 | 67 | 62 |
| Commercial area with noise-sensitive area where workplaces are predominant (commercial area) | 70 | 65 | 60 |
| Commercial area with noise-sensitive area where residential buildings are predominant (mixed commercial / residential area) | 68 | 63 | 58 |
| Noise-sensitive areas where educational, cultural, health institutes, or summer residential and camping areas are predominant (residential areas for recreational purpose, educational, hospitals) | 65 | 60 | 55 |
| **New Road** | Above values minus 5 dB(A) | | |

*Turkish Requirements as per CGDYY (Annex 8, Table 1)*

*Table 9-3* *IFC Environmental Noise Standards*

| Land Use Type (Receptor) | IFC Guideline Values ($L_{eq}$) Daytime (07:00-22:00) | Night Time (22:00-07:00) |
|---|---|---|
| Residential area | 55 | 45 |
| Commercial/industrial area | 70 | 70 |
| Noise abatement measures should achieve either the levels given above or a maximum increase in background levels of 3 dB(A) at the nearest off-site receptor location shall be met | | |

*IFC General EHS Guidelines, 2007*

*Table 9-4* *Turkish Environmental Noise Limits for Construction Activities*

| Type of Construction | Noise Standard (dB(A) |
|---|---|
| Construction of roads | 75 |
| Construction of buildings, others | 70 |

*Turkish Requirements as per CGDYY (Annex 8, Table 5)*

### 9.3.4 *Vibration*

Vibration levels are stipulated for very sensitive areas in Annex 8, Table 7 of the Regulation on the Assessment and Management of Environmental Noise - CGDYY. The levels apply to operation and construction of the Project. They are listed in Table 9-5.

*Table 9-5* *Turkish Limits for Vibration*

| Land Use Type (Receptor) | Maximum ground floor vibration values allowed for driven pile and construction machines (peak value in mm/s)* | |
|---|---|---|
| | Continuous | Discontinuous |
| Administrative and downtown areas | 5 | 10 |
| Industrial and commercial areas | 15 | 30 |

* Frequency: 1 Hz to 80 Hz
*Turkish Requirements as per CGDYY (Annex 8, Table 7)*

## 9.4 BASELINE SITUATION 2009

The Project corridor is situated in a densely urbanized area with many sources of noise, particularly traffic. At some places, noise will also be caused by activity in markets, playgrounds, sports areas and meeting places. In addition, nature can contribute to the overall sounds and noise, for example through wind blowing or waves on the shore.

### 9.4.1 *Environmental Noise Measurements for the ESIA*

In order to obtain local data for the environmental noise situation, a baseline monitoring survey has been conducted. Spot sample measurements were taken at nine locations along the alignment and in its vicinity during November 2009. Nine single measurements on randomized dates and times were carried out at each location and included measurements during daytime, evening, and night time. The sampling locations on the European and Asian Sides are shown in Figure 9-1.


*Figure 9-1 Noise Spot-Sampling Locations and Measured Noise Levels for Daytime (Ld) and Night time (Ln)*


*Figure 9-1 Noise Spot-Sampling Locations and Measured Noise Levels for Daytime ($L_d$) and Night time ($L_n$)*

Details of the measurements are provided in Annex L (measurement protocols with photography and brief description of the locations). The results of the measurements are summarized in Table 9-6.

*Table 9-6* *Summary of Environmental Noise Measurements*

| Location | Mean equivalent noise pressure level in dB(A) * | | | Comment on microphone location |
|---|---|---|---|---|
| | $L_d$ | $L_e$ | $L_n$** | |
| EUROPEAN SIDE | | | | |
| #1 – Kumkapi Fish Market | 75.1 | 76.5 | 74.4 | At roadside |
| #2 – Kennedy Cd, proposed toll gate | 70.7 | 67.8 | 67.9 | Distance from the roadside: about 30 m |
| #3 - Kennedy Cd, proposed ventilation shaft | 64.1 | 59.2 | 64 | Distance from the roadside: about 20 m |
| #4 – Tiyatro Sk | 73.0 | -- | 63.6 | Distance from the roadside: about 540 m; local road |
| #5 – Park near Sultan Ahmet Mosque | 61.2 | 63.9 | 55.7 | Distance from the roadside: about 370 m; local road |
| #6 – Topkapi, entrance | 56.0 | 48.3 | 52.4 | Distance from the roadside: about 310 m; local road |
| ASIAN SIDE | | | | |
| #11 – Selimiye military barracks | 75.8 | 75.2 | 65.4 | At roadside |
| #12- - E5 near Haydarpasa Numune Hospital | 78.9 | 78.2 | 71.3 | At roadside |
| #13 – E5 opposite to Medopol Hospital | 79.5 | 80.1 | 73.5 | At roadside |

* In general, the daytime and the night time mean are based on three or four measurements, whereas the evening value is based on only one or two measurements
** The night time spot-samples were taken prior to 2:00 a.m. Measurements in the late night (e.g. 2:00 – 5:00 a.m.) in general reveal significantly lower levels which also account for the calculation of the night time $L_n$.

The following can be concluded from Table 9-6:

- Along Kennedy Cd, the daytime noise levels varied between 64 and 75 dB(A) with the higher value at the Kumkapi Fish Market next to the existing road and the lower at the proposed location of the ventilation shaft which is more distant from the existing road;
- Night time levels along Kennedy Cd differed insignificantly or only by about 3 dB(A) from the daytime levels, indicating only a limited drop in traffic flow before 1:00 in the night;
- The daytime measurements along the Asian part of the scheme revealed levels between 76 and 80 dB(A) at the roadside;
- The noise levels obtained during night time on the Asian side were about 6 to 10 dB(A) less than the daytime means, indicating a noticeable drop in traffic flow after 1:00 at night;
- In the evening, most $L_e$ levels obtained directly at the scheme were close to the daytime levels $L_d$.

Locations away from the route were measured in order to get a general noise baseline for areas where the impact from current traffic on Kennedy Cd is minor. Topkapi and Sultan Ahmed Camii are considered to represent sensitive areas in terms of the Turkish noise regulations. The measured noise levels at these locations met the applicable standards of 65 dB(A) and 55 dB(A) for day and night time [(6)].

### 9.4.2 *Sound Propagation Modelling for Current Traffic*

Sound propagation modelling of current road traffic emissions has been carried out in order to determine the current environmental noise situation along the scheme.

On the European side, the annual average daily traffic (AADT) at Kennedy Caddesi in 2009 is in the order of 90,000 vehicles/day between Kazliçesme (Genç Osman Cd), Yenikapi and Mustafa Kemal Cd, and 40,000 vehicles/day further along the coastline beyond Aksakal Caddesi. Traffic flows on major

[6] It is common practice that a limit value is still met in case of an exceedance by 1 dB(A)..

connecting roads are about 60,000 vehicles/day at Yenikapi and 30,000 vehicles/day at Kazliçesme and Aksakal Cd (7).

The AADT on the D100 on the Asian side ranges from about 70,000 vehicles/day at Dr. Eyüp Aksoy Cd to 130,000 vehicles/day at Göztepe interchange at the end of the scheme. Traffic flows on the connecting roads are roughly 30,000 vehicles/day at the D100 between the harbour and Eyüp Aksoy Cd interchange, 40,000 vehicles/day at Dr. Eyüp Aksoy Cd, 90,000 vehicles/day at Cevre Yolu, and 25,000 vehicles/day at Libadiye Cd at Göztepe Interchange.

For the assessment and evaluation of noise impact it is important to understand that large differences in traffic flow figures are necessary to result in perceptible noise changes. For example a doubling of traffic flow is required to cause a just-perceptible increase of 3 dB(A). So, at a traffic flow of 80,000 vehicles/day the sound pressure level is 3 dB(A) higher than at 40,000 vehicles/day.

Based on the traffic flow figures for 2009, noise levels along the alignment were predicted for the daytime, evening, and night time. The adjacent sections of major connecting roads are also included to allow assessment of future potential changes on the wider network in consequence of the Project. The detailed results of the modelling are presented in Annex L and illustrative findings are presented and discussed below.

The assessment in the ESIA focuses on night time levels since the night time standards are the most stringent (10 dB(A) lower than daytime values). Traffic data from Jacobs 2010, indicate that average traffic flows through the night are roughly 50% of the daytime average. This means a difference of 3 dB(A) between the day and night time noise levels which is less than the 10 dB(A) difference between the standards.

Noise contours for the applicable night time noise limits of 55 dB(A) for noise-sensitive areas and 58 dB(A) for residential areas in 2009 scenario reveal exceedance of the relevant limits at the following locations (8):

- km 1+700 – 2+250: first row of buildings of the residential area west of the road;

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7 Please note that the traffic figures provided in this section are roughly rounded figures in order to keep the numbers easy. The respective precise data are provided with Annex K.

8 "First row" can also include some affected buildings located behind the 1st row

- km 2+750 – 3+350: first row of buildings of Istanbul Samatya Education and Research Hospital;
- km 5+200 – 6+500: first row of buildings directly beyond the railway
- km 10+800 – 11+100: first row of buildings of the residential areas to north and south of the road; Medopol Hospital (also affected from traffic on connecting roads);
- km 11+700 – 12+200: first row of buildings of the residential area south of the scheme;
- km 11+700 – 12+700: first row of buildings of the residential area north of the scheme;
- km 13+000 – 14+500: first row of buildings of the residential area south of the scheme;
- km 13+500 – 13+800: first row of buildings of the residential area north of the scheme.

For educational buildings no night time sensitivity is anticipated and daytime limit values are not exceeded.

In comparison with the noise levels obtained from the spot-measurements (cf. Section 9.4), the predicted values at the locations alongside the alignment fit within a variance of about 5 dB(A) (cf. Table 9-7).

The impact predicted for locations away from the route is quite low and local noise dominated the measurements. With differences of more than 15 dB(A) between the alignment's contribution and the measured levels, the noise generated by the traffic on the alignment is not relevant for these locations (9).

[9] As example for the logarithmic scale: A predicted contribution of 50 dB(A) increases an existing level of 60 dB(A) by only 0.4 dB(A).

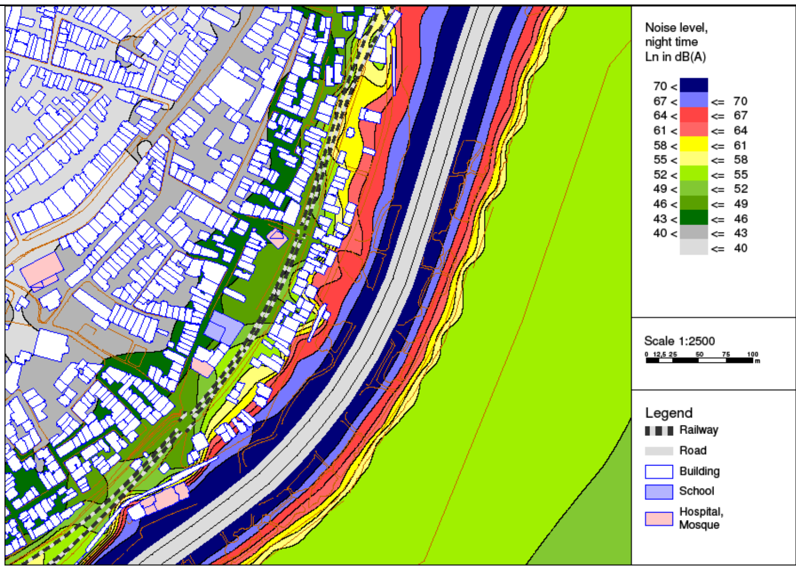
*Table 9-7 Comparison of Predicted Noise Levels with Measured Noise Levels*

| Location ID | Equivalent noise pressure level in dB(A); day time / night time<br>Calculated traffic noise from the scheme roads | Measured overall noise level | Location information |
|---|---|---|---|
| #1 | 70-76 / 67-70 | 75-76 / 74 | Adjacent to road |
| #2 | 67-73 / 67-70 | 68-71 / 68 | Adjacent to road |
| #3 | 67-70 / 61-67 | 59-64 / 64 | Adjacent to road |
| #4 | <40 | 73 / 64 | Offset location |
| #5 | <40 | 61-64 / 56 | Offset location |
| #6 | <40 | 48-56 / 52 | Offset location |
| #11 | 73-76 / 61-67 | 75-76 / 65 | Adjacent to road |
| #12 | 79-82 / 67-73 | 78-79 / 71 | Adjacent to road |
| #13 | 70-76 / 67-73 | 79-80 / 74 | Adjacent to road |

Figure 9-2 and Figure 9-3 show illustrative sections of the traffic noise contours predicted for the 2009 scenario. The light yellow and yellow coloured noise contours in the figures indicate the night time noise limit values for sensitive and residential areas. It can be seen that the standards are only exceeded close to the roads. The propagation of sound into the built-up areas is limited by sound shielding effects from buildings in the first rows. For the first row of buildings the noise standard can be exceeded if situated close to the scheme, whereas the level at the second row of buildings meets the standard unless there is open space between the first row buildings enabling the sound wave to propagate through.

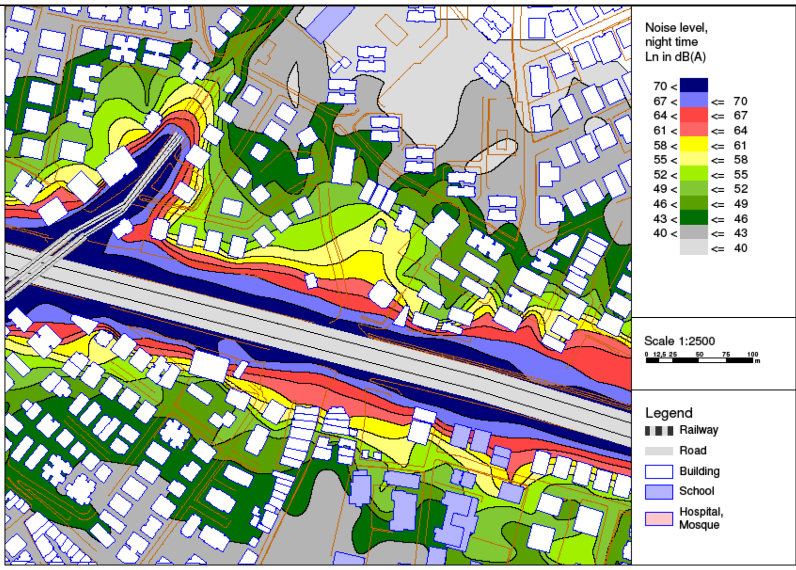
Figure 9-2 shows an example of these effects for the residential area located between the scheme and the railway at km 2+000. The Turkish noise limit of 55 dB(A) for residential areas along existing roads is exceeded at buildings that are located in the first row and are oriented in the same direction as the scheme roads.

Figure 9-3 shows that current traffic flows cause the Turkish noise limit for residential areas to be exceeded in the first row of buildings. Comparison of the figures with reference to the IFC noise standards shows that the night time standard of 45 dB(A) for residential areas may be exceeded in the second row or sometimes beyond this.




*Light yellow colour indicates from where on the Turkish noise limit value for noise-sensitive areas is exceeded (e.g. school, hospital).*
*Yellow colour indicates the Turkish noise limit value for areas of mainly residential use.*

***Figure 9-2 Night time noise contours from Sound Propagation Modelling of the 2009 Scenario for the Residential Area at Kennedy Caddesi (km 2+000)***




*Light yellow colour indicates from where on the Turkish noise limit value for noise-sensitive areas is exceeded (e.g. school, hospital).*
*Yellow colour indicates the Turkish noise limit value for areas of mainly residential use.*

***Figure 9-3 Night Time Noise Contours from Sound Propagation Modelling of the 2009 Scenario for the Area East of Acibadem Cd (km 12+200)***

## 9.5 *IMPACTS OF THE PROJECT ON ENVIRONMENTAL NOISE*

In order to predict the impact of the Project on environmental noise, the same modelling was carried out for the Project with the tunnel operating at its maximum flow of 130,000 vehicles per day. According to the traffic forecasts from Jacobs 2010, this will be reached around the year 2023 which has therefore been chosen as the reference year. Between the opening year of the tunnel, which is expected to be 2015, and 2023 traffic through the tunnel is forecast to grow from 80,000 to 130,000 vehicles/day. Further traffic flow data are provided in Chapter 8 (Section 8.6).

In the future, designs of vehicles and tyres are likely to reduce sound emissions from individual vehicles but these effects have not been taken into account as their effects on sound generation can not be predicted at present. The forecasts of future vehicle noise pressure levels are therefore likely to be conservative.

The predictions discussed in this Section are based on a standard concrete asphalt road surface.

Since the traffic in Istanbul will grow in future, without construction of the tunnel, a reference scenario was modelled in order to provide a baseline for the year 2023. The assessment is based on comparison of the two scenarios with and without the Project. The 2023 with-Project scenario includes all changes to the road network included in the 2023 without-Project scenario plus the widened tunnel approaches, and the new U-turns and the interchanges. All traffic flow data were provided by Jacobs (Jacobs 2010). The contribution of traffic to environmental noise for the 2023 scenarios was modelled in the same way as described for the 2009 scenario.

The tunnel itself is no source of sound emissions since the sound generated inside a tunnel is absorbed by the tunnel walls and air turbulences inside the tunnel. Furthermore, the tunnel walls enclose the noise source completely so that no sound will be perceivable outside the tunnel walls. However, sound will be emitted from the tunnel portals where these damping effects cease. Therefore, the emissions from the portals are considered in the model. The emissions, however, have no strong contribution to the noise of the road traffic itself due to the location of the portals below ground and the shielding effect of the road cut walls.

Important Project-related changes in the traffic flows are the increase in traffic along Kennedy Cd as far as the tunnel and along D100 from the tunnel to the end of the scheme. Reduction in traffic will occur around the eastern coast of the historic peninsula and on some connecting roads (*eg* Mustafa Kemal Cd, Dr. Eyüp Aksoy Cd).

The ventilation shafts are included in the modelling as point sources. They are equipped with a ventilation system comprising three exhaust fans with a combined sound power level of about 131 dB(A) [10]. In order to abate sound pressure levels from these outside the vent shaft structure, sound attenuation equipment will be installed inside the shaft providing a reduction by 42 dB(A). Due to this sound attenuation, the noise pressure level at a distance of 10 m from the shaft at ground level will be below 53 dB(A). This will be a minor contribution to environmental noise since it will be masked by the traffic noise of the roads which ranges between 56 and 62 dB(A).

In analogy to Figure 9-2 and Figure 9-3 the predicted noise contours for the with-Project scenario in 2023 are shown in Figure 9-4 and Figure 9-5.

The future with-Project scenario shows that the Turkish noise standards for residential areas near to upgraded roads will be exceeded at buildings in the first row and sometimes also in the second row, unless sound reduction measures are taken. Mitigation measures are discussed in Section 9.7 below.

Comparison with the results for 2009 indicates that the noise contours are about 3-4 dB(A) higher, corresponding with the predicted doubling to quadrupling of traffic between the 2009 and the 2023 with-Project scenario.

Since traffic flows will increase not only through operation of the tunnel but also due to general increase of traffic over time, the ESIA refers to the future situation without tunnel as the baseline for defining the impacts of the Project. In order to show this effect, Figure 9-6 provides a calculation of the differences of the noise levels with and without the Project in 2023, for the illustrative sections. In this context it has to be stressed that differences in the dB-scale require special interpretation since a decibel difference is independent from the absolute level and thus does not stand for an impact. Decibel differences need always to be discussed with reference to the absolute level at the respective location. The figure shows that most of the differences between the with-Project and the no-Project scenario stay below 3 dB(A). Higher differences are predicted for locations where more than doubling of the traffic is expected, like the U-turns, or road gradients differ between the current and the future road based on the preliminary alignment design.

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[10] Sound power level is the parameter to describe the strength of a sound source, whereas a sound pressure level describes the impact on a receptor. Environmental noise is expressed as sound pressure level.

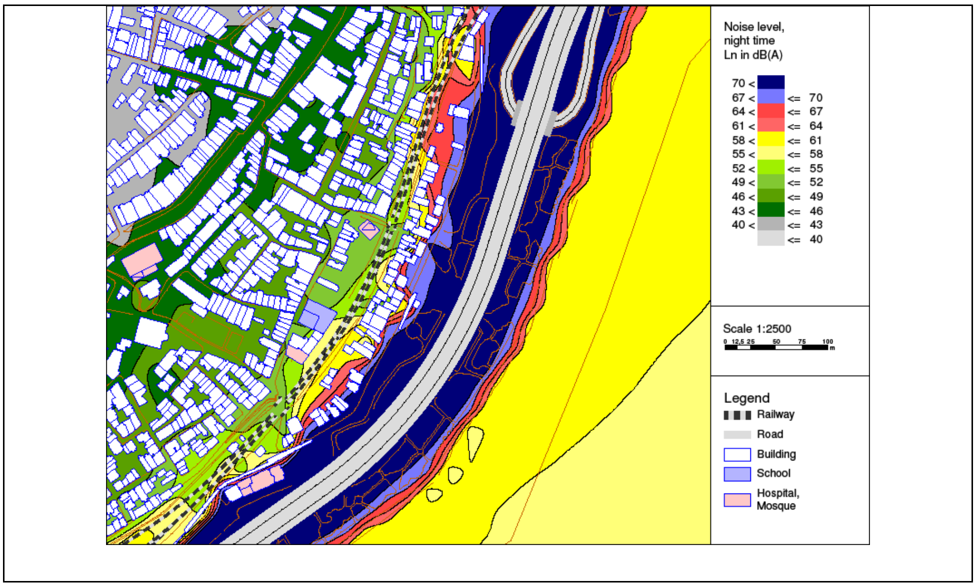



*Figure 9-4 Night Time Noise Contours from Sound Propagation Modelling of the 2023 With-Project Scenario for the Residential Area at km 2+000*

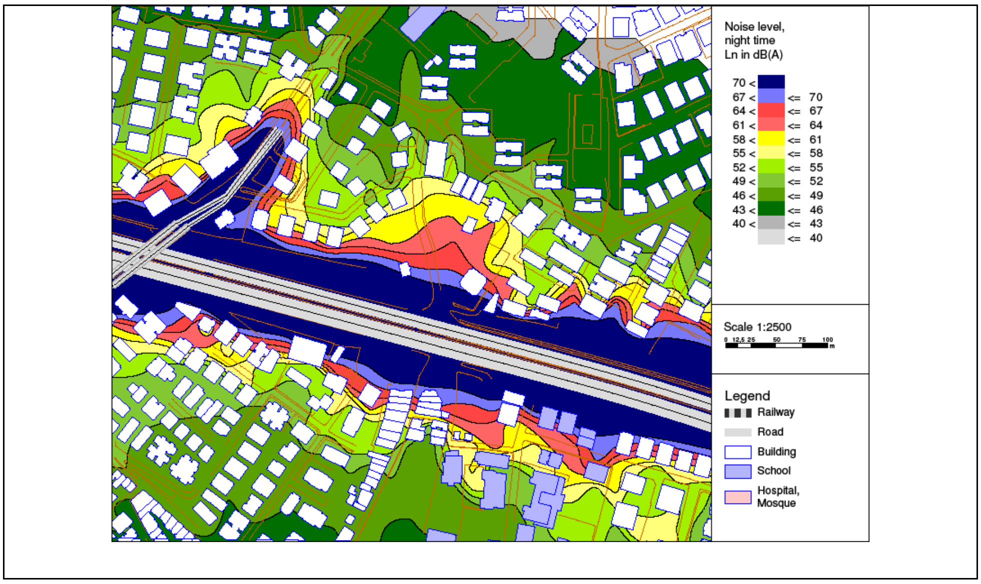
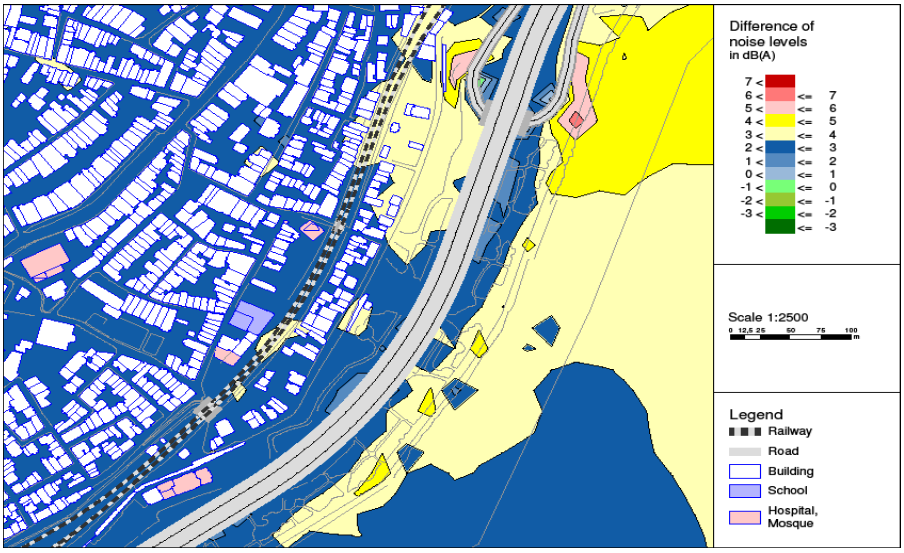
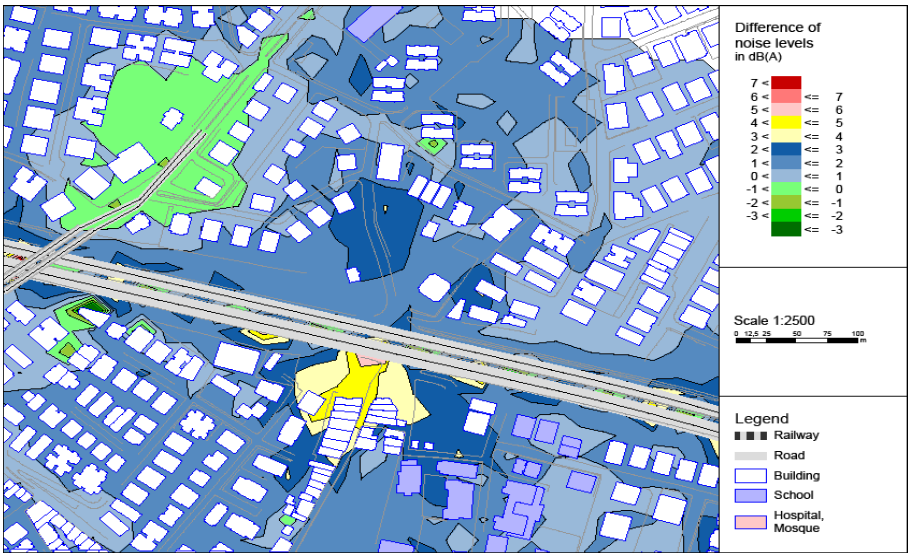


*Figure 9-5* *Night Time Noise Contours from Sound Propagation Modelling of the 2023 With-Project Scenario for the Area east of Acibadem Cd (km 12+200)*




Yellow and red colours indicates differences of more than 3 dB(A)
Green is showing a reduction

*Figure 9-6* *Difference in Night Time Noise Levels between the With-Project and the Without-Project Scenario for the Scheme Sections at km 2+000 and 12+000*

## *9.6 EVALUATION OF THE PROJECT'S IMPACT ON ENVIRONMENTAL NOISE*

The significance of Project related increase of noise is evaluated with respect to two parameters. The first criterion is whether or not the predicted noise levels in the 2023 with-Project scenario will exceed the Turkish noise limit values relevant to the local land use. The prime focus is on sensitive receptors like hospitals and schools where the night time limit is 55 dB(A) at for upgraded roads, and residential areas where the night time limit is 58 dB(A). For schools the night time values are not applied since at night times schools are assumed to be not in use.

Where the relevant noise limit is exceeded consideration is then given to the difference between the scenarios with and without the Project. A significant impact is identified if a noise limit value is exceeded and the Project-related change is greater than 3 dB(A). According to the IFC General EHS Guidelines, the Project should not cause an increase of 3 dB(A) or more at the nearest off-site receptor.

Table 9-8 provides an assessment of the impacts in locations with potentially sensitive uses, providing information on the predicted traffic noise levels in 2023 with the tunnel, the difference with and without the tunnel in 2023, and the noise levels calculated for 2009.

For all scenarios the Turkish noise limits for existing and upgraded roads are exceeded for buildings in the vicinity of the scheme. The table provides an estimate of the number of affected buildings in the first rows facing the road, based on the noise contour plots for 2 m receptor height. Buildings beyond the first row may also be affected with a greater impact in upper storeys where obstacles are less likely to provide screening of windows from the road. Overall the total number of buildings affected by the recorded noise levels could be two to three time higher than shown in Table 9-8. In order to evaluate the Project-related effect, Table 9-8 provides also the differences of noise levels between the 2023 scenarios with and without the Project. Jacobs 2010 predicts a general traffic flow increase by 2023 regardless of implementation of the Project. With the Project, the tunnel related traffic will increase the flow along the approach roads. In addition, the vehicles that use the U-turns on Kennedy Caddesi add to the main traffic flow. From the differences provided in the table it can be seen that at several sections where there are noise-sensitive receptors the difference will exceed the threshold of 3 dB(A). Mitigation measures to meet the IFC Guidelines are discussed in Section 9.7.

*Table 9-8 Noise Impacts on Sensitive Areas without Mitigation Measures*

| **Area use** | **Location** | **Name** | **Daytime (for first row buildings)** | | | **Night time (for first row buildings)** | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | **2023 with-Project noise level in dB(A)** | **Difference between with-Project and without-Project levels in dB(A)** | **2009 noise level in dB(A)** | **2023 with-Project noise level in dB(A)** | **Difference between with-Project and without-Project levels in dB(A)** | **2009 noise level in dB(A)** | **Comment** |
| **EUROPEAN SIDE** | | | | | | | | | |
| Residential | 1+700 – 2+250 (west) | | < 77 | < +3 | < 69 | < 70 | < +4 | < 65 | Some buildings > +3 |
| School | 2+200 (west) | Armenian Kindergarten and Primary School | < 60 | < +2 | < 57 | n.a. | n.a. | n.a. | |
| Hospital | 2+750 – 3+350 (north) | Istanbul Samatya Education and Research Hospital and Cerahpasa Medical Faculty and Hospital | < 63 | < +3 | < 62 | < 63 | < +4 | < 59 | Some buildings > +3 |
| Residential | 3+950 – 4+180 (north) | | < 72 | < +2 | < 72 | < 68 | < +4 | < 65 | Some buildings > +3 |
| Residential | 4+450 – 5+200 (north) | | < 68 | Km 4.45-5.0: <+2<br>Km 5.0 -5.2: < +5 | < 64 | < 68 | Km 4.45-5.0: <+2<br>Km 5.0 -5.2: < +5 | < 61 | Few buildings > +3 |

| Area use | Location | Name | Daytime (for first row buildings) | | | Night time (for first row buildings) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | **2023 with-Project noise level in dB(A)** | **Difference between with-Project and without-Project levels in dB(A)** | **2009 noise level in dB(A)** | **2023 with-Project noise level in dB(A)** | **Difference between with-Project and without-Project levels in dB(A)** | **2009 noise level in dB(A)** | **Comment** |
| School | 4+700 (north) | Private Bezciyan Armenian Primary School | < 54 | < +2 | < 50 | n.a. | n.a. | n.a. | |
| Residential | 5+200 – 6+000 (north) | | < 74 | < +3 | < 74 | < 74 | < +3 | < 69 | |
| Residential | 6+000 – 6+500 (north) | | < 74 | < 0 | < 74 | < 70 | < 0 | < 70 | |
| **ASIAN SIDE** | | | | | | | | | |
| Public buildings | 9+500 – 10+400 | Barracks, Authorities, University | < 77 | < 0 | < 73 | < 70 | < +1 | < 70 | Affected from connecting road; Project section without impact (tunnel) |
| Hospital | 10+000 – 10+400 | Numune Hospital, Dr. Siyami Ersek Hospital | < 68 | < 0 | < 68 | < 64 | < +1 | < 62 | Affected from connecting road; Project section without impact (tunnel) |
| Residential | 10+800 – 11+100 (south) | | < 74 | < +2 | < 68 | < 70 | < +3 | < 64 | |
| Residential | 10+800 – 11+000 (north) | | < 75 | < +1 | < 71 | < 70 | < +2 | < 65 | |

| Area use | Location | Name | Daytime (for first row buildings) | | | Night time (for first row buildings) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2023 with-Project noise level in dB(A) | Difference between with-Project and without-Project levels in dB(A) | 2009 noise level in dB(A) | 2023 with-Project noise level in dB(A) | Difference between with-Project and without-Project levels in dB(A) | 2009 noise level in dB(A) | Comment |
| Hospital | 11+050 – 11+150 (north) | Medopol Hospital | < 72 | < 0 | < 69 | < 70 | < 0 | < 65 | |
| School | 11+400 (south) | Istek Acibadem College | < 74 | < +4 | < 66 | n.a. | n.a. | n.a. | Affected from connecting roads |
| Residential | 11+600 – 12+750 (north) | | < 76 | < +3 | < 70 | < 73 | < +3 | < 67 | |
| Residential | 11+700 – 12+750 (south) | | < 77 | < +3 Km 12.0 – 12.2: < +4 | < 70 | < 73 | < +3 Km 12.0 – 12.2: < +5 | < 69 | Some buildings > +3 |
| School | 12+250 – 12+350 (south) | Dogus University | < 76 | < +2 | < 72 | n.a. | n.a. | n.a. | |
| Public buildings | 12+900 (south) | Ministry (Department of MoEF) | < 71 | < +1 | < 68 | n.a. | n.a. | n.a. | |
| Residential | 13+000 – 13+500 (south) | | < 70 | < +1 | < 69 | < 67 | < +1 | < 64 | |
| Residential | 13+500 – 14+500 (south) | | < 67 | < +1 | < 65 | < 65 | < +2 | < 62 | |

| Area use | Location | Name | Daytime (for first row buildings) | | | Night time (for first row buildings) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | 2023 with-Project noise level in dB(A) | Difference between with-Project and without-Project levels in dB(A) | 2009 noise level in dB(A) | 2023 with-Project noise level in dB(A) | Difference between with-Project and without-Project levels in dB(A) | 2009 noise level in dB(A) | Comment |
| School | 13+400 – 13+550 (south) | Muratpasa Primary School | < 65 | < +2 | | n.a. | n.a. | n.a. | |
| School | 13+650 – 13+750 (north) | Seyh Sami High School | < 68 | < +1 | | n.a. | n.a. | n.a. | |
| Residential | 13+400 – 13+700 (north) | | < 73 | < +1 | | < 70 | < +2 | < 67 | |
| Public buildings | 13+700 – 13+900 (north) | Üsküdar Municipality Cultural Centre | < 62 | < +1 | | < 62 | < +2 | < 57 | |
| School | 13+980 – 14+050 (north) | Yildirim Beyazit Primary School | < 62 | < +1 | | n.a. | n.a. | n.a. | |
| School | 14+150 – 14+350 (south) | Göztepe Halil Turkkan Primary School | < 69 | < +1 | | n.a. | n.a. | n.a. | |

### *9.6.1 Summary*

Environmental noise along the scheme will increase in line with the increase of traffic flows. The traffic flows on the approach roads will be higher in 2023 with the Project than without.

Environmental noise generated by traffic will exceed the Turkish noise limits applicable to sensitive areas for areas located close to the approach roads in 2023 both with and without the Project. The Project will cause levels to be more than 3 dB(A) higher than the situation without the Project at some locations along the approach roads. Significant noise impacts are therefore predicted to occur as a result of the Project. Approximately 80-100 residential buildings are estimated to may be affected by exceedance of the Turkish noise limit together with exceedance of the 3 dB(A) threshold for the difference between the with-Project and the no-Project scenario. An additional 700-800 buildings may be affected by exceedance of the Turkish limit but with a difference below 3 dB(A). Measures to mitigate the adverse effects are addressed in the next Section.

Increases in traffic along the main roads connecting to the ends of the scheme at Genç Osman Caddesi and Libadiye Caddesi will not increase noise levels at the roadside by more than 3 dB(A). No significant impacts are predicted to occur on these roads.

The Project will lead to a reduction in traffic on Kennedy Caddesi north and east of the tunnel portal and on the main connecting roads along the route on both the European and Asian approaches and these changes will lead to small benefits from reductions in noise along these routes.

The installation of noise attenuation equipment in the ventilation shafts means that noise from this source contributes only to minor extent to the Project-related noise.

## *9.7 MITIGATION MEASURES AND RESIDUAL IMPACTS*

The main risk of significant adverse impacts on environmental noise will arise during night time when the predicted average traffic flows are still high and the sensitivity of receptors is higher than during daytime. Mitigation of noise from traffic could be achieved by changes in vehicle design but this cannot be achieved by ATAŞ. Mitigation measures therefore focus on decision of the road and traffic management.

The following measures can be considered:

- Traffic management: measures to avoid stop-start traffic and congestion and to encourage vehicles to travel at optimal speeds for sound emissions can reduce noise levels;
- Road surface: top-layer paving with porous asphalt ('silent pavement') can reduce the noise by 2 to 4 dB(A) depending on its composition;
- Noise shielding: installation of sound barriers can reduce noise levels at receptor locations. These need to be solid barriers typically of several metres in height to protect upper floors in buildings;
- Noise insulation: if the above the measures are insufficient noise levels can be reduced at the receptor by installing noise insulation (double glazed windows with ventilation).

Reducing noise by speed limits would require a very substantial reduction in speed from the 80 km/h limit on the approach roads (for example, a 60 km/h limit would achieve a reduction of less than 1 dB(A)) and would not therefore be sufficient on its own to avoid significant impacts. This is not therefore proposed as a scheme-wide mitigation measure although it may be used in specific locations if monitoring suggests that noise standards cannot be met by other means.

Use of low-noise road surfacing is considered to be feasible and will be adopted by ATAŞ at locations along the route where there are sensitive receptors nearby.

Noise barriers are not considered to be feasible on the European approach road because of the historical importance and amenity of the surroundings. They would introduce an intrusive feature into the park and into views of the old city from the shore and the sea. They are more feasible on the Asian approach and will be considered here if needed. To achieve the necessary mitigation on the European side and possibly at some locations on the Asian side, consideration may therefore need to be given to insulation of sensitive buildings such as hospitals and schools.

The exact details of mitigation required at each sensitive location can not sensibly be determined based on the outline tender design of the Project. ATAŞ is therefore committed to undertaking further noise modelling once the detailed design is completed to determine what is required at each receptor location to comply with the Turkish standards and meet the IFC 3 dB(A) threshold, and the necessary measures will be designed and implemented during construction of the Project.

ATAŞ will also perform noise monitoring during the year after opening of the Project to determine whether environmental noise standards are being exceeded. Monitoring locations will be selected at representative buildings along the scheme which are affected by noise. The success of noise mitigation measures and the need for further mitigation will be evaluated from the results of these measurements.

## *9.8 CONSTRUCTION PHASE*

### *9.8.1 Noise from construction activities*

Construction works are typically significant sources of noise for neighbouring communities and land uses. Sources of noise from construction of the Project are likely to include:

- excavation;
- earth moving;
- loading, handling and transportation of spoil;
- demolition of structures which have to be removed;
- drilling;
- blasting;
- crushing, screening;
- ready mix concrete delivery by concrete mixing trucks;
- concrete pumping;
- road paving (*eg* paver, asphalt spreader, compactor, road milling machine);
- operation of other machinery (*eg* compressors, saws, jackhammers, cranes);
- lorries delivering materials and removing spoil and other waste from the works.

The types of equipment in use and the resulting noise levels will vary over the construction programme and at different locations along the route.

On the European side works will include widening of the approach road, excavations for and construction of underpasses and the cut and cover sections, and building of structures such as footbridges from km0+000 to the toll plaza (km5+400), as well as at the European vent shaft and operations building. On the Asian side, works will be similar from km10+800 through to km14+600 and there will be additional activity at the TBM access point from which the main tunnel boring will take place, including delivery and storage of tunnel segments and removal and treatment of spoil.

In order to assess potential noise impacts from construction activities, a range of typical construction site scenarios were developed for sound propagation modelling. Table 9-9 sets out typical sets of construction equipment which might be expected to be involved in a section of the route when different types of activity (excavation, alignment works, underpass construction, *etc*) are taking place. It is assumed that all the listed equipment will be working simultaneously in an area 200 m long and 20 m wide. Table 9-9 provides data on the typical sound power level ($L_w$) for each item of equipment, the number of items of each type of equipment assumed to be present on the site, an estimate of their average operating time as a percentage of a typical day (OT), and the resulting effective sound power level from the whole site ($L_{w\text{-Site}}$). For the example operations the cumulative sound power level is calculated to lie between 116 and 120 dB(A) for a virtual point source representing the different sources. In order to consider operation of equipment at various parts of the construction works area, a homogeneous distribution of continuously operating noise sources throughout the construction works area was assumed. Dispersion modelling then was based on the homogeneously distributed area related sound power level. This approach provides a conservative (over-estimated) prediction of construction noise as it is unlikely that all this equipment would be operating simultaneously in an area of the assumed size.

The estimated site sound power level is most likely to be about 117 dB(A). When propagation of this level is modelled the resulting distribution of ambient noise levels is illustrated in Figure 9-7 for an example construction site situated at km2+000 where Kennedy Caddesi runs close to the neighbouring residential area between Yedikule and Kocamustafapasa train stations [11].

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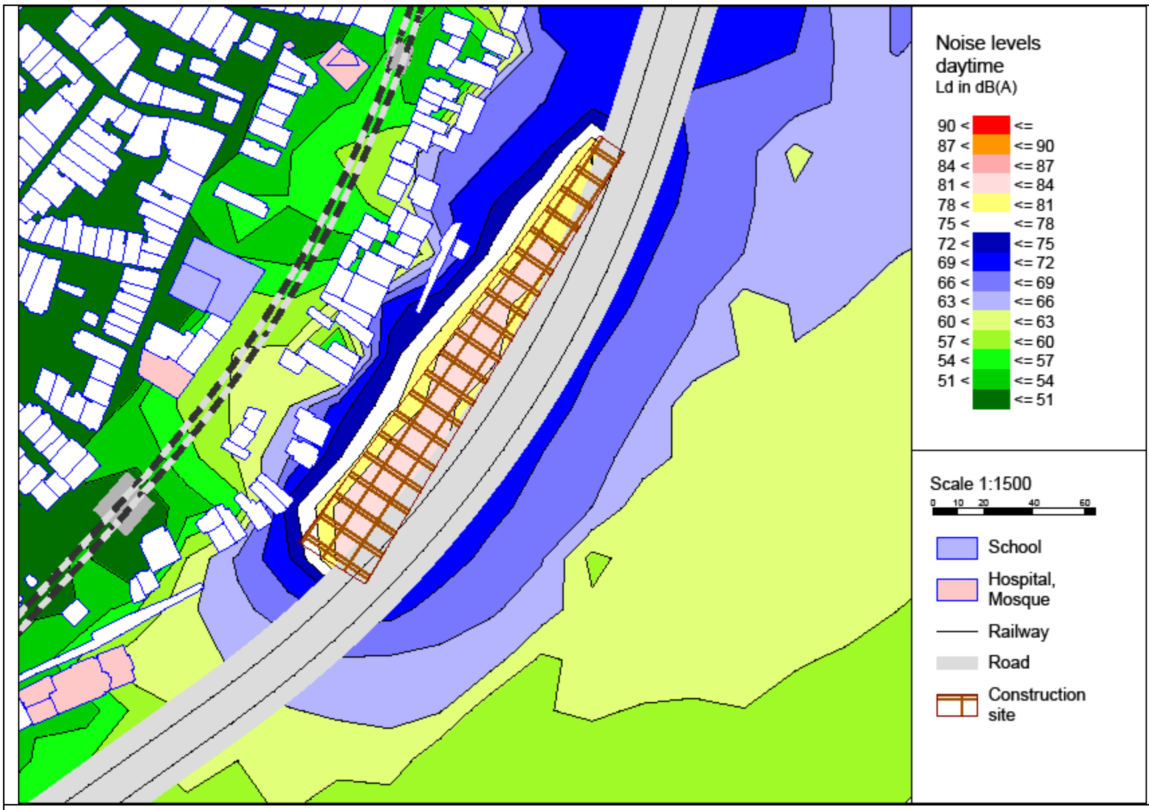
[11] The modelling method for noise from the area source employs ISO 9613-2 calculation rules; software SoundPLAN_V.7

*Table 9-9 Examples of construction site types, related machinery and effective sound power level ($L_w$) of the construction site*

| Equipment | Equipment Specific Sound Power Level $L_w$ in dB(A) | Excavation | | | Construction | | | Alignment Works | | | Underpass | | | Cut and Cover | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No.* | OT** | $L_w$ | No.* | OT** | $L_w$ | No.* | OT** | $L_w$ | No.* | OT** | $L_w$ | No.* | OT** | $L_w$ |
| **Loader** | 110 | 2 | 50 | 110 | | | | | | | 2 | 50 | 110 | 2 | 50 | 110 |
| **Grader** | 111 | | | | | | | 2 | 50 | 111 | 1 | 50 | 108 | | | |
| **Dozer** | 114 | 1 | 50 | 111 | | | | 1 | 50 | 111 | 1 | 50 | 111 | 1 | 50 | 111 |
| **Excavator** | 110 | 1 | 50 | 107 | 2 | 50 | 107 | 1 | 50 | 107 | | | | | | |
| **Dump Truck** | 109 | 2 | 80 | 111 | 2 | 80 | 111 | 1 | 50 | 106 | 1 | 50 | 106 | 2 | 80 | 111 |
| **Piling Plant** | 112 | | | | | | | 1 | 25 | 106 | 1 | 50 | 109 | 1 | 50 | 109 |
| **Crane** | 109 | | | | 1 | 50 | 106 | 1 | 50 | 106 | | | | 4 | 50 | 115 |
| **Hydraulic Hammer** | 100 | | | | | | | | | | 1 | 50 | 97 | 2 | 50 | 94 |
| **Concrete Mixing Truck** | 107 | | | | 1 | 50 | 104 | 2 | 25 | 104 | 1 | 50 | 104 | 2 | 50 | 107 |
| **Concrete Pump** | 107 | | | | 1 | 50 | 104 | | | | | | | 2 | 50 | 107 |
| **Compressor** | 110 | 1 | 50 | 107 | 2 | 50 | 110 | | | | 1 | 50 | 107 | 1 | 50 | 107 |
| **Generator** | 98 | | | | 2 | 50 | 98 | | | | | | | 2 | | |
| **Poker Vibrator** | 106 | | | | 2 | 25 | 103 | 4 | 25 | 106 | 2 | 25 | 103 | 4 | 25 | 106 |
| **Compacting Roller** | 108 | | | | | | | 2 | 50 | 108 | 1 | 50 | 105 | | | |
| **Forklift** | 104 | | | | 2 | 50 | 104 | | | | | | | | | |
| **Steel Saw** | 98 | | | | 2 | 25 | 95 | | | | | | | | | |
| **Asphalt Plant** | 104 | | | | | | | 1 | 100 | 104 | | | | | | |
| **Total $L_{w\text{-}Site}$** | | **7** | | **117** | **17** | | **116** | **15** | | **117** | **12** | | **117** | **23** | | **120** |

* No – number of items of equipment
** OT – operation times as average percentage of the day




**Effective sound power level of the site: 117 dB(A)**

*Figure 9-7 Noise modelling of construction activity at an example location (km2+000)*

The Turkish limit for noise from road construction is 75 dB(A) (see Section 9.3). Figure 9-7 shows that noise levels at the closest properties will be below 75dB(A) and that the standard will not be exceeded more than 30 m from the site boundary. Even for the highest sound power level from cut and cover activities (120 dB(A)) the limit value will not be exceeded at the nearest property at this location.

The calculations indicate that construction noise is not expected to be a significant issue as construction passes residential property and other sensitive receptors along much of the route, although there are individual buildings at closer locations in some sections. Noise may exceed the standard for short periods at nearby homes as particularly noisy activities take place, and along Kennedy Caddesi there is the potential for disturbance of recreational activity in the park (although people are not expected to use the park as much as usual whilst construction is underway because of the general disturbance). As a result of these factors, although the assessment indicates that there are likely to be only minor impacts, a number of good practice measures will be adopted to control noise from construction.

### *9.8.2 Construction Site Noise Mitigation*

The Turkish regulations require that construction activities in or close to residential areas shall not normally be carried out during evening and night time (Regulation on the Assessment and Management of Environmental Noise – CGDYY; see Section 9.3). If it is essential to perform some limited construction activities during evening or night time, for example to avoid unacceptable disruption to traffic, a separate permit must be obtained and construction activities must meet lower noise limits (70 dB(A) during evening and 65 dB(A) during night time). The Turkish Regulation on Control of Excavated Soil, Construction and Demolition Wastes also stipulates the general rule to minimise noise from excavation and construction. The Project will comply with these requirements. If a special permit has to be obtained for evening or night working local residents will be kept informed of the planned works.

In order to minimise noise and risk of resulting annoyance and as good construction practice, the following measures will be taken by ATAŞ to mitigate construction noise [12].

- Noise generating activities will be performed during night time only when essential and in accordance with a special permit obtained for the purpose.
- The slurry treatment plant located at the Asian side will be acoustically shielded such that the external sound pressure level is below 85 dB(A).
- Where practicable, demolition works will be carried out using equipment which breaks concrete by bending rather than by percussive methods.
- All construction equipment will comply with the requirements of the European Directive 2000/14/EU on sound emission of equipment operated outdoors.

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12 Based on IFC EHS Guidelines for Construction Materials Extraction and IFC General EHS Guidelines regarding Construction and Decommissioning

- Where construction equipment is provided with sealed acoustic covers or enclosures these will be kept closed whenever the machines are in use.

- Machines will be shut down or throttled down to a minimum when not in operation.

- Maintenance procedures will be implemented in order to keep equipment in good working condition to minimise extraneous noises caused by poor performance.

- If practicable and safe, audible reversing alarms will not be used near sensitive receptors.

- Noisy activities taking place within construction sites will be located as far as possible away from sensitive receptors including homes, places of worship, schools and hospitals.

- In particular:

    - crushers will be located at least 50 metres away from sensitive receptors;

    - excavation of hard materials within 50 metres of sensitive receptors will be carried out by hydraulic or electrical power (*eg* actuating rotary drills).

    - if piling is required within 100m of sensitive premises this will be carried out using bored piling or casings driven by torque and hydraulic pressure.

- On site structures such as containers, offices, hoardings will be used to screen sensitive receptors from noise sources as far as possible. Where necessary movable noise barriers (2-2.5 m high) will be used to ensure receptor noise levels are less than the limit value adjacent to noisy activities.

- If blasting or other very noisy activities can not be avoided near schools, hospitals or places of worship, scheduling of such works shall be discussed with the relevant premises.

- Noisy activities near schools shall be carried out during non-education times.

- Noisy activities near entertainment facilities and restaurants located close to construction sites shall be scheduled for non-opening times.

A monitoring programme will be set up to measure noise levels at the closest sensitive receptors as work starts on each new section along the route. If levels at receptors exceed the standards, measures will be taken to reduce emissions so that the limit values are met.

Although ATAS will adopt these measures to mitigate noise impacts during construction, the nature of construction activities means that significant noise impacts could still occur for short periods at certain locations (hours, days or at most weeks). ATAS will ensure that local residents and managers of other sensitive facilities are kept advised of planned noisy periods and will respond to any questions or complaints in accordance with the Grievance Procedure established for the project.

### *9.8.3 Noise from Construction Traffic*

Heavy goods vehicle (HGV) road transport will be required to remove spoil from the works and deliver materials such as concrete, asphalt and pre-fabricated concrete tunnel segments.

The largest quantity of material will be spoil. It is estimated that about 200,000 $m^3$ of spoil will be removed from the European side and 780,000 $m^3$ from the Asian side. An estimate of the truck frequency required to transport these quantities off-site gives an average of 50 truck movements per hour over 5 months on the European side [13] and 35 movements per hour for 30 months on the Asian side[14]. Compared with the current traffic flow of 3,000 to 4,000 light vehicles and about 150 to 300 heavy vehicles per hour for Kennedy Caddesi the estimated number of European HGV trips will cause traffic noise to increase by less than 1 dB(A) which is an insignificant impact. For the Asian side of the scheme fewer hourly trips will be required and with the higher flow of traffic on the D100 the impact will be less than for the European section.

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[13] Transportation of 200,000 $m^3$ with middle size trucks carrying 8 $m^3$ requires 25,000 trips. The major period for earthworks is assumed to be 5 months of 20 work days. With 10 hours per day for transportation activities, a frequency of 25 hourly transports is required. Each trip comprises of two movements one from and one to the site.

[14] Similar for Asia: 780,000 $m^3$ is equivalent to ca. 100,000 trips; tunnel boring will take ca. 30 months, therefore the average hourly frequency of trips is ca. 17.

Although there will be no significant impact from traffic noise ATAS will be taking action to minimise the volumes of spoil requiring disposal for other reasons, and these will contribute to minimising any risk of adverse impact.

### *9.8.4 Vibration*

Vibration annoyance and damage from construction work is most typically associated with percussive piling. As noted in Section 9.8.2 piling in the vicinity of sensitive premises will be carried out using vibration reduced techniques (bored piling or casings driven by torque and hydraulic pressure). Driven and hydraulic hammer piling will not be used in sensitive locations. Other sources of vibration could include operation of heavy equipment or vehicles. Associated vibration levels are low and will be short-lived but may be perceptible at receptors close to the construction activity.

Tunnelling can give rise to a form of impact similar to vibration known as ground borne noise. This is low frequency noise which could be perceived in buildings above the tunnel in a manner similar to vibration. The land sections of the tunnel are located mostly under parkland or port uses and there are no sensitive buildings above the route. Some impacts from this source may occur at the Asian part where sensitive buildings are located at the end of the tunnel (e.g. Numune Hospital, Dr. Siyami Ersek Hospital).

The Turkish Regulation on the Assessment and Management of Environmental Noise (CGDYY) establishes limit values for vibration (see Section 9.3). ATAŞ will monitor vibration on commencement of relevant activities to ensure these requirements are met and if the standards are exceeded measures will be taken to reduce vibration. Particular attention will be given to monitoring at historical buildings which tend to be more sensitive to structural or cosmetic damage from vibration than modern buildings. Some equipment used in universities, hospitals and recording studios may also be particularly sensitive to vibration. Any such locations will be identified by the contractor and discussions held with the relevant parties to ensure construction is managed to avoid adverse effects on use of the equipment.

# 10 BIODIVERSITY AND NATURE CONSERVATION

## 10.1 INTRODUCTION AND SCOPE

This chapter presents an assessment of the potential impact of the proposed Project on biodiversity and resources of nature conservation interest. The chapter considers the following types of impact:

- loss of habitats of nature conservation interest and their resident flora and fauna as a result of site clearance for permanent and temporary land take for the Project;
- disturbance of habitats and fauna as a result of dust, noise, run-off, traffic and other disturbance during construction and from increased traffic during operation.

The risk of introduction of alien species that might prove to be invasive or damaging to native flora and fauna has also been considered but is judged to be unlikely given the nature of proposed Project and the urban nature of the existing environment.

## 10.2 METHODOLOGY AND INFORMATION SOURCES

The Project corridor is situated in a dense urban resulting in few features of ecological interest in the area. For this study information on ecological setting, habitats and flora and fauna was gathered by walkover surveys along the alignment and literature review undertaken in autumn 2009.

Areas of importance for nature conservation and biodiversity are protected under Turkish Law and various international conventions as summarised in Annex C and the importance of sites can be evaluated by reference to these designations (see Section 10.3.4).

As yet there is no Turkish system for designation and protection of species according to their level of threat. Data derived from the field survey have therefore been evaluated according to IUCN and Bern Convention standards.

The Bern Convention on the Conservation of European Wildlife and Natural Habitats (1) was adopted by the Council of Europe in Bern, Switzerland in 1979, and came into force in 1982. The principal aims of the Convention are to ensure conservation and protection of wild plant and animal species and their

(1)http://www.coe.int/t/dg4/cultureheritage/nature/Bern/default_en.asp natural habitats, to increase cooperation between contracting parties, and to regulate the exploitation of certain species (including migratory species). To this end the Convention imposes legal obligations on contracting parties, protecting over 500 wild plant species and more than 1000 wild animal species.

The Convention lists species in three appendices:

- Appendix I: Strictly protected flora species - deliberate picking, collecting, cutting or uprooting of these plants is prohibited;
- Appendix II: Strictly protected fauna species – deliberate capture and killing, deliberate damage to or destruction of breeding sites, deliberate destruction or taking of eggs from the wild and possession of and internal trade in these animals (dead or alive) are prohibited. Appendix II includes threatened European mammals, birds, amphibians and reptiles. In addition, nearly all migratory songbirds are included, regardless of conservation status;
- Appendix III : Protected fauna species - protected but a certain level of exploitation is possible if the population level permits.

Turkey signed the Bern Convention in 1979 and ratified it in 1984. Contracting parties undertake to take all appropriate measures to ensure conservation of the habitats of the listed wild flora and fauna species. Such measures should be included in the Parties planning and development policies and pollution controls, with particular attention to the conservation of wild flora and fauna. Each Contracting Party should take appropriate and necessary legislative and administrative measures to ensure the conservation of the habitats of the wild flora and fauna species, especially those specified in Appendices I and II, and the conservation of endangered natural habitats, and to give special attention to the protection of areas that are of importance for migratory species specified in Appendices II and III as wintering, staging, feeding, breeding or moulting areas.

Contracting parties also undertake to strictly control the introduction of non-native species.

The International Union for the Conservation of Nature (IUCN) maintains a List of Threatened Species (the IUCN Red List) which is a widely recognised, global approach for evaluating the conservation status of plant and animal species. It provides taxonomic, conservation status and distribution information on taxa that are facing a high risk of global extinction. Species are categorised as:

- Critically Endangered (CR): A taxon is Critically Endangered when it is considered to be facing an extremely high risk of extinction in the wild;
- Endangered (EN): A taxon is Endangered when it is considered to be facing a very high risk of extinction in the wild;
- Vulnerable (VU): A taxon is Vulnerable it is considered to be facing a high risk of extinction in the wild;
- Near Threatened (NT): A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying or is likely to qualify for a threatened category in the near future;
- Least Concern (LC): A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for the higher categories. Widespread and abundant taxa are included in this category.

## *10.3 BASELINE*

### *10.3.1 European side*

A map showing areas of undeveloped land (*ie* land which is not built on) along the European approach road, and indicating cover and habitat is presented in Annex M. The European approach is almost entirely located within ground reclaimed from the sea since the 1940s and occupied by the existing carriageways and verges of Kennedy Caddesi and coastal parkland. Habitats all man made and can be categorised as amenity grassland and ornamental planting as well as landscape planting around the road and neighbouring buildings.

It is estimated that there were about 2,700 trees within the park and along the road verges in November 2009. These include typical parkland and urban species such as plane, ash, poplar, locust, lote tree, willow, horse chestnut, sycamores, maple, cedar and oak species, as well as various shrubs and ornamental plants. Planes, clustered willows, horse chestnuts, oak species, ash and maple species, various shrubs and ornamental plants are found at the roadside and along the central reservation of Kennedy Caddesi. There are several fig trees along the city sea walls.

The area of the toll plaza, operations building, tunnel approach ramps and the slip road to Kennedy Caddesi, and the site of the European ventilation shaft, are all well planted with parkland trees of varying size and age.

Typical planting and observed species around the European approach road are illustrated in photographs in Figure 10-3 to 10-3.

*Figure 10-1 Planting along the old city wall on the road side of the Old City*

*Figure 10-2 Planting along the ruins of the Theodosian Wall next to the sea*

***Figure 10-3 Typical Planting along the Route of the European Approach Road***

During the field survey a number of insects, reptiles, snails and mammals were observed. They include butterflies, lizards, bats and marten, and bird species typical of urban and coastal environments. Observed species are listed in Annex M and their Bern Convention and IUCN status is noted. There are a number of Bern Appendix II species but all are identified as of least concern by IUCN.

It should be noted that 90% of the Turkish fauna appear in the Bern Appendices as species requiring protection. This is due to the fact that 80% of the West Palaearctic animal population is found in Turkey and adequate information on the Turkish fauna has not been available at the meetings of the Bern Convention to identify their individual status.

Evidence of birds having used trees for nesting was observed in 48 locations along the route, including poplar species, oriental plane, box elder, black locust, willow species, ash species, and holm oak. The observed bird species fall into in six groups: natives, residents, winter visitors, summer migrants, passage migrants and vagrants (see Annex M, Table M-1).

*Figure 10-4* Bird nest on **Platanus orientalis** - Oriental Plane

*Vanessa atalanta* - ***Red Admiral***

*Pieris brassicae* - ***Large White***

*Corvus corone* - ***Hooded Crow***

*Erithacus rubecula* - ***European Robin***

***Figure 10-5*** ***Observed Animal Species and Bird Nest***

Lesser horseshoe and common pipistrelle bats were both observed. These are likely to roost and hibernate in built structures in preference to the types of trees recorded along the route.

### *10.3.2 Asian Side*

A map showing areas of undeveloped land on the Asian approach road, and indicating cover and habitat is presented in Annex M. A small parkland area with trees and grass is located at the proposed site for the Asian ventilation shaft. A graveyard with planted woodland is present to the northeast of Eyüp Aksoy Interchange. Other areas are roadside verges, planted areas within intersections, and landscape planting around neighbouring buildings including trees and shrubs. Roadside verges along of D100 are less regularly maintained throughout the year than amenity grassland and planting. Examples of planting along the Asian approach road are illustrated in Figure 10-7. A total of ca. 1300 trees were counted in green areas along the route on the Asian side in November 2009.

***Figure 10-6 Area of Asian Ventilation Shaft***

*Figure 10-7* ***Typical Planting along the Route of the Asian Approach Road (existing overbridge over Dr. Eyüp Aksoy Cd)***

An open watercourse (Kurbagalidere Creek) runs in a deep channel south of the Göztepe interchange at the eastern end of the route. The stream is partially canalised and it is culverted under the D100. It flows in culvert from beneath built up areas to the north. The water is heavily contaminated by disposal of wastes in the bed as illustrated in Figure 10-8 (see also Chapter 7).


*Figure 10-8* ***Kurbagalidere Creek***

The fauna species observed during the site visit were similar to those on the European side and included birds, mammals, reptiles, butterflies and snails. They are listed in Annex M with a note of their IUCN and Bern status. No species of more than Least Concern status were identified.

Evidence of birds having used trees for nesting was observed in several locations along the Asian approach route, including in oriental plane, white poplar, and Japanese Pagoda trees.

Common pipistrelle bats may roost or hibernate in larger and older trees along the route.

### 10.3.3 *Literature review*

A review of the literature on fauna species along the route is presented in Annex M. The only species for which records exist which are of more than Least Concern status are the great Capricorn beetle (Vulnerable) and the Yelkouan shearwater (Nearly Threatened) (see Figure 10-9). The first is a tree beetle typically found in oak trees and identified as a forest industry pest in some countries. The Yelkouan shearwater is a resident marine and coastal bird that typically breeds on offshore islets in the Mediterranean and the Black Sea. It is a very common resident in the Bosphorus and Dardanelles but there are no definite records of breeding sites [1].

***Great Capricorn Beetle*** ***Yelkouan Shearwater***

***Figure 10-9 Vulnerable and Nearly Threatened Species in the Istanbul Region***

[1] BirdGuides Ltd; Birds of the Western Palaearctic; Oxford University Press 2006.

### 10.3.4 *Designated and Protected Sites*

There are no areas protected for nature conservation reasons in the immediate vicinity of the surface components of the Project. The tunnel runs beneath the Bosphorus and the entire strait is designated as an Important Bird Area by Birdlife International as shown in Figure 10-10. Key extracts from the citation [1] are noted on the next page.

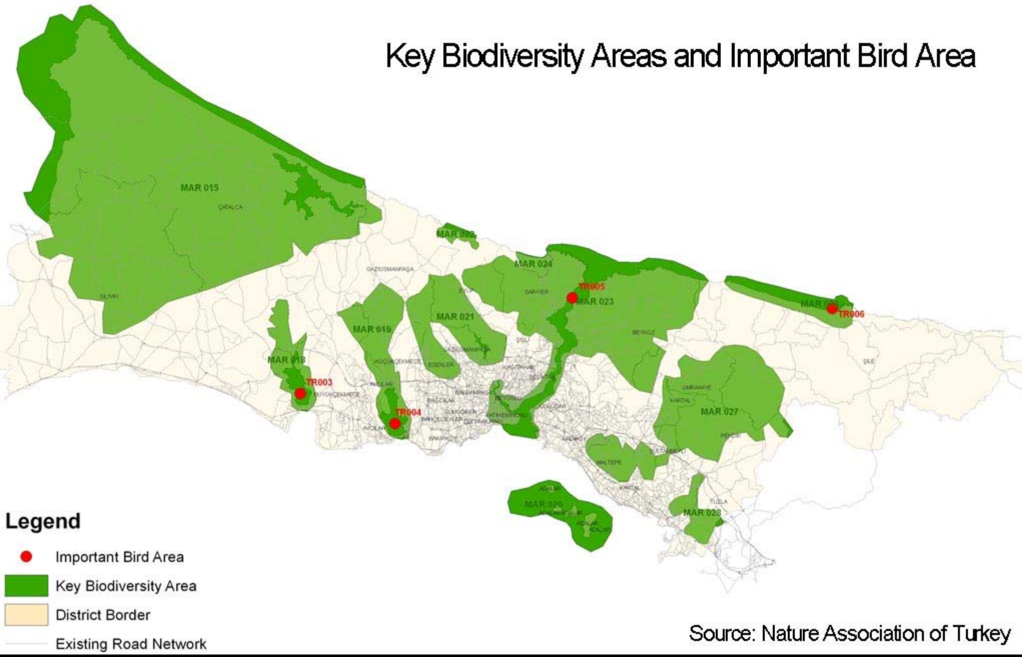


***Figure 10-10 Key Biodiversity Areas and Important Bird Areas***

[1] BirdLife International (2009) Important Bird Area factsheet: Bosphorus, Turkey. Downloaded from the Data Zone at http://www.birdlife.org on 2/12/2009

***The Bosphorus Strait Important Bird Area***

The Bosphorus Strait runs north-south for c.33 km, and is c.1.5 km wide. The site includes forested areas east (Polonezköy Nature Park) and west (Belgrade forest) of the strait, which are known to be of importance to roosting migrants. It does not include the Camlica hills (in east Istanbul) or the islands in the Sea of Marmara, which would qualify as an IBA in their own right due to the large numbers of migrants passing over, but which provide limited scope for bird conservation.

The site is a major migratory bottleneck, where more than 20,000 storks and raptors regularly pass in spring and autumn. Few counts covering the entire migration period have been undertaken. Total counts made in the mid-1960s and early 1970s and covering the entire autumn migration period are as follows: *Ciconia nigra* (8,318), *Ciconia ciconia* (338,353), *Pernis apivorus* (25,751), *Milvus migrans* (2,707), *Buteo buteo* (32,895) and *Aquila pomarina* (18,898). More recent autumn records include 11,703 *Aquila pomarina* at Camlica and 11,379 of the same species at Sariyer, both on the same day in September 1990. *Ciconia* sp. often roost in flocks of thousands in fields outside the city. Disturbance by *Larus cachinnans* and possibly pollution are thought to be behind a drastic decline in numbers of breeding *Milvus migrans*.

The main threat is the rapid urban and industrial expansion of Istanbul. Mining and road building also result in the loss of natural habitats. The conservation of forested areas on both sides of the strait is crucial, in order to preserve raptor roosting sites. There are isolated instances of raptor persecution.

The Bosphorus is also proposed as a Key Biodiversity Area (KBA Bogazici-Bosphorus) by IUCN and the Nature Association of Turkey [1]. The KBA stretches along the Istanbul strait and includes the forested areas in the north which are also part of the IBA mentioned above. Besides 23 bird species, the KBA includes two mammals, one amphibian, three reptile and eight insect species which are listed either in the global or national red book.

Some parts of the strait are covered by protective designations under Turkish law but none of these are within the city.

### *10.3.5 Future Baseline*

Current development plans in Istanbul envisage no significant developments along the above ground sections of the route and the ecological baseline is not expected to change.

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[1] Eken, G., Bozdogan, M., Isfendiyaroglu, S., Kilic, D.T., Lise, Y. (editors) 2006. Türkiye'nin Önemli Doğa Alanları (Key Biodiversity Areas of Turkey), Doğa Derneği (Society of Nature), Ankara.

## 10.4 *IMPACT ASSESSMENT*

### 10.4.1 *Temporary and Permanent Land Take for the Project*

Land will be occupied permanently by the widened approach roads and temporarily during construction. All existing vegetation and habitats within the existing roadside verges, central reservations and intersections will be removed, along with part of the amenity grassland and parkland planting along the coastal park on the European side and at the site of the Asian ventilation shaft. Some areas of grassland and trees on the borders neighbouring properties may also be lost. None of the habitats affected are of nature conservation importance and their loss is not considered to be significant.

### 10.4.2 *Loss of Trees and Breeding Sites for Birds*

Clearance of vegetation for permanent and temporary land take will result in the felling of substantial numbers of trees varying species, sizes and ages. Out of the total of almost 4,000 trees identified along the route, approximately 1350 trees on the European side and 400 trees on the Asian side will need to be felled. All these are relatively recently planted, parkland and urban species and several are non-native. Their loss is considered to constitute a minor impact on biodiversity. Their loss will also remove perhaps as much as half of the nesting habitat for common birds in the coastal strip along the European side. This has the potential for moderate impacts on nesting capacity during the breeding season (typically March to August). In a broader regional context this loss is of minor significance as displaced birds are likely to be able to find replacement sites relatively easily.

If trees where birds are nesting are felled during the breeding season (March – August) this could result in breach of the requirements of the Bern Convention which prohibits deliberate damage to breeding sites and eggs. This would constitute a critical impact.

### 10.4.3 *Impacts on Other Species*

Other species of conservation interest identified along the approach routes currently co-exist alongside the existing roads and are not expected to be significantly affected by the widening:

- observed bat species are known to roost mainly in old buildings and attics rather than in the trees and are unlikely to be affected by land take for the project;

- lizards were observed mainly around the historic walls which will not be physically affected during construction or operation of the Project;
- common water birds are present mainly around the harbours and shoreline on the European side but as the Project has no direct effects on the shore during construction or operation no significant impacts on these species are expected.

The location of the tunnel beneath the seabed of the Bosphorus and the absence of any direct intervention in the marine or coastal environment means that there should be no impacts on the Bosphorus Strait Important Bird Area and Key Biodiversity Area.

### *10.4.4 Disturbance during Construction and Operation*

During construction there will be an increase in levels of dust, noise and general disturbance arising from activities along the approach roads. This may cause minor impacts on birds discouraging them from using the area around the works for breeding, feeding, resting, *etc*. Tunnelling beneath the seabed will also result in increases in noise levels at the seabed and in adjacent waters as the tunnel boring machine passes beneath. These impacts will be short-lived and given the existing environment in the narrow channel crossed by the route, with very heavy shipping traffic, any increase in noise would be expected to have a negligible effect on marine animals.

There will be an increase in noise from long term traffic levels during operation. These changes are not expected to result in any significant impact on habitats or fauna of conservation importance, especially given the urban nature of the existing environment and the presence of the existing road.

## *10.5 MITIGATION MEASURES AND RESIDUAL IMPACTS*

The loss of existing amenity planting and trees will be mitigated by the following measures.

- Contractors will be required to consider the potential loss of trees in deciding on temporary work areas, with the aim of avoiding unnecessary felling, in particular of old, large and attractive trees.
- A detailed tree survey will be carried out to determine the species, age, height and condition of all trees to be felled and this information will be used to plan replacement planting (see below).

- Vegetation clearance and felling of trees where birds may be nesting will be undertaken only outside the nesting period between March and August.
- All trees will be inspected prior to felling to identify whether bats are roosting or hibernating in the trees and, if this is the case, the affected animals will be relocated to an alternative suitable site. If bats are disturbed alternative habitat will be provided in the form of bat boxes (artificial roosts) located in suitable trees.
- All felled trees will be replaced by new planting on at least a one-for-one basis, and three-for-one for large and old trees. Species will be selected with a view to using native species where suited to the location. A mix will be used to provide early cover using fast-growing species and longer term succession.
- If there is insufficient land available for replacement tree planting along the roadside and in the coastal park, alternative planting areas will be identified elsewhere in the city.
- Actions will be taken to improve the amenity and biodiversity value of remaining and new areas of planting by replacing poor specimens, filling gaps and undertaking regular maintenance around areas under the control of ATAS during the BOT contract period (*ie* around the toll plaza, tunnel entrances).

Disturbance during construction will be controlled by adoption of good construction site practices as detailed elsewhere in this report.

With these measures the resulting impact on biodiversity and nature conservation interests is considered to be of minor significance only.

# 11 ARCHAEOLOGY & BUILT HERITAGE

## 11.1 INTRODUCTION

### 11.1.1 Scope

This chapter addresses the following archaeology and built heritage impacts:

- Direct impacts on known and unknown buried archaeological resources;
- Direct impacts from physical intervention in aboveground historic structures, including buildings, monuments, walls;
- Indirect impacts on the setting and character of historic structures and areas, caused by changes in views and increases in traffic, including consideration of the status of the UNESCO World Heritage Site;
- Physical damage to historic structures through proximity to construction works or to the operational road;
- Indirect impacts on materials of historic buildings caused by increases in air pollution on the new road and the wider road network.

### 11.1.2 Approach

The archaeological and built heritage assessment has involved:

1) Gathering existing and available baseline data (historic knowledge and documents; official designations and associated documentation, such as UNESCO information; and information from the Istanbul Development Plan) regarding archaeological and built heritage resources along and around the Project alignment.

2) A site visit and route walkover to better understand the setting and character of the area and specific historic structures along the route.

3) Undertaking a targeted archaeogeophysical investigation along the project route on the European Side at locations where either sub-surface excavation is involved or where desk research suggests there is potential for buried archeological remains.

4) Identifying sites and features at risk of different types of impact:

a. features within the Project boundary are considered to be at risk of direct physical impact;

b. features within 50 metres considered to be at risk from traffic on the new road as a result of vibration or accidental damage:

c. features within 100 metres considered to be at risk from damage during construction from vibration or accidents;

d. features within 500 metres considered to be at risk from indirect effects on their setting and character and from potential air pollution;

5) Assessing whether significant impacts are likely to occur based on consideration of the proposed works and the importance and vulnerability of the features that could be affected (importance and vulnerability are judged by referring to the current condition of features and their historic importance and protected status (national or international)).

6) Developing mitigation measures for design, construction and operation of the Project to address significant negative impacts and provide benefits where possible.

The preparation of this Archaeological and Built Heritage chapter has been assisted by Mr. Haluk Cetinkaya BSc, MSc, PhD, who undertook the desk-based and academic research and assisted with the impact assessment and mitigation. Mr. Cetinkaya is an Assistant Professor in the Department of Archaeology at Mimar Sinan University (Fine Arts University). He obtained his Ph. D in 2003 on the topic of *The Middle Byzantine religious architecture in Constantinople*. His full CV is presented in Annex A.

## 11.2 BASELINE ENVIRONMENT

### 11.2.1 *Features of Archaeological and Historic Importance*

The important archaeological and historic heritage of Istanbul and the Project area is described in Annex N. Eleven locations of known or potential importance have been identified in the vicinity of the Project (within 100 metres). Their key features are described in Table 11-1 and their locations are shown in Figure 11-1. These are all located on the European side and the assessment therefore focuses on this part of the project.

The European part of the Project also runs alongside the UNESCO World Heritage Site of the Historic Areas of Istanbul, an area of international importance covering the whole of the historic peninsula east of Kazliçesme within which are located many features of historic and cultural importance. The World Heritage designation and the protection of sites under Turkish law are discussed in Section 11.2.3.

Figure 11-1 shows areas of known infilling:

- *Historic infill*: land fronting the Marmara Sea and the Golden Horn which was reclaimed for the sea during pre-Byzantine, Byzantine and Ottoman periods. The fill ranges in depth from 2 to 12 m and given its age may contain material of historic interest; and

- *Modern infill*: these areas were reclaimed since the 1940's and provide the foundations for the coastal road, Kennedy Caddesi. This fill is unlikely to contain material of historic interest.

It also shows the 13 locations along the Project route which have been subject to archaeogeophysical investigation undertaken in early 2010. These investigations were targeted at areas where desk research suggests that archaeological material may be located. The results from this investigation are summarized in Section 11.2.2.

### *Figure 11-1 Archaeological and built heritage receptors*

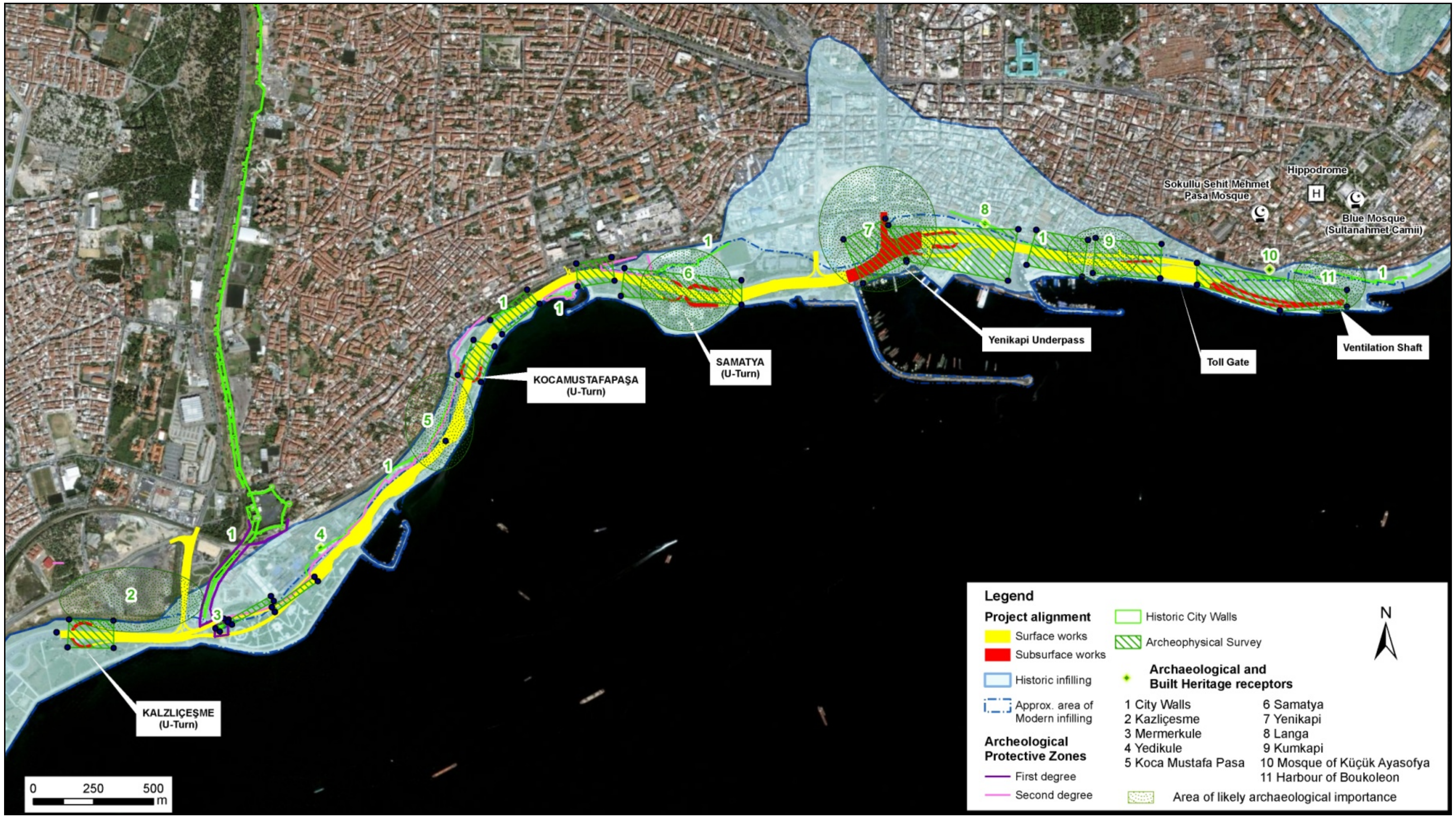


*Table 11-1 Description of Significant Archaeological and Historic Features (see Figure 11-1)*

| Number and Name | Historical overview | Status and condition |
|---|---|---|
| **1**: City Sea Walls<br><br>[*Photo 1 & 2*] | These are the original city walls of the city-state of Byzantion. They were originally reported in 400 B.C. The sections closest to the coast are thought to have been built later than this date and the consensus is that the main sea walls were built by Constantine in 439 A.D. The 8.5 km long sea walls had 188 towers and 13 gates by the beginning of the 15th century. | The city sea walls have undergone many phases of partial destruction and subsequent repair over the last 1,500 years. During the construction of Rumeli railroad, parts in the areas of Çatladı kapı, Kumkapı, Yenikapı and Davutpaşa were destroyed. Further sections were lost during the construction of the second railroad in 1910. The gate of Samatya was destroyed in 1913/1914. Greater losses occurred during the construction of coastal road of Sirkeci-Florya between 1957-1959 (Kennedy Caddesi) and only isolated sections or original walls now remain including one south of the road at Samatya. |
| **2**: Tanneries and iron works at Kazliçesme | During the construction of Yedikule Castle by Sultan Mehmet II, the area of Kazliçesme was reserved for tanneries and slaughterhouses. In the 17th century, tanneries in this area also produced shoes and writing material. According to an Ottoman document dating from 1781/1782; the area of Kazliçesme contained approximately 360 tanneries and 33 slaughterhouses. These were relocated in 1993 after centuries of being located in this area.<br><br>The southwestern part of Kazliçesme contained one of the first industrial establishments of the Ottoman empire, an iron furnace. The factory was partially active in 1846 and continued its production until early 20th century when it fell into disuse. | Kazliçesme is the westernmost section of the Project. The Project is located in a modern infilled area and any archaeological remains within the Project boundary will be buried. The chimneys of some of the former tanneries still remain north of the route in an area currently used as a park and picnic ground. Some of these listed as Protected Heritage Sites. |

| **Number and Name** | **Historical overview** | **Status and condition** |
|---|---|---|
| **3**: Mermerkule (the Marble Tower)<br>[*Photo 3*] | It is thought that Mermerkule was a mansion built during the first decade of the 15th century for Kantakuzenos family. Mid 19th century photographs and maps of the same period support this view. Restoration works on the adjacent City Walls in the vicinity suggested that, based on the construction techniques and materials; Mermerkule belongs to the Late Byzantine period (approximately 14-15$^{th}$ centuries). | This historical structure is located immediately south of Kennedy Caddesi and is listed as a Protected Heritage Site. The setting of the Tower is affected by road and traffic and the structure has been subject to periodic vandalism. |
| **4**: Byzantine remains at Yedikule | During the construction of a factory at the end of 19th century in Yedikule; bricks stamped with the name of Emperor Basil I, who reigned between 867-886 and some Byzantine structures were found in this area. Additionally, columns were found scattered along the coast. Based on these findings, it was suggested that the Church of Saint Diomedes was located in this area. | This location is currently occupied by modern development. |
| **5**: Mosque, Medrese, Hospital and Church at Koca Mustafa Paşa | This area is named after Koca Mustafa Paşa, who started his career in the Ottoman court during the reign of Mehmet II and became the Grand Vizier in 1511. He constructed a complex of buildings including a mosque and a medrese. The mosque was formerly the 14$^{th}$ century Byzantine church of Hagios Andreas en te krisei. Outside the sea walls an Armenian hospital was constructed in 1743. A church, dedicated to Saint John, (Surp Hovhannes in Armenian) was constructed in 1807. | This location is currently a recreation area of park and picnic grounds. |
| **6**: Palace of Helen, Samatya | The name of Samatya is derived from Psamathion in Byzantine times, meaning "sandy". During the construction of Istanbul University Education and Research Hospital in 1960's, various archaeological finds were uncovered. It was not unexpected as this is the area of the Palace of Helen, mother of emperor Constantine I (Helenianai). During an archaeological survey of 2005, substructures related to the Palace of Helen were uncovered behind modern apartment buildings. Part of the sewer of the Palace was also discovered during construction of a road connecting the hospital to Kennedy Caddesi. | The location is currently a park and picnic grounds. |
| **7**: Harbour of | This may be the location of the entrance to the Harbour of Theodosius, the main port | The northern section of this ancient port/harbour is |

| Number and Name | Historical overview | Status and condition |
|---|---|---|
| Theodosius, Yenikapı | of the ancient city and one of the largest in the ancient world. It was created at the end of 4th century by Emperor Theodosius I, on the deep bay where the River Lykos met the sea. One of two granaries known from earlier times (horrea Alexandrina and horreum Theodosianum) was renamed as Lamia, and was still in use in 10th century. It has been suggested that a large part of the harbour was gradually silted-up but that it remained in part use until the 13th century. More recent archaeological excavations may indicate that the use of the Harbour of Theodosius ended in the 11th century and that after the 12th century it became a dumping ground. | currently being excavated and is protected. The section which may underlie the Project is not listed as a Protected Site. |
| **8**: Langa | The historic neighbourhood of Langa formally known as probably Vlanga or Ulanka is located north of the sea walls. The name Langa has been known from sources as early as 12th century associated with the harbour of Konstoskalion (see item 9). | The area is now occupied by modern development. |
| **9**: Konstoskalion Harbour, Kumkapı | Kumkapi is the likely site of Konstoskalion Harbour. During the Ottoman period vessels carrying sand to the harbour gave name to the gate and the neighbourhood (Kumkapı: gate of sand). In 1652, around 100 shops and 15,000 houses were burnt down in Kumkapı and Kadırga harbours. A second fire in Yedikule and Kumkapı destroyed 30,000 houses and 8 churches in 1660. A French traveller in the second part of the 17th century described a square tower within the sea approximately 20 metres away from the sea walls called “Belisarios Tower”. | During construction of Kennedy Caddesi in 1957, the mosque of Malkoç Süleyman ağa (built in 17th century and restored in 1886 by Sheikh Ali Hoca) was destroyed.<br><br>The sea walls have been partially destroyed in this area by historic dumping of construction materials, garbage, fire and earthquake debris, and by recent construction of the railroad and the coastal road. |

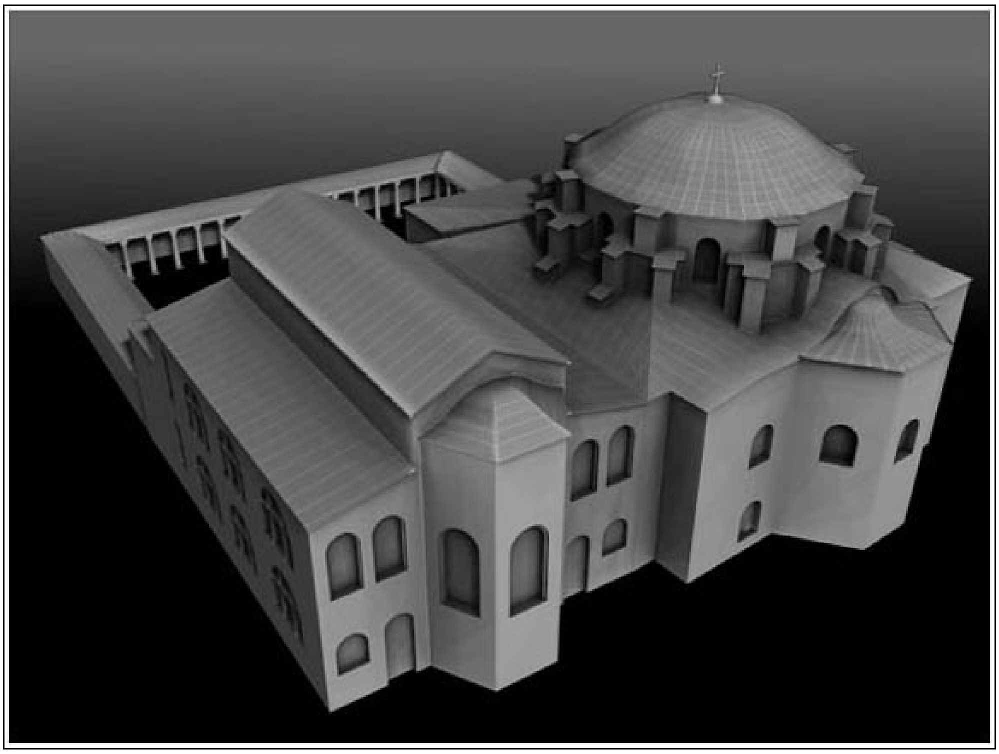
| Number and Name | Historical overview | Status and condition |
|---|---|---|
| **10**: Church of Ss. Sergius and Bacchus/Mosque of Küçük Ayasofya (Little Hagia Sophia)<br><br>[*Photo 4*] | The Church of Ss Sergius and Bacchus (now the Little Hagia Sophia Mosque) is located on the site of a church of Emperor Justinian I dedicated to the Apostles Peter and Paul north of the route of Kennedy Caddesi. The Church of Apostles Peter and Paul was probably built between 518-520. The Church of Ss Sergius and Bacchus became a pilgrimage site because it housed important relics. After the Ottoman conquest, it was converted into a mosque around 1510. Recent restorations indicate that there was a fill of around 1 metre from the 17th century inside the building. | This already-damaged building was further affected by construction of the Sirkeci-Halkalı railroad in 1870-1871 and 1910. Construction of the coastal road in 1957 resulted in loss of the medrese and a stable outside the line of the seawalls. |
| **11**: The palace and harbour of Boukoleon | 5th century sources mention a palace constructed by Emperor Theodosius II at the southeastern end of the peninsula. According to other sources another palace was built at the same location in the third quarter of the 10th century. The earliest mention of the palace and the harbour is the Book of Ceremonies of Emperor Constantine Porphyrugenitus from the 10th century. It was also recorded by 18th and 19th century researchers and travellers who noted that there were statues of marble lions and a three arched opening on the balcony. These arches were still visible around 1850.<br><br>The Harbour of Boukoleon was used by the Emperor for short sea journeys and was directly attached to the Great Palace. There were statues of lions, bulls, bears and ostriches in front of marble steps. Destruction of both palace and harbour began with the construction of the railroad in 1871, followed by fire in June 1912, and construction of the coastal road in 1957. | Part of the surviving section of the palace is in the list of Protected Heritage Sites. Although the palace arches disappeared with construction of the railroad in 1871, the lion statues were brought to the Istanbul Archaeological Museums. One of the few standing remains is the "House of Justinian" (part of the palace gardens) although this is in poor condition due to long-term neglect and damage from construction of the railway and coastal road. |

**Photo 1**: Section of the remaining City Walls (western end of European Side)

**Photo 2:** Section of the remaining City Walls south of Kennedy Caddesi at Samatya (central part along European Side)

**Photo 3:** Mermerkule (Marble Tower)

**Photo 4:** Model of Church of Ss. Sergius and Bacchus



### 11.2.2 *Archaeogeophysical survey results*

A total of 13 locations along the project route were selected for archaeogeophysical investigation using the standard geophysical technique of ground-penetrating radar. These locations were selected on based on desk-based research and interpretation of historical mapping.

In the majority of the locations investigated, remains of the City Walls were found under the existing road. This is not surprising as the City Walls are known to have been destroyed at many locations due to modern construction works (as noted in Table 11-1).

Other archaeological remains have been identified at the following locations:

- north of the existing Yenikapi junction: the remains are mostly under the existing above-ground buildings;
- north of Kumkapi: remains are north of the existing road and rail line and also under the existing buildings; and
- east of the office building occupied by the Directorate for the Protection of Historic Environment (Kucuk Ayasofya Necip Fazil Kisakurek Kultur Merkez): remains are north of the existing road and under lands currently occupied by open parkland.

### 11.2.3 *Protected Areas*

The Historic Areas of Istanbul was inscribed on the UNESCO World Heritage List in 1985. The site is classified as having *Outstanding Universal Value*. This is defined as cultural and/or natural significance which is so exceptional as to transcend national boundaries and to be of common importance for present and future generations of all humanity [(1)]. As such, the permanent protection of this heritage is of the highest importance to the international community as a whole. The World Heritage Committee considers a property as having Outstanding Universal Value if the property meets one or more of the following ten criteria listed below. Note that only criteria (i) to (iv) in italics below apply to cultural heritage sites and thus to the Historic Areas of Istanbul.

*(i) Represent a masterpiece of human creative genius;*

[1] Operational Guidelines for the Implementation of the World Heritage Convention (WHC. 08/01); UNESCO, January 2008

*(ii) Exhibit an important interchange of human values, over a span of time or within a cultural area of the world, on developments in architecture or technology, monumental arts, town planning or landscape design;*

*(iii) Bear a unique or at least exceptional testimony to a cultural tradition or to a civilization which is living or which has disappeared;*

*(iv) Be an outstanding example of a type of building or architectural or technological ensemble or landscape which illustrates (a) significant stage(s) in human history;*

(v) Be an outstanding example of a traditional human settlement, land-use, or sea-use which is representative of a culture (or cultures), or human interaction with the environment especially when it has become vulnerable under the impact of irreversible change;

(vi) Be directly or tangibly associated with events or living traditions, with ideas, or with beliefs, with artistic and literary works of outstanding universal significance (The Committee considers that this criterion should preferably be used in conjunction with other criteria);

(vii) Contain superlative natural phenomena or areas of exceptional natural beauty and aesthetic importance;

(viii) Be outstanding examples representing major stages of earth's history, including the record of life, significant on-going geological processes in the development of land- forms, or significant geomorphological or physiographic features;

(ix) Be outstanding examples representing significant ongoing ecological and biological processes in the evolution and development of terrestrial, fresh water, coastal and marine ecosystems and communities of plants and animals;

(x) Contain the most important and significant natural habitats for in-situ conservation of biological diversity, including those containing threatened species of outstanding universal value from the point of view of science or conservation.

The inscription for the Historic Areas of Istanbul refers to all four cultural heritage criteria (i) to (iv).

To be deemed of *Outstanding Universal Value*, a property must also meet the conditions of *integrity* and/or *authenticity* as defined in the World Heritage Convention Operational Guidelines and must have an adequate protection and management system to ensure its safeguarding.

At present Turkey has yet to adopt a Statement of Outstanding Universal Value for the Historic Areas of Istanbul and there is therefore no specific framework against which to evaluate the impact of developments on the values. The UNESCO World Heritage Committee 34th Session [1] did however make specific reference to the setting of the Süleymaniye Mosque and the overall skyline of the historic peninsula.

Figure 11-2 shows the boundary of the UNESCO designation and four core areas of interest within the designation. ICOMOS (the International Council On Monuments and Sites) noted in its justification for listing that:

*"One cannot conceive of the World Heritage List without this city which was built at the crossroads of two continents, which was successively the capital of the Eastern Roman Empire, the Byzantine Empire and the Ottoman Empire and which has constantly been associated with major events in political history, religious history and art history in Europe and Asia for nearly twenty centuries."*

Since its inscription, significant threats to the site have been identified by the World Heritage Committee, including:

- Continued degradation of the vernacular architecture within the protected zones (particularly Ottoman-period timber houses in the Zeyrek and Süleymaniye core areas);
- Quality of repairs and reconstruction of the Roman and Byzantine Walls and associated palace structures, including Tekfur Saray and the 'Anemas Dungeon' (Blachernae Palace);
- Uncontrolled development and absence of a World Heritage management plan;
- Lack of coordination between national and municipal authorities, and of organisational relationships between decision-making bodies for the safeguarding of World Heritage at the site;
- Potential impacts of new buildings and new development projects on the World Heritage site and the lack of impact studies before large-scale developments are implemented.

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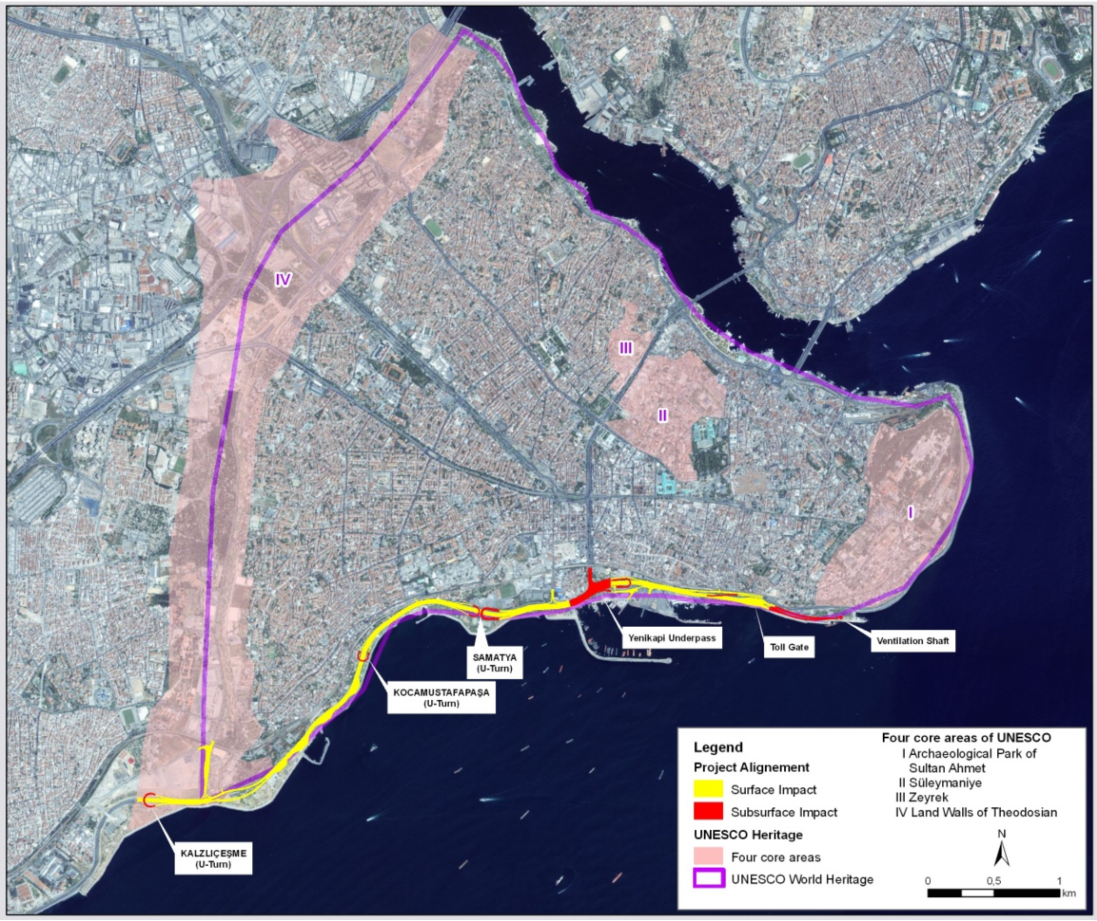
[1] Report of the Decisions Adopted by the World Heritage Committee at its 34th Session (Brasilia, 2010) **WHC-10/34.COM/20**

*Figure 11-2 UNESCO World Heritage Site Designation*




Specific projects also listed by the World Heritage Committee as potential threats to the Outstanding Universal Value of the site include Marmaray Rail project, the Four Seasons Hotel project and the Bosphorus Road Tunnel Project.

UNESCO reports in 2008 and 2009 [1] refer to plans to establish a buffer zone around the World Heritage Site to protect the skyline of the city as one of the principal features of the site. This should include views from the Bosphorus

[1] UNESCO World Heritage Committee Thirty-second session Quebec 2 – 10 July 2008 Mission Report "Historic Areas of Istanbul (Turkey) (356)" (Doc Ref 32 COM) and "State of Conservation of World Heritage Properties Inscribed on the World Heritage List 2009" (Doc Ref WHC-09/33.COM/7B)

with the dominant features of the domes of Hagia Sophia and the great imperial mosques and their accompanying minarets.

Previous Missions have expressed concern over the legislative arrangements, conservation plans and the effectiveness of organizational relationships between decision making bodies responsible for the safeguarding of World Heritage.

There is no specific legislation to protect the World Heritage Site but several sites within the peninsula are subject to protection under Turkish law including:

- Legislation for the Conservation of Cultural and Natural Heritage (Law No.2863, National Level, amended by Laws No.17.06.1987, No.3386; No.5226, Dated: 14.07.2004);
- Environment Law (Law No.2872);
- National Parks Law (Law No.2873);
- Bosphorus Law (Law No. 2960);
- Coastal Zone Law (Law No.36921/3830), Decree Law on the Establishment of Administration for Specially Protected Areas (Decree Law No.383); and
- Law for Pious Foundations (Law No. 2762).

Sections of the Land and Sea Walls are identified as First and Second Degree Archaeological Protection Zones and these are shown in Figure 11-1. Other protected monuments located up to 500 m from the Project are shown in the maps in Annex I. There are several areas within the historic peninsula declared as tourism centres.

### *11.2.4 Future Baseline*

The various World Heritage Reports note that the *Outstanding Universal Value* of the World Heritage Site is at risk from many threats, one of which is further intrusive development within and close to the historic core. Although progress in relation to providing a framework for the protection of the historic core has been made since its designation in 1985, the site is still at risk of being placed on UNESCO's List of World Heritage in Danger (1).

The extensive archaeological investigations at Yenikapi carried out for the Marmaray Project have resulted in important discoveries in the form of harbour structures and no less than 32 Byzantine ships dating from the 7th – 11th centuries. A permanent display of the finds with a comprehensive exhibition catalogue will make the results of the excavations accessible to the researchers and public.

## 11.3 IMPACT ASSESSMENT AND MITIGATION

The assessment of impacts and the proposals for mitigation of significant impacts are presented in two sections:

- Section 11.4 discusses the potential for direct impacts on archaeological and historic features from development of the Project including risk of damage during construction and operation of the Project;
- Section 11.5 discusses the impact on the character and setting of the historic peninsula and the World Heritage Site from visual intrusion and traffic.

## 11.4 IMPACTS ON SITES AND FEATURES OF ARCHAEOLOGICAL AND HISTORIC IMPORTANCE

### 11.4.1 *Assessment of Impacts*

Table 11-2 below presents the results of the assessment and the proposed mitigation for significant impacts on the eleven sites identified in Section 11.2. Mitigation proposals are described in more detail in Section 11.4.2 and 11.4.3.

### 11.4.2 *Mitigation of Significant Impacts*

In summary the main aspects of concern and the proposals for mitigation are as follows.

1 World Heritage Committee, 34th session: Brasilia, Brazil 25 July-3 August 2010 (WHC-10/34.COM/20)

*11.4.2.1* *Risk of locating unknown buried archaeology along the route, in particular in areas of excavations for underpasses, the tunnel and ventilation shaft.*

Where the Project requires subsurface excavation, there is a risk that archaeological remains may be uncovered. An archaeogeophysical survey was undertaken in early 2010 at 13 areas identified as at risk to provide further information on potential for archaeological finds. The results of this investigation are summarised in Section 11.2.2.

Subsequent discussions with four of the Protective Councils (Council No 4 , Council No 5, Council No 6, and the Renovation Council) along the route resulted in the these authorities approving the Project subject to certain conditions.  These conditions will be met as follows:

- The results of the archaeogeophysical survey will be submitted to Protective Council No 4 and the Renovation Council.
- The Project route will not enter into the buffer zone of any designated historic sites, apart from constructing a pedestrian underpass to provide grade separated access to the Marble Tower (this is a mitigation measure and discussed in Section 11.4.2.1). DLH will need to approve this design change and then permission from the Protective Councils will be required regarding this mitigation measure.
- Where the archaeogeophysical investigations (Section 11.2.2) identified the potential for archaeological remains to exist at the road section of Ataturk Caddesi joining to Yenikapi Interchange a Government-approved archaeologist will be present on site to observe during site clearance and excavation of areas where there is potential for finds. Any finds will not be disturbed until they can be properly investigated and assessed by a competent specialist and they will then be removed to an appropriate museum or similar facility.  This will include sampling of soils where there is evidence of palaeo-environmental deposits (evidence of past history in fossils, organic residues, minerals, *etc)*. Results of all investigations will be published.

In response to the findings of both the desk-based and archaeogeophyscial investigations, the designs for two elements of the scheme are being reconsidered to reduce the potential for intrusion into possible buried archaeology associated with the nearby remains of the Theodosian Harbour at Yenikapi.  The main part of this harbour has been excavated following finds made during the Marmaray Project but the Yenikapi and Samatya underpasses could involve excavation in further areas of archaeological significance.

ATAS is therefore investigating moving the Samatya underpass slightly to the west and replacing the Yenikapi underpass with an at-grade junction which will involve only shallow works, thereby significantly reduce the potential for sub-surface archaeological impacts. It should be noted that, based on their own archaeological studies which indicate that the original underpass configuration would not result in significant archaeological impacts, the Municipality currently would prefer the design of the Yenikapi interchange to remain as an underpass.

ATAS will work with the Municipality to resolve this matter during the detailed design period. Note that permission from the Protective Councils will be required to construct the original underpass configuration and it is very likely that such permission will only be obtained should it be proven that the underpass will not result in significant archaeological impacts.

*11.4.2.2 Risks of physical damage to historic structures near the route as a result of operation of construction equipment, deposits of materials and general construction activity.*

Construction near historic features will be planned and undertaken so as to minimise the risk of any physical damage. Personnel operating equipment in the vicinity of historic features will be informed of the need to take particular care not to cause damage.

*11.4.2.3 Risks of vibration from blasting and piling during construction*

Blasting and percussive piling near historic structures will not be permitted. Where piling is essential bored piles and casings driven by torque and hydraulic pressure will be used.

Vibration monitoring will be undertaken prior to and during construction to establish existing levels of vibration and measure changes during construction at buildings within 100 m of piling locations [1]. Measured levels will be compared with guidance on acceptable vibration at the foundation of buildings in British Standard BS7385 [2]. This states that that there should

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[1] Empirical studies indicate that vibration impacts from pile driving are typically not detected at distances greater than 100m (Hiller DM, Crabb GI, 2000).

[2] BS 7385 (1993): Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground-borne vibration

typically be no cosmetic damage to modern buildings if transient vibration does not exceed 15mm/s at low frequencies, 20mm/s at 15Hz, and 50mm/s at 40Hz and above. The guideline values should be reduced to 50% or less for more critical buildings including historic buildings that may be in poor repair and houses. Thus, the permitted maximum vibration velocity (Peak Particle Velocity) at the closest part of any sensitive property (including historic and residential) will be:

- Less than 10 Hz - *8 mm/s*
- 10 to 50 Hz - *12.5 mm/s*
- Greater than 50 Hz - *20 mm/s*

If these limits are exceeded on a regular basis (for more than 3 days in a 6-day period), then construction will stop and the cause of the vibration will be investigated and if necessary remedial action will be undertaken, for example selecting a different construction technique. The new construction method will be monitored to ensure it is operating within the vibration limits.

The following structures will also be inspected prior to and during construction to check for any surface or structural damage and if any impact is detected work will cease until remedial measures are taken and alternative methods will then be used to avoid further damage:

- standing sections of the City Sea Walls along the Project route;
- protected historic chimneys at Kazliçesme;
- Mermerkule;
- the Church of Ss. Sergius and Bacchus /Mosque of Küçük Ayasofya;
- House of Justinian (in the Palace and Harbour of Boukoleon).

*11.4.2.4 Reduction in the accessibility of Mermekule and adverse effect on its setting as a result of construction of a second carriageway south of the tower*

It is not possible to widen the existing road on its current line without physical impact on the Tower and construction of separate eastbound carriageway is therefore proposed to avoid this. This will isolate the tower between the carriageways and affect its setting. The impact on setting cannot be avoided but the introduction of a grade-separated pedestrian underpass to allow access to it is being considered. The approval of the Protective Councils will be required for an underpass in this location as it will enter the protected site buffer zone.  The Tower is not a significant visitor attraction and has been damaged by vandalism.

*Table 11-2 Assessment and Mitigation of Impacts on Sites of Archaeological and Historic Importance*

| Number and Name | Potential impacts | Mitigation | Impact significance |
|---|---|---|---|
| **1**: City Walls Sections by the Sea of Marmara | The Project will not cause any direct impact on the sea walls and the widening of the existing road will not change their character or setting. There is some risk of archaeological finds being encountered near the walls along the route. An archaeogeophysical survey at various locations where standing walls remain was undertaken to provide further information on the potential for finds during construction. It revealed that the foundations of the City Walls can be found at locations under the existing road. However, works to the existing road will not impact on the sub-surface City Wall remains. | A chance finds procedure in accordance with relevant international standards will apply during the construction phase. | No impact |
| | There is a risk of damage to the remaining sections of the sea walls from collisions, tipping of materials and other physical hazards from operation of construction equipment and from vibration caused by blasting and piling. | Construction will be planned and carried out in a manner to minimise risk of physical damage to historic structures. Personnel operating equipment in the vicinity of historic features will be informed of the need to take particular care not to cause damage.<br><br>Blasting and percussive piling will not be used in the vicinity of historic features at risk of damage from vibration, including standing sections of the sea walls. Bored piling and casings driven by torque and hydraulic pressure will be used instead.<br><br>Vibration monitoring will be undertaken prior to and during construction to confirm that vibration levels as a result of the Project do not exceed specified standards, as described in Section 11.4.2.3.<br><br>Historic structures identified in Section 11.4.2.3 will be inspected prior to and at regular intervals during construction to check for any surface or structural | Minor |

| Number and Name | Potential impacts | Mitigation | Impact significance |
|---|---|---|---|
| | | damage and if any impact is detected work will cease until remedial measures are taken and alternative methods will then be used to avoid further damage.<br>A chance finds procedure in accordance with relevant international standards will apply during the construction phase (see Section 11.4.3). | |
| **2**: Tanneries and Iron Works at Kazliçesme | Construction of the Underpass at Kazliçesme will involve excavations into and possibly below the modern fill in this location. The area north of the line of the sea walls contained many historical workshops, tanneries and an iron factory. These may have used sea transport and old harbour features may remain below the modern infill, including a pier used to bring iron ore from Büyükada. There is a small possibility that excavations could extend below the modern fill and encounter buried features. However, the archaeogeophysical survey only identified the foundations of the City Walls under the existing road. Construction works to the existing road will not impact on the sub-surface City Wall remains. | A chance finds procedure in accordance with relevant international standards will apply during the construction phase. | Minor |
| **3**: Mermerkule (the Marble Tower) | A new carriageway will be constructed south of the Tower leaving it located on a parcel of land between the east and westbound carriageways of the approach road. This will have an adverse impact on the setting of the monument and hinder accessibility to it for visitors. The historic setting of the Mermerkule is already significantly affected by the existing road and it has been damaged by vandalism. It is not a significant tourist attraction and entry to the tower is not possible today. | Consideration is being given to providing an additional pedestrian underpass as part of the Project to provide access to Mermerkule although there will still be a reduction in accessibility and an adverse effect on its setting. This will require approval from the Protective Councils.<br>Construction will be planned and carried out in a manner to minimise risk of physical damage to the | Moderate |

| Number and Name | Potential impacts | Mitigation | Impact significance |
|---|---|---|---|
| | There is a risk of damage to the structure during construction from operation of equipment, etc, and from vibration.<br><br>The new roadway will be constructed to a depth of 1 m in an area which is currently a public park. Construction will not disturb any buried archaeology. The archaeogeophysical survey identified the foundations of the City Walls under the existing road and construction works to the existing road will not impact on these remains. | structure. Personnel operating equipment in the vicinity of the Tower will be informed of the need to take particular care not to cause damage.<br><br>The structure will be inspected prior to and during construction and vibration monitoring will be undertaken at the Tower.<br><br>Although no impact on archaeology is predicted, a chance finds procedure will be applied during construction. | |
| **4**: Byzantine remains at Yedikule | The Project will widen the existing road involving construction to a depth of ca. 1 m. Construction will not disturb any buried archaeology which will be located beneath the modern fill. | Although no impact on archaeology is predicted a chance finds procedure will be applied during construction. | No impact |
| **5**: Mosque, Medrese, Hospital and Church at Koca Mustafa Paşa | In this location construction of the Kocamustafapasa U-Turn will require excavation to a depth of 7m. The area has been subject to modern and older infill and although construction is unlikely to intrude into historic materials, it is known that an Armenian hospital was constructed in 18th century outside the line of the sea walls a few hundred metres away. It is thought that there was a cemetery associated with this hospital, the gravestones of which are scattered in the recreational area and outside the church of Surp Hovhannes. The extent of this cemetery is not known so the possibility remains that gravestones may be uncovered. The archaeogeophysical survey identified only remains from the City Walls under the existing road and construction works to the existing road will not impact on these remains. | An archaeological watching brief as well as chance finds procedures will be in place during construction. | Minor |
| **6**: Palace of Helen at | Construction of the underpasses at Samatya will be mainly in modern | As a result of the assessment, consideration is being | Minor |

| Number and Name | Potential impacts | Mitigation | Impact significance |
|---|---|---|---|
| Samatya | infill but there is a small chance that older deposits could be disturbed including features associated with the palace of Helen and the harbour of Theodosius (see Item 7 below). An archaeogeophysical survey at various locations where standing walls remain was undertaken to provide further information on the potential for finds during construction. This investigation identified archaeological remains at the section of Ataturk Caddesi joining to Yenikapi Interchange. | given to:<br>• moving the Samatya underpasses slightly to the west to take them out of the area of interests;<br>• replacing the Yenikapi underpass with an at-grade junction this avoiding intrusion into older deposits beneath the modern fill.<br>These changes will be investigated in consultation with DLH and the municipality. They will require the approval of the Protective Councils.<br>The chance finds procedure will be applied during construction. | |

| Number and Name | Potential impacts | Mitigation | Impact significance |
|---|---|---|---|
| **7**: The Harbour of Theodosius, Yenikapı | The location of the Theodosian Harbour has been confirmed by archaeological excavations associated with the Marmaray Project but its full extent is not known. The excavations have made extensive discoveries of harbour structures and Byzantine vessels. Entry into the ancient harbour is most probably at the Atatürk Boulevard. The original Project design entails construction of deep underpasses at Yenikapi and Samatya, both possibly within the boundaries of the harbour. There is the potential to disturb archaeological deposits and make further important finds. The archaeogeophysical survey identified archaeological remains at the section of Ataturk Caddesi joining to Yenikapi Interchange and design changes are proposed to address this impact. | As a result of the assessment, consideration is being given to:<br>• moving the Samatya underpasses slightly to the west to take them out of the area of interests;<br>• replacing the Yenikapi underpass with an at-grade junction this avoiding intrusion into older deposits beneath the modern fill.<br>These changes are being investigated and if they prove feasible and are approved by DLH they will be adopted. It should be noted that the Municipality has expressed a preference for the original underpass design at this interchange. ATAS will work with the Municipality and DLH to resolve this matter during the detailed design period.<br>Additionally, a Government-approved archaeologist will be present to undertake a watching brief and respond to any chance finds. | Minor |
| **8**: Langa | Intrusive works for the Project will be located south of the line of the sea walls and this area will not be affected. | Although no impact on archaeology is predicted, a chance finds procedure will be in place during construction. | No impact |
| **9**: Konstoskalion Harbour, Kumkapı | Widening of the existing road at Kumkapı and construction of the toll plaza and the start of the tunnel could involve works intruding into historic deposits in this area. An archaeogeophysical survey at various locations where standing walls remain was undertaken to provide further information on the potential for finds during construction. | A chance finds procedure will be applied during construction. | Minor |

| Number and Name | Potential impacts | Mitigation | Impact significance |
| --- | --- | --- | --- |
| | Although archaeological remains were identified, there are north of the existing road and rail line and will not be impacted by the Project. | | |
| **10**: Church of Ss. Sergius and Bacchus /Mosque of Küçük Ayasofya (Little Hagia Sophia) | The cut and cover tunnel construction will extend to a depth of approximately 10 metres. Although it is in an area of modern infill, it is possible that evidence associated with the stable and medrese removed for construction Kennedy Caddesi could remain on the line of the tunnel. An archaeogeophysical survey at various locations where standing walls remain was undertaken to provide further information on the potential for finds during construction. Although archaeological remains were identified, there are north of the existing road and rail line and will not be impacted by the Project. | A chance finds procedure will be applied during construction. | Minor |
| **11**: The Palace and Harbour of Boukoleon | The tunnel, electrical building and ventilation shaft could all lie within the area where the ancient harbour was located. Although most of the features have been lost to previous construction there is a possibility that harbour structures and associated finds could be encountered. An archaeogeophysical survey at various locations where standing walls remain was undertaken to provide further information on the potential for finds during construction. Although archaeological remains were identified, there are north of the existing road and rail line and will not be impacted by the Project. | A chance finds procedure will be applied during construction. | Minor |

### 11.4.3 *International Performance Standards and Requirements*

In addition to these specific measures ATAS is committed to complying in all other respects with relevant international standards.

- ATAS will operate a chance finds procedure during construction in all locations of subsurface works and a specific archaeological watching-brief at locations identified as of possible archaeological importance. This will comply with the requirements of IFC Performance Standard 8 and EBRD Performance Requirements 8 and as required by the Protective Councils a government approved specialist will be appointed to advise on any finds.

- ATAS will comply with relevant national law on the protection of cultural heritage, including national law implementing the Convention on Protection of the World Cultural and Natural Heritage and other relevant international law.

- ATAS will protect and support cultural heritage by undertaking internationally-recognised practices for the protection, field-based study and documentation of cultural heritage. This commitment has already been partially implemented with the commissioning of Dr Haluk Çetinkaya of Mimar Sinan University to undertake desk-based research on the archaeological heritage along the project route and to identify the potential archaeological and built heritage risks and impacts. Additionally, archaeogeophysical investigation has been undertaken in early 2010 (reported in Section 11.2.2) at locations along the route identified as of potential interest.

- ATAS is committed to locating and designing the Project to avoid significant damage to cultural heritage. The ESIA process has identified areas of potential archaeological significance and the project design is being modified to minimise the risks at these locations.

- ATAS will consult with communities who use, or have used within living memory, the cultural heritage for long-standing cultural purposes. Consultations have already been held with the relevant national and local regulatory agencies and approval for the Project has been granted by the four Preservation Councils responsible for cultural heritage resources along the route.

- ATAS will consult with the Turkey National Commission of UNESCO to establish their opinion on the proposals for protection of cultural heritage during the ESIA disclosure period and in later stages of project implementation.

- ATAS will not significantly alter, damage or remove any critical cultural heritage.

- ATAS will:

    - comply with all national and local cultural heritage regulations and protected area management plans;
    - consult protected area sponsors and managers, local communities and other key stakeholders (including the Municipality and UNESCO);
    - take actions to promote and enhance the conservation aims of the protected area.

### 11.4.4 *Public Information and Education*

To support the final commitment noted above, ATAS will develop a route-wide public information and education scheme on both the European and Asian sides. The purpose will be to inform the local community and visitors to the coastal park of the historical context of the area and its archaeological significance. The form and detail of this public scheme will be developed in consultation with the Municipality of Istanbul and UNESCO. The scheme is likely to include the provision of information boards at the locations of key archaeological sites, such as Mermerkule and House of Justinian (at the Palace and Harbour of Boukoleon).

## 11.5 *IMPACTS ON THE HISTORIC AREAS OF ISTANBUL (WORLD HERITAGE SITE)*

In addition to the local impacts of the Project on particular sites and features of historic interest, there is considerable concern about its wider implications for the character of the World Heritage Site as a result of changes in patterns of traffic movements in and around the old city and impacts on the world-famous skyline of the World Heritage Site.

### 11.5.1 *Impacts from Traffic*

Traffic modelling information provided by Jacobs Consultancy shows that the Project will generally reduce levels of traffic within the historic peninsula.

Figure 11-3 and Figure 11-4 illustrate the changes average weekday peak hour and inter-peak traffic flows in and around the peninsula with and without the Project in 2015 (the planned year of opening). Roads with less traffic are shown in light to dark blue, and those with increased traffic in yellow, orange and red.

*Figure 11-3 2015 – Average weekday A.M. peak hour*

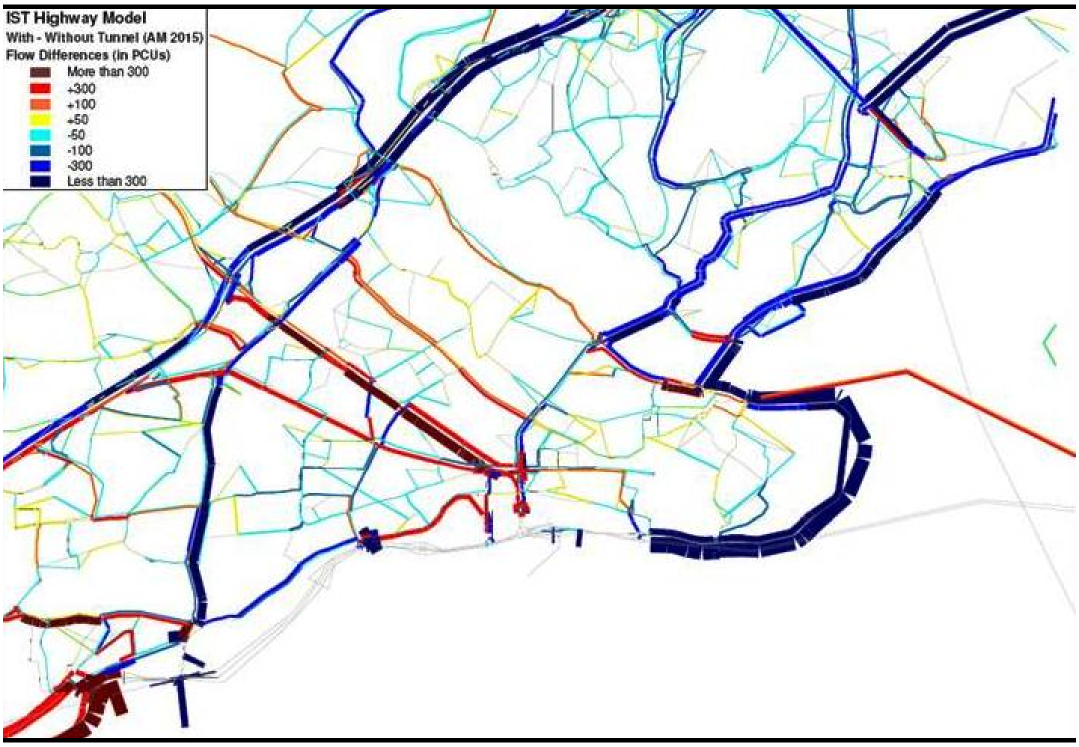
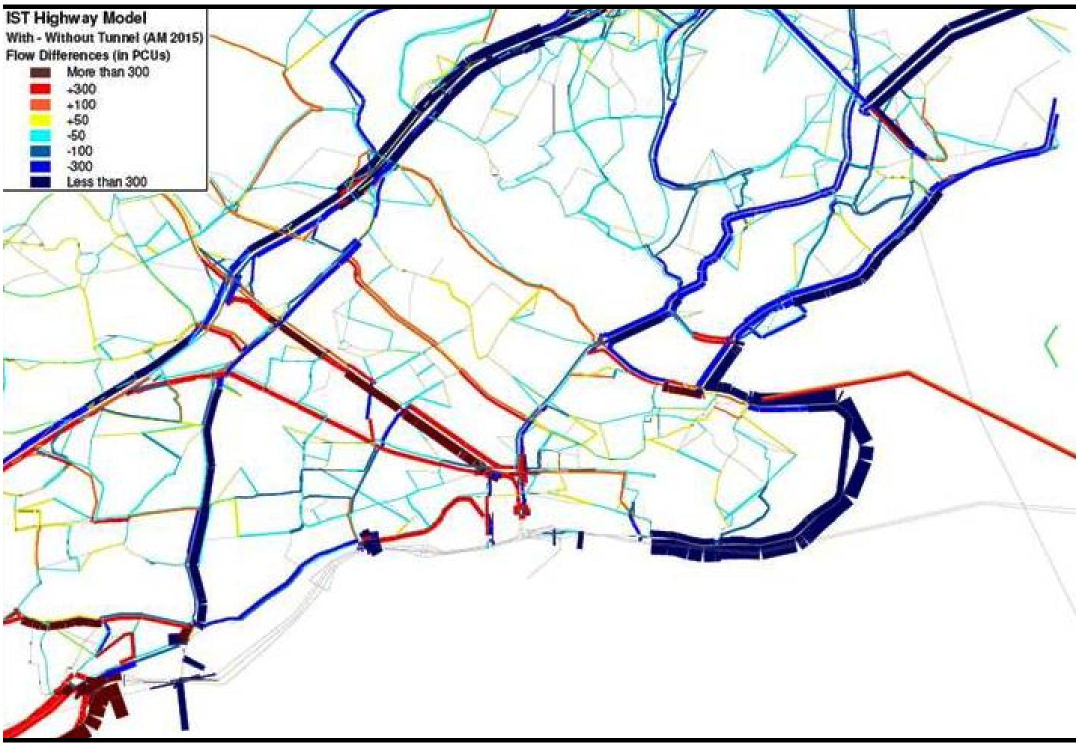



*Figure 11-4 2015 – Average weekday Inter-peak hour*



The Project leads to a reduction in traffic on the section of Kennedy Caddesi to the east of the tunnel portal around Sultan Ahmet (Core Area I of the World Heritage Site), including the Blue Mosque, Hagia Sophia and Topkapi Palace. AM peak flows are reduced by 28% on the section up the Galata Bridge and 17% beyond the bridge. There are also significant reductions (7-10%) on the Galata and Atatürk Bridges across the Golden Horn. Traffic is also reduced on 100 Yil Caddesi, the main dual carriageway which runs immediately outside the Theodosian Land Walls (Core Area IV). There is a small, general reduction in traffic on most minor roads within the peninsula as a result of more traffic using the upgraded coastal road and bypassing the historic peninsula, including in Core Areas II and III of the UNESCO designation (Sulemaniye and Zeyrek). There are also significant reductions (approximately 7-10%) on the Galata and Atatürk Bridges across the Golden Horn.

There are some increases in traffic on roads running trough the old city towards Yenikapi interchange. These are greatest on Adnan Menderes Bulvari and are caused by traffic travelling between the D-100 and the tunnel. Eastbound traffic volumes on the D-100 motorway increase by approximately 8% in the A.M. peak (much less in the inter-peak period).

Overall, reductions in traffic on minor streets throughout the historic peninsula and in the core areas, especially on the route around the eastern end of the peninsula, are expected to lead to a small positive impact for the old city and the *Outstanding Universal Value* of the World Heritage Site by reducing noise and air emissions from traffic, reducing visual impact on the town and streetscape of the historic peninsula, and reducing potential damage to sensitive buildings and structures from traffic-based ground vibration.

### 11.5.2 *Impacts on the Skyline*

The Project will not impact on the silhouette of the historic peninsula of Istanbul as seen from the Bosphorus. The original proposal envisaged a number of elements which had the potential to cause possible impact on this view but these elements have all been lowered so that no structure exceeds approximately 7 m above existing ground-level. In this way the Project remains below the line of the old sea walls and the city beyond them so that no structure intrudes into the view of the old city.

The key design changes are noted below:

- The toll plaza structure was originally approximately 14m in height including signs on the top of the structure. These will now be removed lowering the height to approximately 7m. There is a minimum vehicle height-clearance requirement (for safety purposes) of 3m and this has been incorporated into the revised design.

- The ventilation shaft close to the tunnel portal the European has been designed to minimise its height whilst achieving acceptable dispersion of emissions. The original height of 7m has been reduced to 5m.

- The Operations Buildings close to the toll plaza on the European Side was originally a three storey building with a height of more than 12m. It is now a two-storey building with a third storey as a basement. The maximum height above ground level of the building is now approximately 6m.

- The proposed replacement of the underpass at Yenikapi with an at-grade intersection would introduce new pedestrian footbridges at this location. If accepted, these will not exceed 7m in height. It should be noted that the Municipality has expressed a preference for the original underpass design at this interchange. ATAS will work with the Municipality and DLH to resolve this matter during the detailed design.

- Other pedestrian footbridges along the European approach have all been designed to ensure that their height does not exceed 6m above ground level.

- The original proposals envisaged the main access for TBM tunnelling being located at the European ventilation shaft. This would have resulted in a tall slurry treatment plant being located on the shoreline during construction, with a significant temporary adverse effect on the skyline in a sensitive location (albeit located close to the radar tower). This was one factor leading to the proposal to access the tunnel from the Asian ventilation shaft and this impact will now be avoided.

It should be noted that these revisions all need to be approved by DLH.

### 11.5.3 *Summary of implications for the Outstanding Universal Value of the Historic Peninsula*

Although a Statement of Outstanding Universal Value has yet to be adopted, no impacts on the various cultural heritage components which contribute to its status are predicted to occur as a result of the Project. The Project will result in a small reduction in traffic volumes on most of the road network within the historic peninsula, although a few of the minor road will have small increases. Traffic will be significantly reduced adjacent to some of the most historically and culturally significant components of the World Heritage Site such as Sultan Ahmet (Core Area I of the World Heritage Site), including the Blue Mosque, Hagia Sophia and Topkapi Palace.

The design of the taller elements of the Project has been amended such that there will be no impacts on the skyline of the historical peninsula.

A suite of specific mitigation measures have been proposed to address archaeological and cultural heritage impacts and ATAS is committed to complying with the relevant aspects of international performance requirements.

ATAS will also develop a route-wide public information and education scheme on both the European and Asian sides. The purpose will be to increase awareness of the local community and visitors to the coastal park and the general Project areas of the historical context of the area and its archaeological and cultural heritage significance. The form and detail of this public scheme will be developed in consultation with the Municipality of Istanbul and UNESCO/World Heritage Council.

# 12 *SOCIO-ECONOMIC EFFECTS*

## 12.1 *INTRODUCTION*

### 12.1.1 *Scope*

This chapter addresses the following potential socio-economic impacts of the Project:

- temporary and permanent changes in the study area's population and demographic characteristics due to the Project;
- direct and indirect employment creation as a result of construction and operation;
- direct and indirect loss of existing employment and business;
- wider (regional) economic impacts; and
- impact of the provision of temporary construction worker accommodation.

These issues were identified during scoping (see Chapter 3) using a social impact screening checklist based on Table 1 of the IFC document, *Good Practice Note: Addressing the Social Dimensions of Private Sector Projects* [1]. The completed checklist is presented in Annex O.

A number of other issues related to social factors are addressed in Chapters 4 (Land Use and Property), 11 (Archaeological and Built Heritage) and 13 (Labour and Working Conditions).

### 12.1.2 *Approach*

The socio-economic assessment has involved:

1) gathering existing and available baseline data regarding current socio-economic conditions and how they may develop in the absence of the Project;

2) determining the direct and indirect socio-economic impacts of the project;

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[1] Good Practice Note: Addressing the Social Dimensions of Private Sector Projects; International Finance Corporation (IFC), December 2003.

3) identifying measures which ATAŞ will take to ensure compliance with international best practice in mitigation of social and socio-economic impacts.

Existing socio-economic data was obtained from a number of sources and references:

- European Public Health Information system (www.euphix.org).
- Ninth Development Plan 2007 – 2013; State Planning Organisation, 2006.
- OECD Economic Outlook No. 86, November 2009.
- OECD Health Data 2009 - Country Notes (Turkey); OECD, 2009.
- Population and social conditions (46/2009); Eurostat.
- Population in Europe 2007: first results; Eurostat, 2008.
- State Planning Organization (www.dpt.gov.tr).
- The Study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in the Republic of Turkey; Transportation Department of IMM, 2009.
- The Socio-Economic Benefits of Roads in Europe; International Road Federation (IRF) Research Council; 2007.
- Turkey's Statistical Yearbook 29982008; Turkish Statistical Institute, 2009.
- Turkish Statistical Indicators 1923 – 2007; Turkish Statistical Institute, 2008.
- Turkish Statistical Institute (www.tuik.gov.tr).
- Turkstat Economic indicators: Quarter II 2008; Turkish Statistical Institute, 2008.
- 2008 Report on the Global AIDS epidemic; UNAIDS (Joint United Nations Programme on HIV/AIDS).

## 12.2 BASELINE

### 12.2.1 *Population and demographics*

#### 12.2.1.1 *National data*

The total population of Turkey in December 2007 was approximately 70.5 million, of which 50.1% were male and 49.9% female. The population of Turkey has been increasing annually at a substantial rate since the 1950s as shown in Figure 12-1. The rate of growth has slowed since 1986 (Figure 12-2) but continues to result in significant year-on-year population growth. The growth rate in 2007 was 1.17%, considerably in excess of the annual growth rate of the majority of industrialised counties. By comparison, the growth rate in the EU was 0.35% with 80% of this due to migration [2].

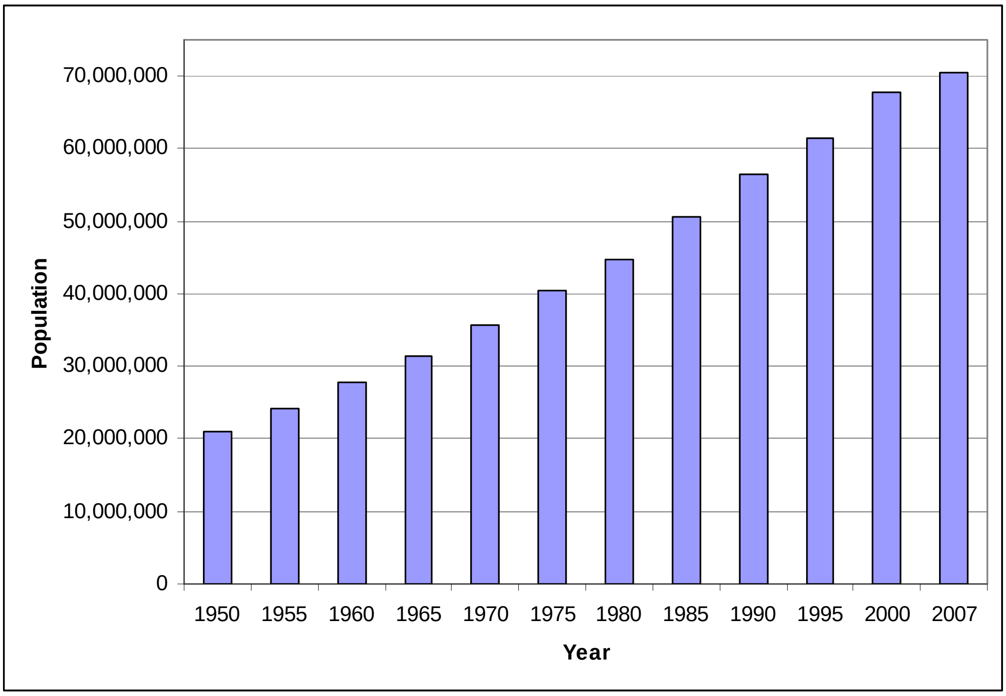


***Figure 12-1 National Population of Turkey*** [3]

[2] Population in Europe 2007: first results; Eurostat, 2008.

[3] Turkish Statistical Indicators 1923 – 2007; Turkish Statistical Institute, 2008.

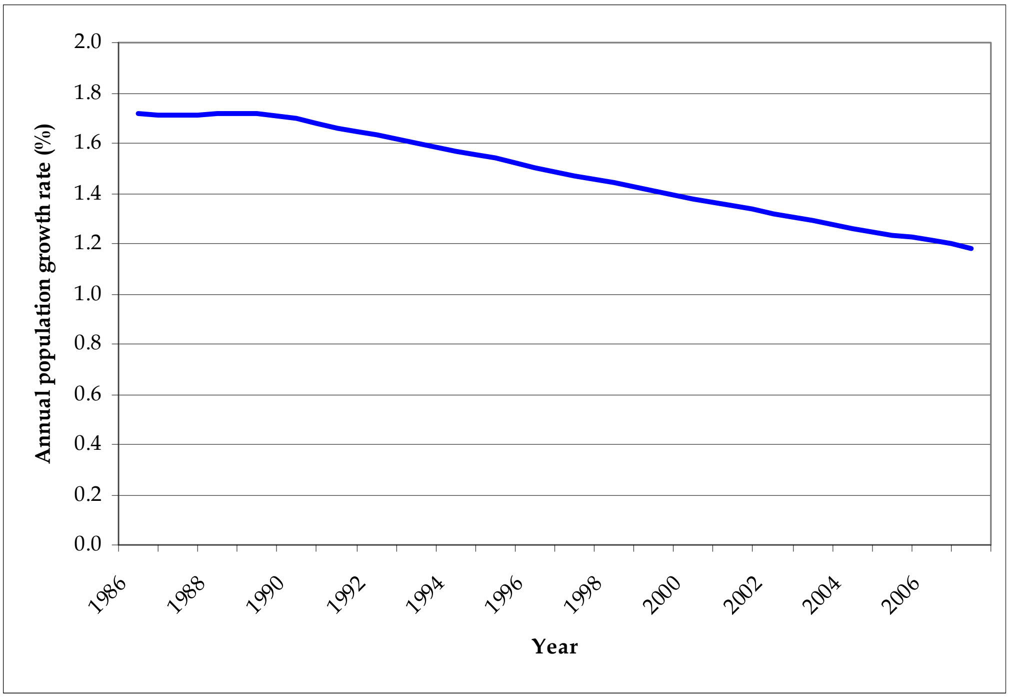


*Figure 12-2 Annual National Population Growth Rate* [4]

### 12.2.1.2 *Istanbul*

Istanbul is the largest city in Turkey with a total population in 2007 of 12.5 million, of which approximately 50% were male and 50% are female [5]. Its share of national population increased from 8.5% in 1970 to 15.9% in 2005. As with the national population, Istanbul has undergone a substantial growth in population, from a city of 3 million in 1970 to a mega-city of 10 million people by 2000 [6]. A substantial part of this growth has resulted from in-migration driven by industrial and urban expansion. The growth peak was in the 1970s and since then the growth rate has steadily declined.

The Transport Masterplan forecasts that the population of Istanbul is expected to increase to between 18 and more than 20 million by 2023; the upper figure being reached with an annual growth rate of 3%.

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4 Turkish Statistical Indicators 1923 – 2007; Turkish Statistical Institute, 2008.

5 Turkish Statistical Indicators 1923 – 2007; Turkish Statistical Institute, 2008.

6 All data in the following section are taken from: The Study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in the Republic of Turkey; Transportation Department of IMM, 2009.

*12.2.1.3 Project Route*

Istanbul is divided into a total of 39 Districts. The Project passes through four of these as shown in Figure 12-3 below.

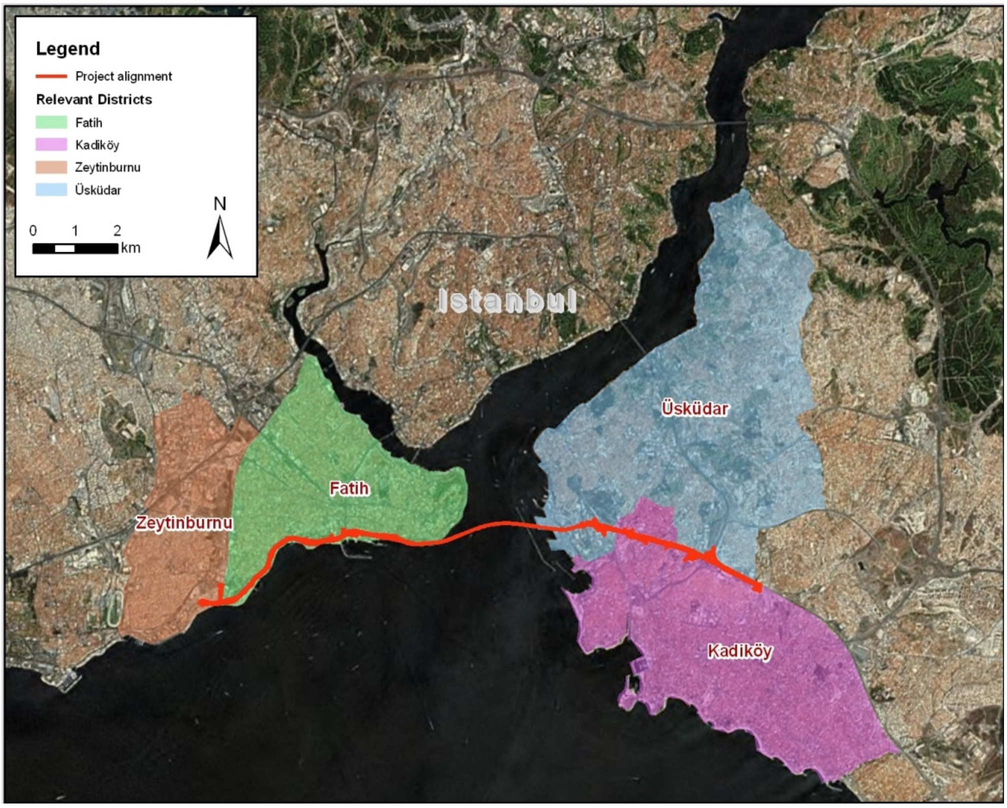


***Figure 12-3 Districts along the Project Route***

Population data for these four Districts for the years 2000 and 2005 is presented in Table 12-1.

All four Districts contain significant populations although these have declined in Fatih and Kadıköy in the period 2000 – 2005. This reflects a trend observed across the city of movement of population away from the old centre. This is illustrated in Figure 12-4.

*Table 12-1* *District Population Data* (7)

| District | 2000 population | 2005 population | % change 2000 - 2005 | % of Istanbul population (2005) |
|---|---|---|---|---|
| Fatih | 403,500 | 369,100 | - 1.8% | 3.2% |
| Zeytinburnu | 248,700 | 287,800 | + 3.1% | 2.5% |
| Kadıköy | 653,300 | 597,900 | - 1.8% | 5.2% |
| Üsküdar | 495,100 | 585,100 | + 3.4% | 5.0% |
| *Total* | *1,800,600* | *1,839,900* | *+ 2.1%* | *15.8%* |
| **Istanbul** | **10,018,700** | **11,606,300** | **+ 3.0%** | **100%** |

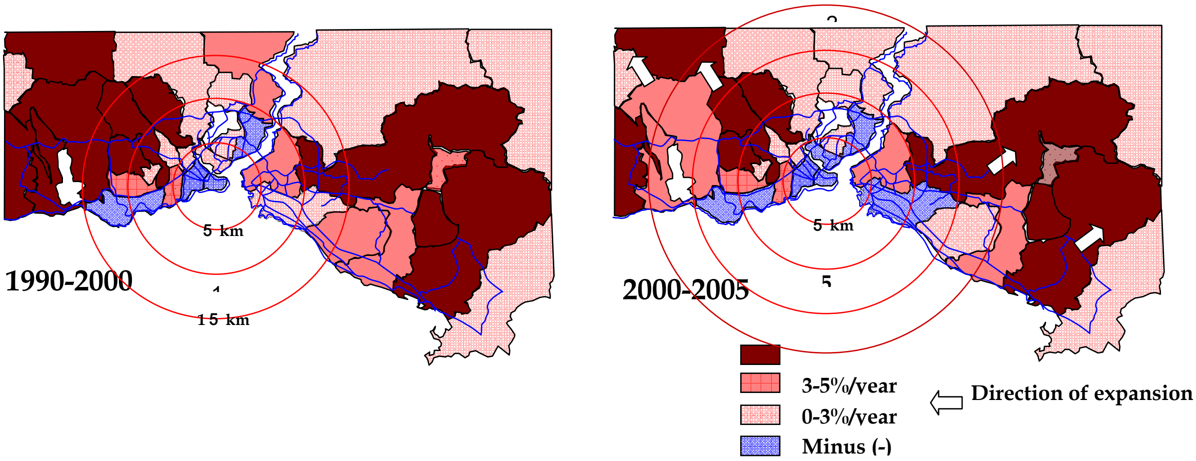


*Figure 12-4* *Population Growth Rate by District 1990-2000 and 2000-2005* (8)

This trend is expected to continue with the Masterplan for Istanbul envisaging the focus of development moving to the west away from the historical peninsula and also to the east beyond Üsküdar and Kadıköy, and the north form the old urban centre.

The population levels in the other two Districts (Zeytinburnu and Üsküdar) increased in the same five year period but with a slowing growth rate. The total population within all four Districts increased by 2.1% in the period 2000 – 2005.

[7] The Study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in the Republic of Turkey; Transportation Department of IMM, 2009.

[8] The Study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in the Republic of Turkey; Transportation Department of IMM, 2009.

The various land uses along the route are described in Chapter 4.

### 12.2.2 *Economy, Employment and Occupations*

#### 12.2.2.1 *Economic growth*

Turkey has undergone a significant level of economic growth since 2001. However, the general trend since 1971 has been very variable with significant peaks (large positive growth) and troughs (large negative growth), the most recent of which was in 2001, when there was 5.7% reduction in real GDP [9]. Figure 12-5 shows Turkey's annual real GDP from 1971 to 2007. Comparison data is also provided for the OECD Area and the EU. Between 2001 and 2007, Turkey's real GDP growth has considerably exceeded that of the OECD and the EU, although Turkey's rate of real GDP growth has been declining since 2005.

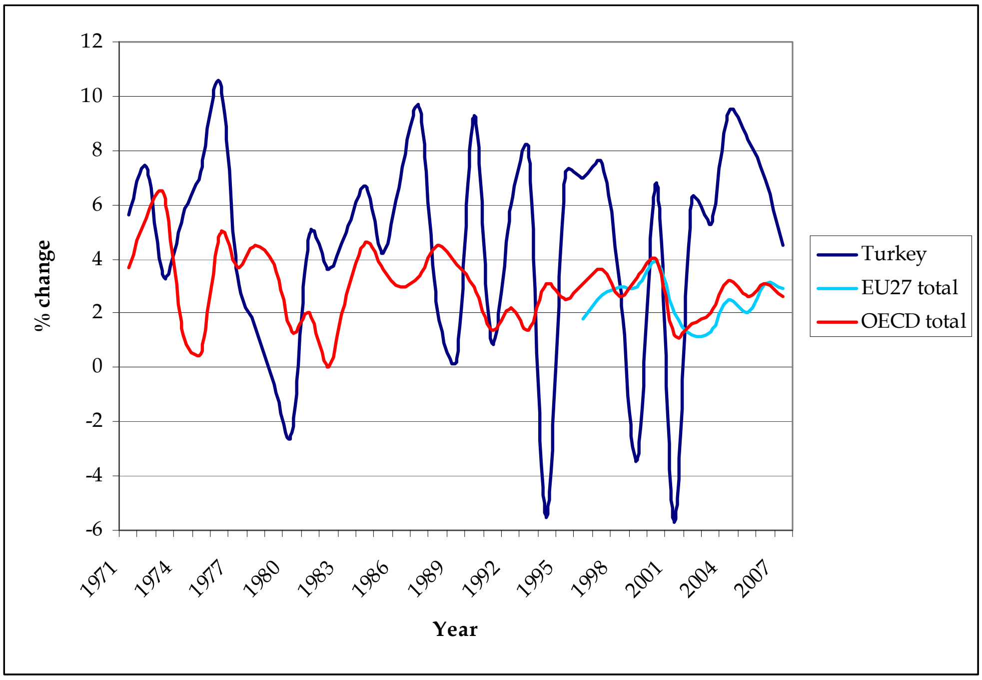


***Figure 12-5 Turkish, OECD and EU GDP annual changes in real GDP [10]***

[9] http://www.oecd.org/statsportal

[10] Real GDP is a measure of the size of an economy adjusted for changes in the value of money: inflation or deflation.

The OECD [11] predicts that Turkey will return to positive growth in 2010 (+ 2.7% GDP) and 2011 (+ 4.6% GDP), reversing the predicted negative growth of – 6.5% GDP in 2009.

### *12.2.2.2 Employment*

Table 12-2 below presents employment data for the years 2000 – 2006, including data on urban and rural employment and employment in Istanbul for 2006.

***Table 12-2 Labour and employment data 2000 to 2006*** **[12]**

| Year | Labour force ('000) | Employed ('000) | Unemployed ('000) | % unemployment |
|---|---|---|---|---|
| 2000 | 23,078 | 21,581 | 1,497 | 6.5% |
| 2001 | 23,491 | 21,524 | 1,967 | 8.4% |
| 2002 | 23,818 | 21,354 | 2,464 | 10.3% |
| 2003 | 23,640 | 21,147 | 2,493 | 10.5% |
| 2004 | 24,289 | 21,791 | 2,498 | 10.3% |
| 2005 | 24,565 | 22,046 | 2,520 | 10.3% |
| 2006 | 24,776 | 22,330 | 2,446 | 9.9% |
| *2006: urban* | *14,882* | *13,081* | *1,802* | *12.1%* |
| *2006: rural* | *9,894* | *9,249* | *645* | *6.5%* |
| *2006: Istanbul* | *4,143* | *3,677* | *466* | *11.2%* |

It can be seen that the rate of national unemployment fell between 2003 and 2006. However 2009 OECD data [13] suggest that Turkey will have a national unemployment rate of 14.6% in 2009, that this will increase to 15.5% in 2010 and then fall slightly to 15.0% in 2011. This in line with predictions of employment across the wider OECD Area.

Data on employment in urban and rural areas in 2006 show that the urban unemployment rate (12.1%) was almost double that of rural areas (6.5%). The unemployment rate for Istanbul (11.2%) is greater than the national average (9.9%) but lower than the urban average (12.1%).

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[11] OECD Economic Outlook No. 86, November 2009.

[12] Turkey's Statistical Yearbook 2008; Turkstat, 2009.

[13] OECD Economic Outlook No. 86, November 2009.

The Istanbul Transportation Masterplan (14) provides employment data (from 2005) for the four Districts in Istanbul within which the Project is located and these are provided below in Table 12-3.

*Table 12-3* ***Relevant District employment data for 2000 and 2005***

| District | 2005 population | 2005 employment at workplace | % growth in employment 2000 – 2005 | % share of total employment in Istanbul (2005) |
|---|---|---|---|---|
| Fatih | 369,100 | 115,997 | - 2.2% | 3.1% |
| Zeytinburnu | 287,800 | 145,881 | + 3.9% | 3.9% |
| Kadıköy | 597,900 | 225,197 | + 2.7% | 6.0% |
| Üsküdar | 585,100 | 146,124 | + 5.5% | 3.9% |
| **Total** | **1,839,900** | **633,199** | **+ 23.6%** | **16.4%** |
| Istanbul | 11,606,300 | 3,862,821 | n/a | 100% |

In line with the reduction in population and the strategy to draw development away from the historical peninsula, employment has declined in Fatih. The three other Districts have recorded increases in employment. The four Districts represent over 16% of all employment in Istanbul in 2005.

Compared to the other Districts in Istanbul, the overall populations within the four Project districts showed relatively modest rates of employment growth (until the global recession of 2008 and 2009), whereas other, generally more distant, Districts showed larger rates of employment growth, some in excess of 20%.

The breakdown of national employment into the main employment types is provided in Figure 12-6 based on data from 2006.

[14] The Study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in the Republic of Turkey; Transportation Department of IMM, 2009.

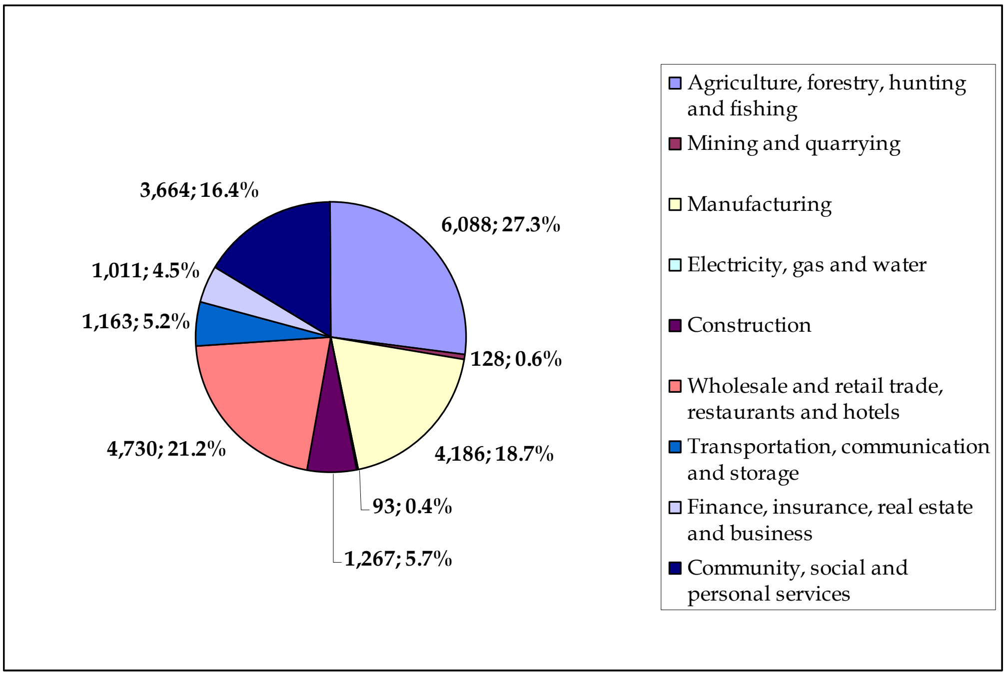


*Figure 12-6* ***National Occupational Data for Turkey (1000s and % of total)*** **(15)**

It can be seen that the largest category of employment on a national-basis is 'Agriculture, forestry, hunting and fishing' (27.3%) followed by 'Wholesale and retail trade, hotels and restaurants' (21.2%). 'Construction' and 'Transportation, communication and storage services', both of direct relevance to the Project, account for 5.7% and 5.2% respectively.

Istanbul is a highly urbanised, modern and well developed city-region and its occupational breakdown differs from the national picture. Comparable data are not available but data from a more simplified three-way employment classification of 'Agriculture – Industry – Services' showed that, compared to national data, agriculture plays an insignificant role in the economy of Istanbul (0.5%)(16). Instead services (57.6%) and industry (41.9%) dominate as shown in Figure 12-7.

15 Turkey's Statistical Yearbook 2008.

16 Turkey's Statistical Yearbook, 2008.

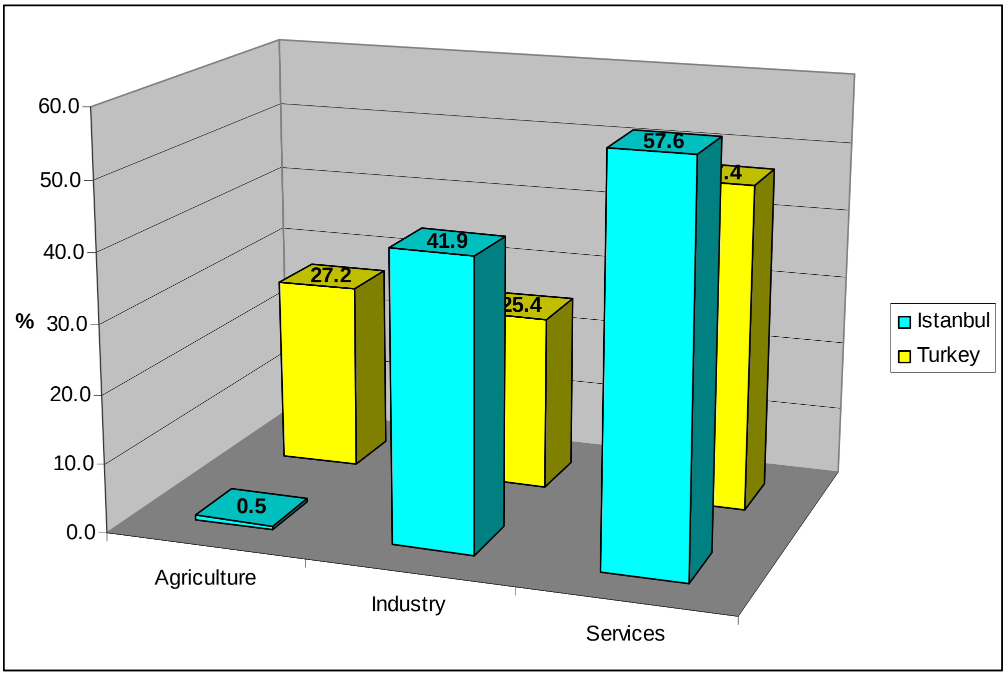


***Figure 12-7*** ***Comparison of Simplified Employment Type Classification between Istanbul and Turkey (% of total)*** (17)

*12.2.2.3* *Income*

Table 12-4 below presents income data from 2005.

***Table 12-4*** ***Average income data for 2005*** (18)

| Income type | Turkey | Urban | Rural |
|---|---|---|---|
| Total income TL | 228,070,236,246 TL | 161,558,726,670 TL | 66,511,509,576 TL |
| Total income % | 100% | 70.8% | 29.2% |
| Average household income | 14,567 TL | 16,263 TL | 11,493 TL |
| Average income per employed household member | 6,264 | 8,507 | 3,841 |

[17] Turkey's Statistical Yearbook, 2008.

[18] Turkstat Economic Indicators II 2008.

In excess of 70% of total incomes in Turkey are earned in urban areas with the balance earned in rural areas. Average household income and average income per household member are considerably higher in urban compared to rural areas.

Specific data are not available but average incomes in Istanbul are expected to be higher than the national urban average, given its status as the largest city of Turkey and its primary role in the national economy. Istanbul has accounted for in excess of 21% of national GDP since 1995 and 22.7% in 2004 [(19)], compared to only 15.9% of population in 2005.

*12.2.2.4 Poverty*

[19] The Study on Integrated Urban Transportation Master Plan for Istanbul Metropolitan Area in the Republic of Turkey; Transportation Department of IMM, 2009.

Table 12-5 presents data from 2006 regarding poverty for Turkey as a whole and for urban and rural areas. The table also presents similar data on poverty rates within the EU.

*Table 12-5* ***Poverty data for Turkey*** [20, 21]

| Poverty type | Details | Turkey | Urban | Rural |
|---|---|---|---|---|
| Food poverty | The proportion of the national population whose average consumption expenditure is below the basic level of food consumption. | 0.74% | 0.04% | 1.91% |
| Food and non-food poverty | This measure of poverty also includes basic good and services needs, in addition to food needs. | 17.81% | 9.31% | 31.98% |
| Relative poverty, based on expenditure | This measure represents the level below which the individuals are below the average welfare level (based on a set of good and services). This is taken to be 50% of the median value of consumption expenditure/person. | 14.50% | 6.97% | 27.06% |
| **Poverty type** | **Details** | | **EU** | |
| At-risk of poverty | Living below the poverty threshold, a situation likely to hamper their capacity to fully participate in society. | | 16% | |
| Material deprivation | Material deprivation is defined as the enforced lacking of at least three of nine items[22]. | | 17% | |

Direct comparison between the Turkish and EU data is not possible due to the different methods and data sets which are used to generate the data but some broad indications can be inferred.

The Turkish data shows that food poverty is not a significant issue in Turkey. It is even less of an issue for urban areas (of most relevance to Istanbul). However, food and non-food poverty together rise to over 9% for urban areas, indicating that non-food related needs (such as basic services and non-food needs) are a greater issue. Relative poverty is almost 7% in urban areas,

[20] Turkey in Statistics, 2008.

[21] Population and social conditions (46/2009); Eurostat.

[22] Ability to face unexpected expenses, ability to pay for one week annual holiday away from home, existence of arrears (mortgage or rent payments, utility bills, or hire purchase installments or other loan payments), capacity to have a meal with meat, chicken or fish every second day, capacity to keep home adequately warm, possession of a washing machine, a colour TV, a telephone or a personal car.

considerably lower than that national average of 14.5%. It is evident that the various measurements of poverty are considerably higher in rural areas.

Comparisons with the EU indicate that the national average of food and non-food poverty in Turkey (17.81%) is broadly similar to that of the EU average for At-risk poverty, which is 16%. The EU's material deprivation average (17%) is slightly higher than the measure Relative Poverty in Turkey, which was 14.5%. It is worth noting that the EU poverty data masks considerable variations among the Member States, with the Nordic Countries having significantly lower levels of poverty and many of the new Member States (such as Romania, Latvia, Poland, Hungary, Cyprus, Lithuania and Slovakia) having much higher levels [(23)].

The global recession of 2008 and 2009, which has resulted in Turkey's national unemployment rate reaching 14.6% in 2009, is likely to have increased levels of poverty.

### 12.2.3 *Health*

The Organisation for Economic Co-Operation and Development (OECD) noted[(24)] that total health spending accounted for 5.7% of GDP in Turkey in 2005 (latest year available), below the average of 8.9% across OECD countries. As Turkey has the lowest GDP per capita among OECD countries, it is not surprising that it also has the lowest per capita health spending of 618 USD in 2005 (adjusted for purchasing power parity).

The same OECD Report also noted that there were significant improvements and advancements in the overall health status of Turkey in recent years and that Turkey registered one of the greatest gains in life expectancy between 1960 and 2007, with an overall increase in longevity of over 23 years, rapidly narrowing the gap with the average across OECD countries. In 1960, life expectancy in Turkey was 20 years below the OECD average. By 2007, it was only about 7 years lower (71.8 years in Turkey compared with the OECD average of 79.0 years).

The infant mortality rate in Turkey has fallen significantly over the past few decades, down from about 190 deaths per 1 000 live births in 1960 to 20.7 deaths in 2007. Despite this improvement, the rate of infant mortality in Turkey remains four times higher than the OECD average of 4.9.

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23 Population and social conditions (46/2009); Eurostat.

24 OECD Health Data 2009.

Tobacco smoking has shown a marked decline over the past twenty years in most OECD countries. Turkey has achieved some progress in reducing tobacco consumption, with the proportion of daily smokers among adults decreasing from 43.6% in 1989 to 33.4% in 2006. However, smoking rates among adults in Turkey remains much higher than the OECD average of 23.3%.

Figure 12-8 below shows the total number of AIDS-infected people (cases and carriers) in Turkey from 2002 to 2006. Figure 12-9 presents a summary map of AIDS cases diagnosed in 2006 in the wider European area and surrounding regions. Figure 12-10 presents a global view of the total HIV infection.

These AIDS and HIV data indicate that AIDS is not a particular health issue in Turkey and that the prevalence of this disease is low compared to most other countries.

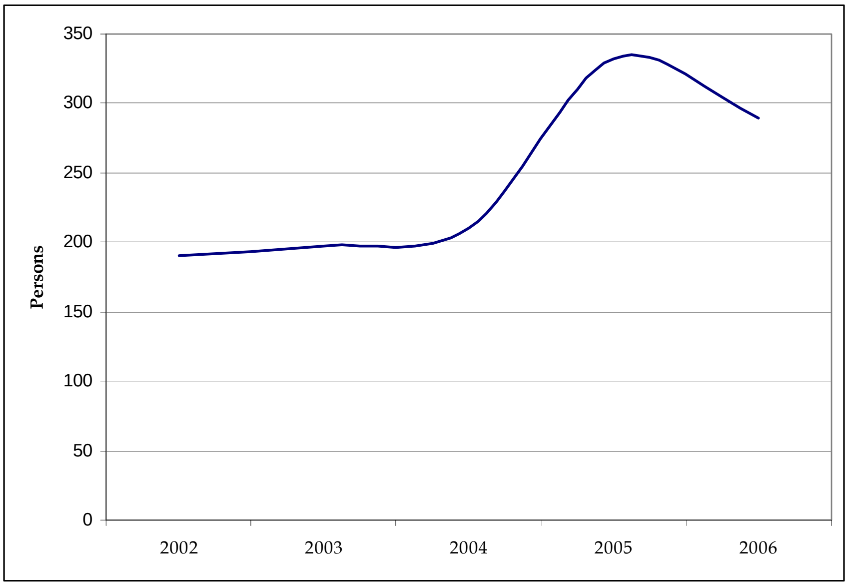


*Figure 12-8 AIDS-Infected People (Cases and Carriers) in Turkey from 2002 to 2006* [25]

[25] Turkey's Statistical Yearbook, 2008.

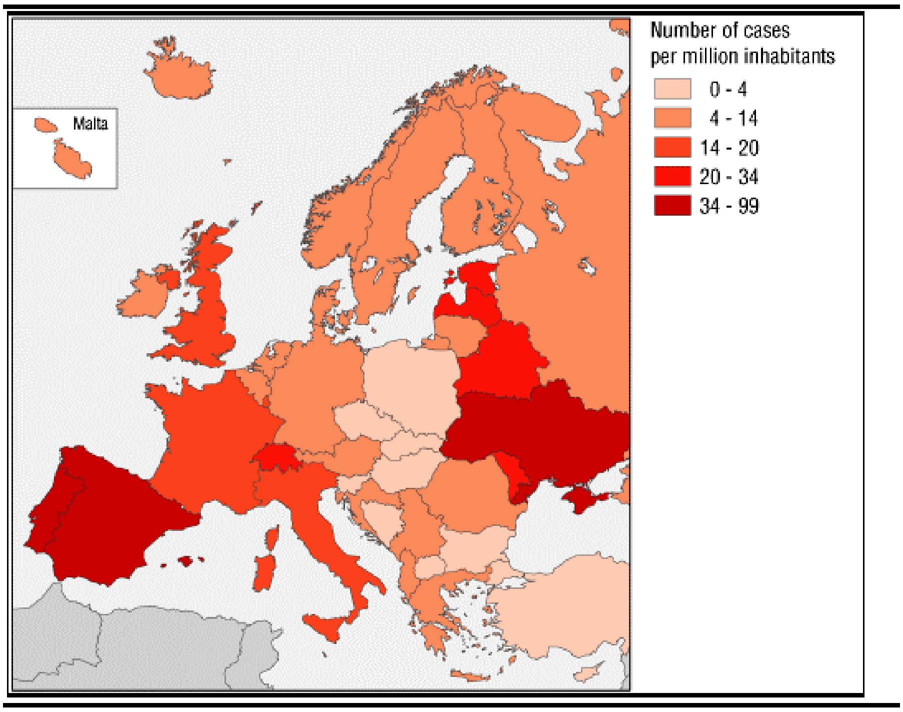


*Figure 12-9 AIDS cases diagnosed in 2006* (26)

[26] http://www.euphix.org.

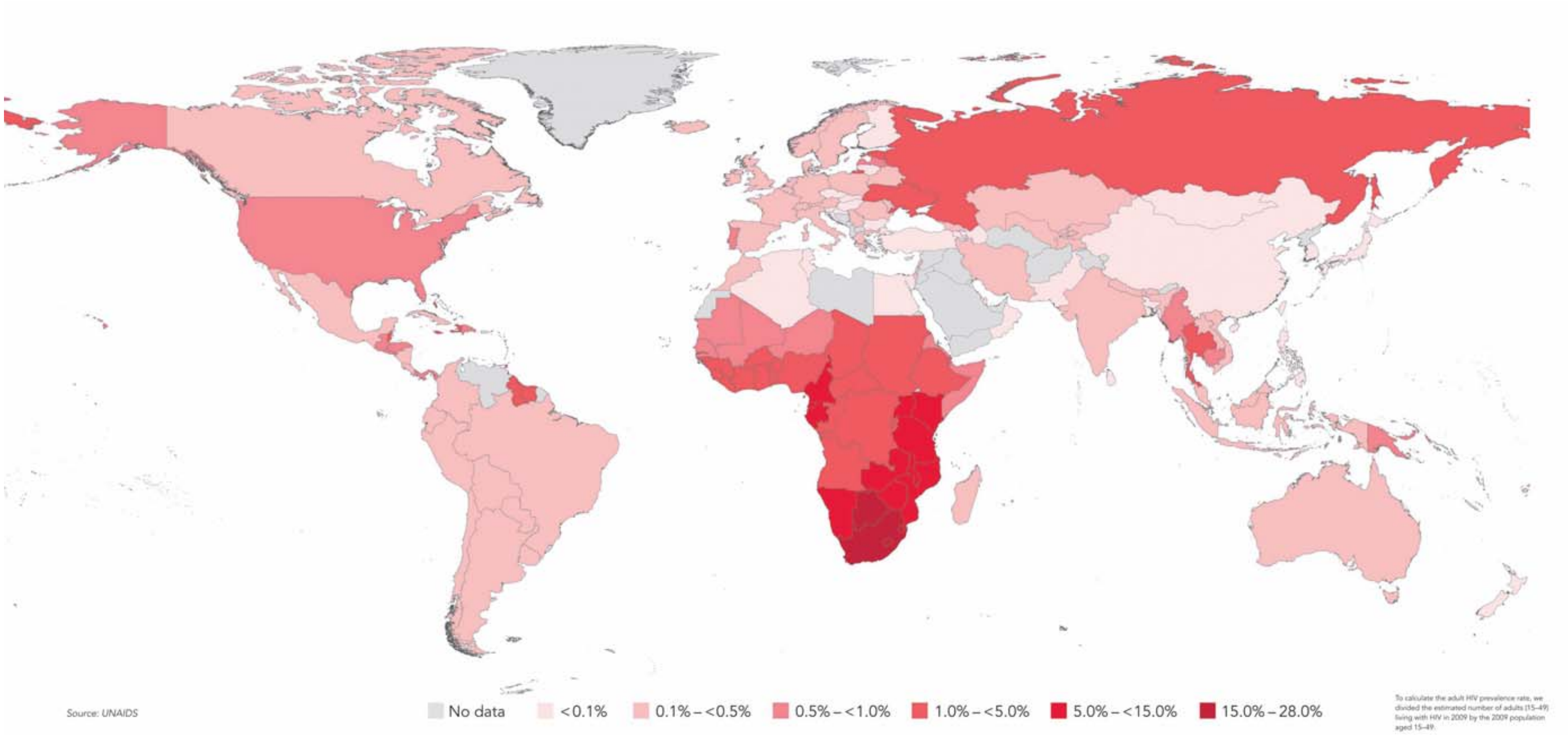


***Figure 12-10 Estimated Adult HIV Prevalence in 2009*** **(27)**

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[27] 2010 Report on the global AIDS epidemic; UNAIDS (Joint United Nations Programme on HIV/AIDS)

### 12.2.4 *Future Developments*

It is expect that the main trends discussed above; namely increasing population levels, economic activity (notwithstanding the current global recession), employment creation and health improvements, will continue in the medium to long-term (post 2011), but at a slower rate.

In the shorter-term, it is likely that the global recession will impact on Turkey's immediate economic prospects with knock-on impacts for employment and incomes. However, the current population of Istanbul is expected to increase.

## 12.3 *IMPACT ASSESSMENT AND MITIGATION*

### 12.3.1 *Direct and Indirect Employment Creation*

#### 12.3.1.1 *Construction*

It is estimated that a total of approximately 1,800 workers (1,640 blue collar, 160 white collar) will be required for construction of the Project. Employment of these workers over the 43 month construction and commissioning period will provide a positive employment impact through creating approximately 6,450 person years of employment.

It is the intention that the large majority of the workforce will be sourced locally and the provision of temporary employment will provide a significant benefit to the economy. Hiring at this level is not expected to cause any overheating in the local labour market or to affect the availability of construction workers for other projects and businesses in the city given the size of the sector in Istanbul. (The existing construction sector in Istanbul is estimated to employ between 200 -250,000 people, ca 6% of total city workforce of 3.8 million.)

It may be necessary to bring a small number of specialist workers in from outside Turkey and the impact of housing incoming workers is discussed in Section 12.3.2.

All construction workers will be employed and remunerated in accordance with the provisions of Turkish law and IFC Performance Standard 2: Labour and Working Conditions (see Chapter 14).

In addition to the direct employment benefits of the Project, indirect and induced employment benefits will also arise. Indirect employment is that created in providing goods and services to the construction project; induced employment is that created by the expenditure of direct and indirect employees' earnings in the economy. Input-output data for Turkey are not available to allow direct estimation of these effects but using available data from various sources suggests that indirect and induced employment could amount to of the order of 90% of Project jobs [28]; that is every person year of direct employment will generate an additional 0.9 person years of indirect and induced employment in the economy.

Total employment creation from the Project could therefore be of the order of 12,250 person years over the construction period. It is generally considered that 10 person years of temporary employment is equivalent in economic terms to about one new full term job so the Project will have a minor impact through creating the equivalent of about 1,200 full time equivalent jobs compared to total unemployment of approximately 466,000 (11.2%) in 2006 [29]. The OECD has estimated that national unemployment has risen since 2006 and that it will peak at 15.5% in 2010 [30].

### 12.3.2 *Impact of the Provision of Temporary Workforce Accommodation*

ATAS will provide two types of temporary construction worker accommodation:

- Emergency construction worker accommodation; and
- Short-term construction worker accommodation.

### 12.3.3 *Emergency Accommodation*

Accommodation for a small number of workers will be provided at the construction compounds near the tunnel entrances, one on each continent. These will provide emergency and overnight accommodation for workers who may be finishing shifts at night and security staff resting during the day. Continuous or regular accommodation will not be provided at these locations. The facilities on the European side will accommodate up to 20 workers, and will be located near the ventilation shaft. The facilities on the Asian side will accommodate up to 30 workers and will be at Eyüp Aksoy Interchange. These camps will be removed when construction is completed.

[28] Data developed by the Scottish Government provide employment multipliers for the Construction sector in 2004 of 1.58 for indirect jobs and 1.93 for direct jobs. See http://www.scotland.gov.uk/Topics/Statistics/Browse/Economy/Input-Output/Downloads

[29] Turkey's Statistical Yearbook 2008; Turkstat, 2009.

[30] OECD Economic Outlook No. 86, November 2009.

### 12.3.4 *Short-term Accommodation*

ATAS intends to employ as many construction workers who are based in Istanbul (and thus have their individual accommodation in the city) as is realistically possible. However, there may be occasions when on-site worker accommodation is required (such as workers who may be needed for a short period of time and who reside outside Istanbul). For such short-term accommodation, ATAS is planning to rent a compound area at a suitable location outside the city centre and will ensure that an acceptable environment is created for workers and workers do not create any problems to the people nearby.

The location of this camp has yet to be decided but it will be developed and managed in accordance with the provisions of IFC Performance Standard 4: Community Health, Safety and Security and the IFC-EBRD guidance on workers accommodation [31] (see Chapter 14). A key objective will be to avoid any impact on the adjacent community or on local services, community facilities and businesses. Unnecessary interactions by the workforce with the local community will be minimised.

### 12.3.5 *Impact on Population and Demographics*

#### 12.3.5.1 *Construction*

The introduction of a small imported workforce into the city during construction and the creation of a small number of permanent jobs during operation will have no impact on the population of the city.

Displacement of residents as a result of the Project is discussed in Chapter 4. Expropriation of buildings may lead to a small number of people needing to move but it appears likely that this can be avoided by fine-tuning the alignment during detailed design.

#### 12.3.5.2 *Operation*

During operation the Project will employ approximately 110 people. This scale of permanent employment is not expected to result in any permanent direct

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[31] Workers' accommodation: processes and standards: A guidance note by IFC and the EBRD, 2009. http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/p_WorkersAccommodation/$FILE/workers_accomodation.pdf

changes in residential or working population in the immediate area around the route.

The wider impact of the Project on the population of Istanbul will be limited because of its location in a mature and developed part of Istanbul where there is limited capacity for new development and thus additional population. The Project is designed to support the Istanbul Masterplan objectives of increasing the westward and eastward focus for development by providing a new route to facilitate movement in these directions, and its development is expected to support this strategy. It is not expected to result in any other changes in population in the wider city as the new approach roads and tunnel are not located in areas where they could open up currently undeveloped parts of the city for development.

### *12.3.6 Direct and Indirect Loss of Existing Employment and Businesses*

Development of the Project may result in the expropriation of a small number of commercial premises. This impact is discussed in Chapter 4. The Project will be designed in order to avoid direct displacement of premises as far as possible through using existing roads and minimising the need for additional land. Where displacement cannot be avoided the BOT Contract provides that the expropriation and compensation of businesses will be undertaken by DLH.

ATAŞ will work with DLH to apply a strict approach to expropriation of any premises that do need to be acquired in accordance with IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement. The details of this are set out in the Resettlement Policy Framework in Annex D. This provides for:

- prompt compensation for the loss of assets or access to assets at full replacement cost;
- compensation of business owners for the cost of re-establishing commercial activities elsewhere and also for the net income lost during the period of transition and also for the costs of the transfer and re-installation of plant, machinery or other equipment;
- provision replacement property of equal or greater value, or cash compensation at full replacement cost to persons with legal rights or claims to land which are recognised or recognisable under the national law;

- compensation of economically displaced persons who are without legally recognisable claims to land for lost assets other than land, at full replacement cost;
- provision of additional targeted assistance (e.g. credit facilities, training, job opportunities etc.) and opportunities to improve or at least restore their income-earning capacity, production levels and standards of living to economically displaced persons whose livelihoods or income levels are adversely displaced; and
- provision of transitional support to economically displaced persons, as necessary, based on a reasonable estimate of the time required to restore their income-earning capacity, production levels and standard of living.

Access will be maintained with all existing land uses, buildings and facilities along the route. Where temporary diversions and alternative access arrangements are required; the relevant land use, businesses or residents will be informed well in advance of the alternative access arrangements. This information will also be freely available on the Project website. No impacts due to alternative access arrangements are anticipated.

ATAŞ and DLH will establish a grievance mechanism consistent with IFC guidance [32] to receive and address specific concerns about compensation and relocation that are raised by displaced persons or members of host communities, including a recourse mechanism designed to resolve disputes in an impartial manner. This is further described in Chapters 4 and 15.

### *12.3.7 Regional Socio-Economic Impacts*

Various studies have reported on the wider economic impact of road construction. The International Road Federation (IRF) Research Council summarised the findings of a number of studies in Europe [33] and noted (p.10):

*"According to a nation-wide report commissioned by the French Senate in 1995, an investment of EUR 150 million in roads creates on average some 3,240 jobs, of which 1,210 are directly related to the road construction works, while 575 are linked to the activities undertaken prior to the construction, and 660 are directly related to the*

[32] IFC Guidance Note No 7 2009; Good Practice Note: Addressing Grievances from Project-Affected Communities.

[33] The Socio-Economic Benefits of Roads in Europe; International Road Federation (IRF) Research Council; 2007.

*production of construction materials in addition to 800 jobs resulting from construction-related investment revenues.*

*In turn, the American Federal Highways Agency (FWHA) estimates that every USD 1 billion of highway investments generates 44,709 full-time jobs, of which 8,390 are directly related to road construction, while 20,924 are in support industries and 15,395 in the industries benefiting from direct or indirect employment in the service sector."*

These sources support the prediction that construction of the Project will yield significant temporary employment and economic benefits in Istanbul and provide a significant boost to the regional construction and supply industry. The provision of on-site catering and welfare facilities for the site and the workforce and the supply of goods and services to the worker camp will provide a small level of benefit to local businesses.

During operation the Project will continue to provide wider regional socio-economic benefits resulting from savings in journey times for business and personal purposes.

The Project is not expected to have any negative micro-economic impacts such as local inflation in prices of good and services.

# 13 COMMUNITY HEALTH AND SAFETY

## 13.1 INTRODUCTION

### 13.1.1 Scope

This chapter shall addresses how the Project may change the community's exposure to risks and impacts arising from equipment accidents, structural failures, releases of hazardous materials, exposure to diseases, and the activities of personnel. The aim is to identify measures to minimize potential risks and impacts to community health, safety and security that may arise from project activities both during routine and non-routine operation.

Main issues to be considered are:

- General Health and Safety of the community;
- Infrastructure and Equipment Safety;
- Hazardous Material Safety;
- Environmental and Natural Resource Issues;
- Community Exposure to Disease;
- Emergency Preparedness and Response;
- Security Personnel Requirements.

The above list of issues to be addressed was determined from the scoping process (summarised in Chapter 3) undertaken at the start of the ESIA process and consideration of the IFC Performance Standard 4 Community Health, Safety and Security [1].

### 13.1.2 Approach

The preparation of this community health and safety chapter has involved:

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[1] http://www.ifc.org/ifcext/sustainability.nsf/Content/PerformanceStandards

1) Gathering relevant baseline data (on issues such as design, equipment, emergency response) and related safety terms and conditions which the client will use for the duration of the Project;

2) Reviewing the planned activities and comparing against the provisions of IFC Performance Standard 4 (Community Health, Safety and Security);

3) Determining the direct and indirect health and safety impacts of the Project; and

4) Developing mitigation measures.

## *13.2 GENERAL HEALTH AND SAFETY OF THE COMMUNITY*

### *13.2.1 Potential Risks and Impacts of the Project*

Impacts on the health and safety of the community may arise during construction as a result of noise, dust and other emissions from earthmoving, blasting, piling, and operation of equipment and vehicles. These impacts are discussed in Chapters 8 and 9 and the main findings relevant to community health and welfare are summarised here.

No significant impacts from dust or noise are predicted during construction provided that good site practices as set out in the ESMP (Annex D) are implemented to minimize the generation and dispersion of dust and noise. Impacts resulting from construction traffic are small since flows are small compared to the existing traffic levels on roads approaching the works.

The operation of the road and tunnel will affect flows of traffic on the approach roads and elsewhere in the city with resulting impacts on related noise and air emissions and road safety. The results from modelling of air and noise emissions are presented in Chapters 8 and 9. Short term exceedances of the 2014 Turkish standard for the short-term 1-hour concentration of NO2 may occur close to the road when meteorological conditions are most unfavourable. People will not generally be present for long periods of time in these areas and significant impacts on health are not therefore predicted to occur. At a city-wide level, the Project will provide a new, shorter route across the Bosphorus and this will reduce the overall number of vehicle kilometres travelled by traffic in Istanbul with a consequent small reduction (ca. 0.3-1%) in the total levels of traffic generated air pollution in the City of Istanbul. This should yield small benefits in improved public health outcomes although these are unlikely to be detectable.

Environmental noise generated by traffic will exceed the Turkish noise limits applicable to sensitive areas close to the approach roads in 2023. Approximately 80 - 100 residential buildings are estimated to be affected. Measures will be integrated into the final design to remove these impacts using low noise road surfaces, noise barriers and, if required, insulation of sensitive buildings. The Project will lead to a reduction in traffic on Kennedy Caddesi north and east of the tunnel portal and on main roads connecting with the tunnel approaches on both the European and Asian sides and these changes will lead to small benefits from reductions in noise along these routes.

The reduction in overall vehicle kilometres travelled as a result of the Project and the diversion of traffic off local streets and onto the tunnel approach roads should lead to a reduction in risk of road traffic accidents affecting pedestrians, cyclists, and motorcycle users and car users in comparison with the situation without the Project in future years. Risks should also be lowered along the approach roads by replacing at-grade crossings with footbridges and making informal crossing away from designated crossing points more difficult. Provisions of crossings designed for prams, pushchairs and wheelchairs should, in particular, reduce the risk of accidents to vulnerable users (such as mothers with children and the disabled).

### 13.2.2 *Measures to Avoid and Minimise Potential Risks and Impacts*

A range of measure to protect the community from any adverse effects during construction (noise, dust and other emissions) and operation are presented in Chapters 8 and 9 and set out in the ESMP.

In order to monitor the impact of the Project on ambient air quality during operation, ATAŞ will set up a continuously operating air quality monitoring station to check whether ambient air quality standards are being exceeded. If monitoring indicates that ambient concentrations are increasing to near the limit values variable message signs will be used to require traffic to slow down and encourage other driving habits which can reduce emissions.

ATAŞ will also perform noise monitoring during the year after opening of the Project to determine whether environmental noise standards are being met. Monitoring locations will be selected at representative buildings along the scheme which could be sensitive to noise. The success of noise mitigation measures and the need for further mitigation will be evaluated from the results of these measurements.

## 13.3 *INFRASTRUCTURE AND EQUIPMENT SAFETY*

### 13.3.1 *Potential Risks and Impacts of the Project*

Weaknesses in the design of structures and shortcomings during their construction could result in failures of infrastructure and equipment and pose significant risks to the life of the people using the roads, tunnel, bridges and underpasses.

The risk of structural failure will increase in the event of natural hazards such as earthquakes and floods.

### 13.3.2 *Measures to Avoid and Minimise Potential Risks and Impacts*

ATAŞ will design, construct and operate the structural elements (tunnel, roads, bridges, underpasses) of the project in accordance with Turkish national and local authority standards. The design elements will also comply with various international standards, such as Japanese, British and German Standards and Guidelines and Standards published by AASHTO (American Association of State Highway and Transportation Officials), PIARC (World Road Association), IEC (International Electro-technical Commission) and NFPA (US National Fire Protection Association) as discussed in Section 2.3.10, and will give particular consideration to potential exposure to natural hazards (see also Section 13.7). The contractor will be required to check and approve all designs and to audit and inspect the construction in accordance with good international construction practice.

Natural disasters such as earthquakes, tsunamis, floods and storms are being thoroughly addressed at all stages of design. All structures will be designed to meet and exceed the seismic standards required by the Turkish Seismic Code (2007) and the requirements of the BOT Contract. In addition, the tunnel will be designed according to Japanese Standards on structural requirements for seismic events. The risk of liquefaction of the coastal area along the European side in the event of earthquakes will be addressed in the design of the road and structures in that area.

## 13.4 HAZARDOUS MATERIAL SAFETY

### 13.4.1 *Potential Risks and Impacts of the Project*

The risks for the community through exposure to hazardous materials during construction and operation of the road and tunnel will be very limited. Hazardous materials will be used to a limited extent during construction, in paints and solvents, in the slurry treatment plant, and for specialist purposes within the tunnel (sealants etc). The large majority of the construction waste and spoil will be inert and suitable for disposal in normal disposal areas. Only a limited amount of waste (oily waste, final resides from slurry treatment, containers with hazardous resides, etc) will have to be disposed of as hazardous waste.

### 13.4.2 *Measures to Avoid and Minimise Potential Risks and Impacts*

Selection, storage, use and disposal of hazardous materials will be strictly controlled during construction in accordance with legal requirements regarding worker heath and safety and environmental protection, and good industry practice. There should be no significant releases into the external environment that could present risks to the public. Spills of hazardous materials will be immediately contained, cleaned up and disposed of in accordance with a Project spill response plan. Hazardous materials will only be transported by specialist contractors holding all necessary authorisations.

## 13.5 ENVIRONMENTAL AND NATURAL RESOURCE ISSUES

Some projects may include significant changes in topography or land use which may increase the risk for natural hazards or may exacerbate related impacts such as landslides or floods.

Since the planned development of the tunnel and roads will not result in a significant change in existing topography or land use, the risk for associated induced natural hazards is low.

The water body of the Bosphorus can be considered as a natural resource which needs to be protected against adverse impacts during construction and operation. Chapter 7 (Water Environment) discusses potential risks for surface waters during construction and operation and identifies corresponding measures to control those risks.

## 13.6 COMMUNITY EXPOSURE TO DISEASE

The Project has no potential for community exposure to water-borne, water-related or vector-borne diseases. The majority of the construction workforce will be locally recruited and the numbers of introduced workers will be small. If necessary they will be housed in small dedicated accommodation camp designed in accordance with strict international standards. Given the cosmopolitan nature of Istanbul and its existing large tourism, maritime transport, and construction sectors, all involving people from many countries, the chance of any significant increase in communicable disease as a result of the Project is negligible.

## 13.7 EMERGENCY PREPAREDNESS AND RESPONSE

### 13.7.1 Potential Risks and Impacts of the Project

Road tunnels present higher risks than open roads associated with vehicle accidents, fire and explosion, and other emergencies. In this Project these are of particular significance because of the history of seismic activity in the region. The proximity of the coast also raises the risk relating to flooding especially in the event of an earthquake.

### 13.7.2 Measures to Avoid and Minimise Potential Risks and Impacts

The tunnel is being designed to meet strict standards for design and operation to minimise the risks of incidents and provide appropriate response in the event of an incident occurring. These provisions are described in Chapter 2. The Lenders Technical Advisor is reviewing the current plans and working with ATAS to ensure all necessary measures are in place to meet international standards. Detailed emergency preparedness and response plans for protection of community health and safety will be prepared, including plans to prevent, prepare for and respond to emergencies affecting road users (vehicles and pedestrians) and the wider community. These will be prepared in consultation with the local emergency services and necessary information will be conveyed to road users and the wider community.

## 13.8 SECURITY PERSONNEL REQUIREMENTS

All worksites will be secured to protect the public and security staff will work in accordance with the terms of Law no. 5188 on the Private Security Services.

Security personnel will be trained in the appropriate use of force should it be required.

# 14 LABOUR AND WORKING CONDITIONS

## 14.1 INTRODUCTION

### 14.1.1 Scope

This chapter reviews the Project proposals against the requirements of IFC Performance Standard 2: Labour and Working Conditions (1) and other relevant international standards including the International Labour Organisation (ILO) Core Labour Standards (2). It addresses the following issues:

- child labour;
- safe and acceptable physical working conditions including construction and operational H&S and training;
- equitable and ethical terms and conditions of employment;
- acceptable standards and management of workers accommodation; and
- worker's grievance mechanism.

Issues associated with the benefits of direct and indirect employment during construction and operation of the Project are addressed in Chapter 12 (Socio-Economic Impacts).

### 14.1.2 Approach

The assessment of compliance has involved:

1) Gathering relevant baseline data (on issues such as employment, income distribution and child labour) an also the employment, employee and health and safety terms and conditions which ATAŞ will use for the duration of the Project;

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1 http://www.ifc.org/ifcext/sustainability.nsf/Content/PerformanceStandards

(2) Elimination of forced and compulsory labour (Conventions 29 and 105)
Abolition of child labour (Conventions 138 and 182)
Elimination of discrimination in respect of employment and occupation (Conventions 100 and 111)
Freedom of association and collective bargaining (Conventions 87 and 98)

2) Undertaking a gap analysis between provisions of IFC Performance Standard 2 (Labour and Working Conditions) and relevant national laws and regulations;

3) Determining the direct and indirect labour and working condition impacts of the Project; and

4) Identifying measures that ATAŞ will undertake to ensure compliance with IFC PS2 and other relevant international performance standards.

## 14.2 GAP ANALYSIS

Table 14-1 presents a comparison of relevant Turkish law and IFC PS2. The information regarding Turkish Law is an overview of the main legal points and not intended to be a legal interpretation of the laws and regulations.

ATAŞ is a recently formed company (specifically created for this Project) so it has yet to establish the policies which will be required to satisfy the requirements of PS2 and national law. ATAŞ is comprised of a number of Turkish and Korean companies (details provided in *Chapter 1*) who have existing policies and procedures within their own organisations which do, however, accord in general with the provisions of PS2 and Turkish laws and regulations.

ATAŞ will use these existing policies and procedures as a starting point for creating the required ATAŞ systems to ensure compliance with PS2 and nation laws and regulations. ATAŞ commits to have these policies and procedures developed and in place prior to the start of any construction activities or any hiring of the general construction workforce.

ATAŞ will develop and implement a specific *Project Policy Document* outlining all of the above policy and procedural requirements. This will be given to all ATAŞ employees and any sub-consultant or contractor employees who are working on behalf of ATAŞ on the Project.

*Table 14-1 Comparison of Turkish Labour Legislation and Policy with IFC Performance Standard 2*

| **Summary of PS2 provision (and PS2 paragraph reference)** | **Key Points of Turkish Law** |
|---|---|
| *Human Resources Policy:*<br><br>6. The client will adopt a human resources policy appropriate to its size and workforce that sets out its approach to managing employees consistent with the requirements of this Performance Standard. Under the policy, the client will provide employees with information regarding their rights under national labour and employment law, including their rights related to wages and benefits. This policy will be clear and understandable to employees and will be explained or made accessible to each employee upon taking employment. | *Turkish Law:*<br><br>No specific provisions. |
| *Working Relationship:*<br><br>7. The client will document and communicate to all employees and workers directly contracted by the client their working conditions and terms of employment, including their entitlement to wages and any benefits. | *Turkish Law:*<br><br>Employment contracts with a fixed duration of one year or more must be provided to employees. Where no written contract is provided, the employer is required to provide the employee with a written document outlining the general and special conditions of work, working time, payment and wages (and any wage supplements), frequency of payment, contact duration (if it is a fixed term contract), and conditions concerning the termination of the contract. |
| *Working Conditions and Terms of Employment:*<br><br>8. Where the client is a party to a collective bargaining agreement with a workers' organization, such agreement will be respected. Where such agreements do not exist, or do not address working conditions and terms of employment (such as wages and benefits, hours of work, overtime arrangements and overtime compensation, and leave for illness, maternity, vacation or holiday) the client will provide reasonable working conditions and terms of employment that, at a minimum, comply with national law. | *Turkish Law:*<br><br>Turkish law recognises the right to form workers unions and related organisations. The objective is to arrange principles on the establishment, organisation, operation and auditing of unions and confederations which are formed by workers or employers. |
| *Workers' Organizations:*<br><br>9. In countries where national law recognizes workers ' rights to form and to join workers ' organizations of their choosing without interference and to bargain collectively, the client | *Turkish Law:*<br><br>Turkish Law recognises the right to collectively bargain and also to form a union (or related organisation). One of the laws notes |

| **Summary of PS2 provision (and PS2 paragraph reference)** | **Key Points of Turkish Law** |
|---|---|
| will comply with national law. Where national law substantially restricts workers' organizations, the client will enable alternative means for workers to express their grievances and protect their rights regarding working conditions and terms of employment.<br><br>10. In either case described in paragraph 9, and where national law is silent, the client will not discourage workers from forming or joining workers' organizations of their choosing or from bargaining collectively, and will not discriminate or retaliate against workers who participate, or seek to participate, in such organizations and bargain collectively. Clients will engage with such worker representatives. Worker organizations are expected to fairly represent the workers in the workforce. | that one of the main purposes of such collective bargaining is to determine principles and methods of collective bargaining agreements, solving the conflicts in peaceful means, strike and lock-out to arrange mutual economical and social situations and work conditions of workers and employers. |
| *Non-Discrimination and Equal Opportunity:*<br><br>11. The client will not make employment decisions on the basis of personal characteristics unrelated to inherent job requirements. The client will base the employment relationship on the principle of equal opportunity and fair treatment, and will not discriminate with respect to aspects of the employment relationship, including recruitment and hiring, compensation (including wages and benefits), working conditions and terms of employment, access to training, promotion, termination of employment or retirement, and discipline. In countries where national law provides for non-discrimination in employment, the client will comply with national law. When national laws are silent on non-discrimination in employment, the client will meet this Performance Standard. Special measures of protection or assistance to remedy past discrimination or selection for a particular job based on the inherent requirements of the job will not be deemed discrimination. | *Turkish Law:*<br><br>Turkish Law forbids discrimination due to race, language, gender, political views and opinion and religion. Employer should treat part time workers with the same rights as full time workers and indefinite period workers to definite period workers unless there are genuine reasons for not doing so.<br><br>If the above laws are violated, workers may claim financial compensation |
| *Retrenchment*<br><br>12. The client will develop a plan to mitigate the adverse impacts of retrenchment on employees, if it anticipates the elimination of a significant number of jobs or a layoff of a significant number of employees. The plan will be based on the principle of non-discrimination and will reflect the client's consultation with employees, their organizations and, where appropriate, the government. | *Turkish Law:*<br><br>Laws and regulations exist to protect against unfair dismissal. If it is decided through a Turkish court of law that a dismissal was without legal justification, then the unfairly dismissed employee can claim financial compensation.<br><br>However, an employer is permitted to dismiss an employee for |

| **Summary of PS2 provision (and PS2 paragraph reference)** | **Key Points of Turkish Law** |
|---|---|
| | legal reasons and in these cases, severance pay must be paid (based on a set of specific employment conditions). |
| *Grievance Mechanism*<br><br>13. The client will provide a grievance mechanism for workers (and their organizations, where they exist) to raise reasonable workplace concerns. The client will inform the workers of the grievance mechanism at the time of hire, and make it easily accessible to them. The mechanism should involve an appropriate level of management and address concerns promptly, using an understandable and transparent process that provides feedback to those concerned, without any retribution. The mechanism should not impede access to other judicial or administrative remedies that might be available under law or through existing arbitration procedures, or substitute for grievance mechanisms provided through collective agreements. | *Turkish Law:*<br><br>No specific provisions. |
| *Child Labour:*<br><br>14. The client will not employ children in a manner that is economically exploitative, or is likely to be hazardous or to interfere with the child's education, or to be harmful to the child's health or physical, mental, spiritual, moral, or social development. Where national laws have provisions for the employment of minors, the client will follow those laws applicable to the client. Children below the age of 18 years will not be employed in dangerous work. | *Turkish Law:* Official Gazette Date/Number: 10.6.2003/25134<br><br>Men under the age of eighteen and women irrespective of their age must not be employed on underground or underwater work like in mines, cable-laying and the construction of sewers and tunnels. Children (under 15 years old) and young employees (15 to 24 years old) must not be employed on industrial work during the night.<br><br>Young employees who are under 16 years, children and workers who have not received occupational training that they are responsible for must not be employed in arduous or dangerous work. |
| *Forced Labour:*<br><br>15. The client will not employ forced labour, which consists of any work or service not voluntarily performed that is exacted from an individual under threat of force or penalty. This covers any kind of involuntary or compulsory labour, such as indentured labour, bonded labour or similar labour-contracting arrangements. | *Turkish Law:*<br><br>Turkish Law forbids forced labour. |

| **Summary of PS2 provision (and PS2 paragraph reference)** | **Key Points of Turkish Law** |
|---|---|
| *Occupational Health and Safety:*<br><br>16. The client will provide the workers with a safe and healthy work environment, taking into account inherent risks in its particular sector and specific classes of hazards in the client's work areas, including physical, chemical, biological, and radiological hazards. The client will take steps to prevent accidents, injury, and disease arising from, associated with, or occurring in the course of work by minimizing, so far as reasonably practicable, the causes of hazards. In a manner consistent with good international industry practice, the client will address areas, including: the identification of potential hazards to workers, particularly those that may be life-threatening; provision of preventive and protective measures, including modification, substitution, or elimination of hazardous conditions or substances; training of workers; documentation and reporting of occupational accidents, diseases, and incidents; and emergency prevention, preparedness and response arrangements. | *Turkish Law:*<br><br>Employers will take all the necessary measures and maintain acceptable working conditions. Employees are under the obligation to obey and observe all the measures taken to ensure acceptable occupational health and safety. Employers must inform the employees of the occupational risks and preventative measures that must be taken to address these risks. The employer must inform employees of their legal rights and obligations and must provide the employees with the necessary training on occupational health and safety.<br><br>The Employer is responsible for the provision of a safe working environment and must provide workers all the required personal protective equipment. The employer must regularly check this and all other health and safety equipment and ensure that it is in good working order. The employer must take necessary measures to prevent occupational illnesses.<br><br>In cases where there is more than one employer or subcontractor at a construction area, the employer will assign one or more coordinators for health and safety responsibility. The employer must prepare a health and safety plan prior to the commencement of construction works. |
| *Non-Employee Workers:*<br><br>17. For purpose of this Performance Standard, "non-employee workers" refers to workers who are: (i) directly contracted by the client, or contracted through contractors or other intermediaries; and (ii) performing work directly related to core functions essential to the client's products or services for a substantial duration. When the client contracts non-employee workers directly, the Client will use commercially reasonable efforts to apply the requirements of this Performance Standard, except for paragraphs 6, 12, and 18. With respect to contractors or other intermediaries procuring nonemployee workers, the client will use commercially reasonable efforts to: (i) ascertain that these contractors or | *Turkish law:*<br><br>No specific provisions. |

| **Summary of PS2 provision (and PS2 paragraph reference)** | **Key Points of Turkish Law** |
|---|---|
| intermediaries are reputable and legitimate enterprises; and (ii) require that these contractors or intermediaries apply the requirements of this Performance Standard, except for paragraphs 6, 12, and 13 [of PS2]. | |
| *Supply Chain:*<br><br>18. The adverse impacts associated with supply chains will be considered where low labour cost is a factor in the competitiveness of the item supplied. The client will inquire about and address child labour and forced labour in its supply chain, consistent with paragraphs 14 and 15 above [of PS2]. | *Turkish law:*<br><br>No specific provisions. |

## 14.3 BASELINE

### 14.3.1 *Child Labour*

Figure 14-1 shows the level of child labour in Turkey for 2006.

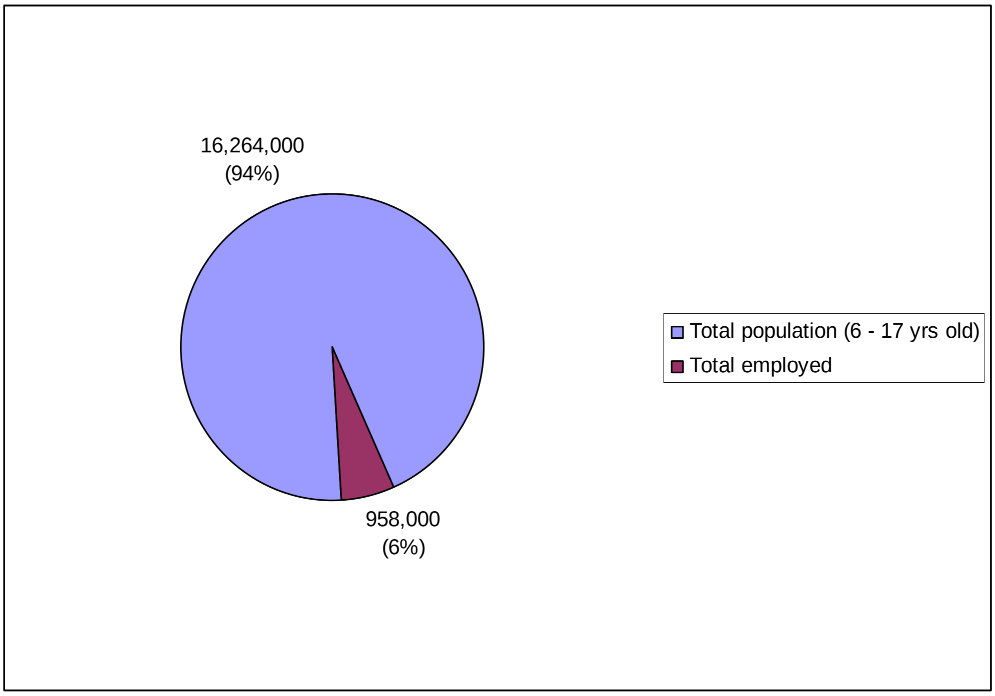


***Figure 14-1 Child Labour in Turkey during 2006***

Approximately 950,000 children (6% of those between the ages of 6 and 17) are employed in Turkey. Approximately two-thirds of the child workforce is male. The majority of this child labour is in the agricultural sector.

Child labour is identified as an issue in Turkey and this is being gradually addressed. In 1999, child labour accounted for over 10% of the total population aged 6 to 17. In 2009 Akin [1] noted that the protection of child workers was one of Turkey's main objectives for the accession process to the European Union and that Turkey has already taken important steps in this area and has set a good example for other countries. As a result of these

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[1] Working Conditions of the Child Worker in Turkish Labour Law; L. Akin (Law Faculty, Ankara University), 2009. (http://www.springerlink.com/content/5t97gjg650276257/fulltext.pdf)

efforts, the International Labour Organisation (ILO) [1] has announced Turkey as a positive example of dealing with the child labour issue. The *2006 Global Report under the Follow-up to the ILO Declaration on Fundamental Principles and Rights at Work*[2] by ILO makes reference to the various policy measures adopted as well as awareness building campaigns and training programmes launched by relevant Turkish organizations and agencies and notes that these have contributed to this achievement of significantly reducing child labour in Turkey. As a result Turkey has reduced the child workforce by almost half in the period 1999 to 2006.

### *14.3.2 Incomes*

Figure 14-2 presents 2003 income data for a range of employment types. The data shows that the greatest salaries are paid to the professional and senior managerial types of employment and the lower salaries going to the types of employment such as elementary workers, and agricultural workers. It can also be seen that there is an income differential between males and females.

[1] The ILO is an independent and international labour organization. Its main aims are to promote rights at work, encourage decent employment opportunities, enhance social protection and strengthen dialogue in handling work-related issues.

[2] The end of child labour within reach. Global report under the Follow-up to the ILO Declaration on Fundamental Principles and Rights at Work. Report of the Director-General, 2006.

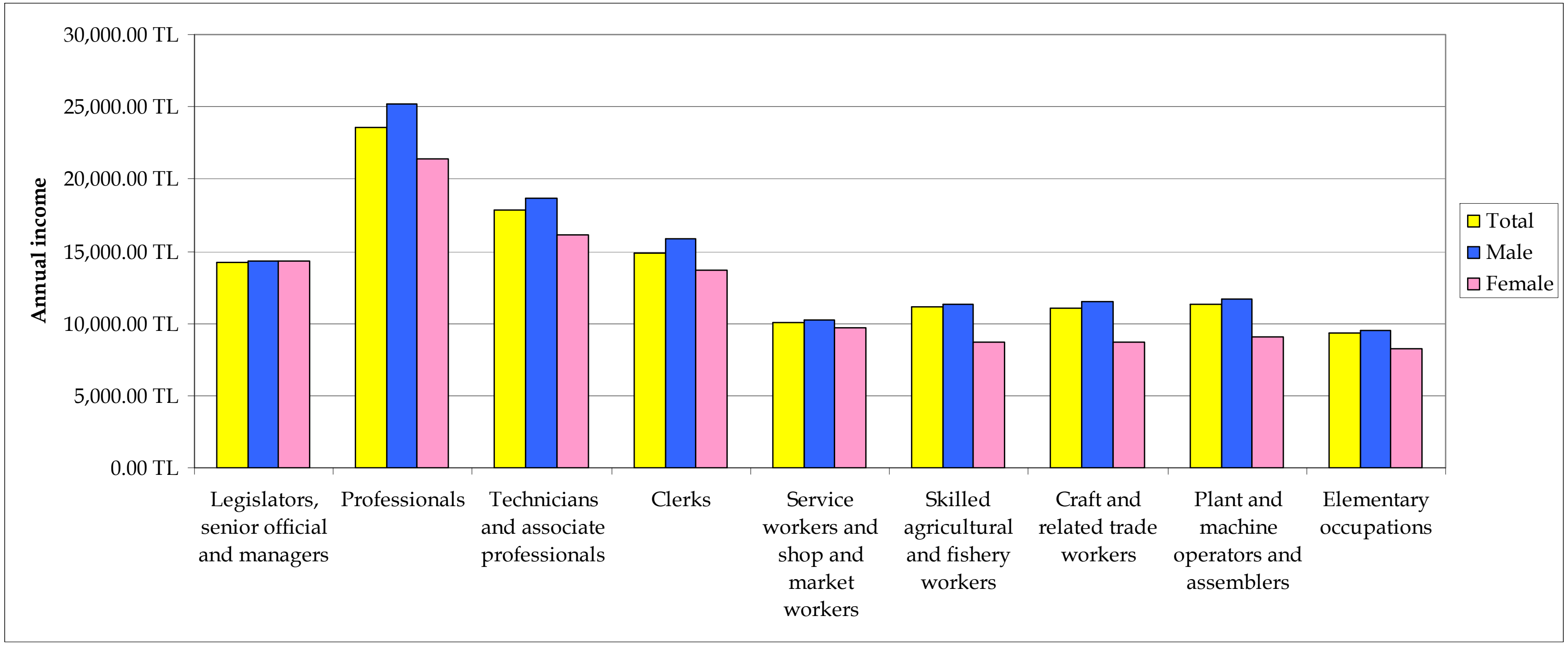


***Figure 14-2 Income Data for a Range of Employment Types in Turkey (2003)***

### 14.3.3 *Income Inequality and Distribution*

Figure 14-3 presents household income distribution (by quintile income distribution) data[1] for Turkey and also for Istanbul in 2003. The data provided indicates that the highest 20% portion of household income in Turkey receives in excess of 48% of total household income in Turkey. For Istanbul, this figure is greater than 50%. The lowest 20% of Turkish households receives only 6% of the total national household income. For Istanbul, this figure is 6.8%. Generally, income distribution in Istanbul is broadly similar to the national income distribution.

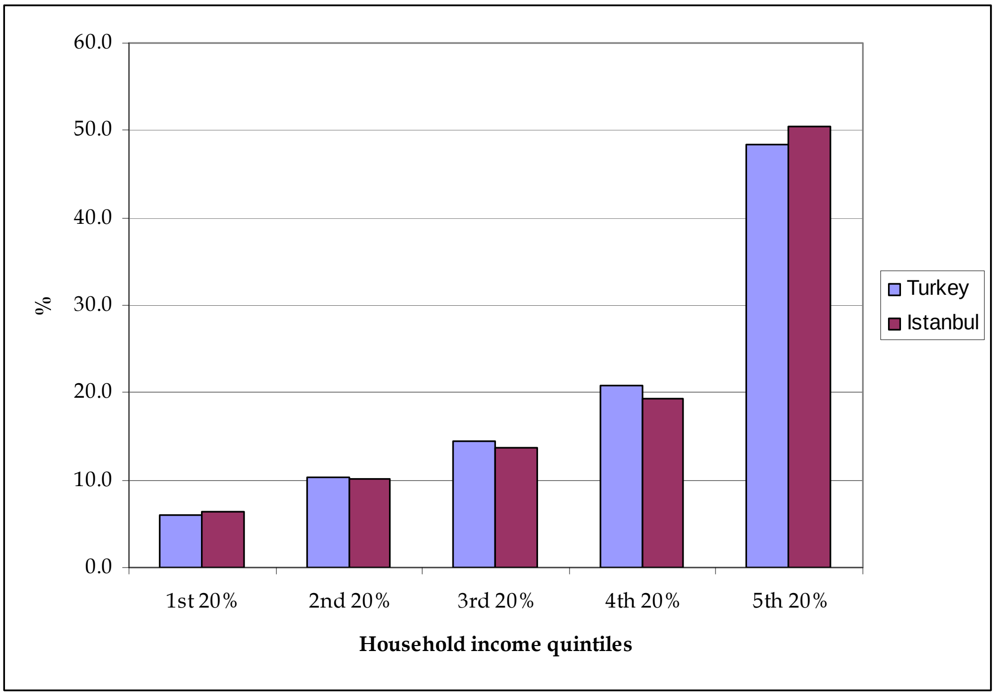


***Figure 14-3 House Income Distribution (2003)***

The equity of overall income distribution can be determined by comparing the ratio of the household income of the highest 20% of households with that of the lowest 20% of households. For the EU-25 countries, this ratio was 4.6 in 2003 (and 4.8 in 2007)[2]. For Turkey, this ratio is 9.9 (2003 data, the latest data

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[1] Turkish Statistical Indicators 1923 – 2007; Turkish Statistical Institute, 2008.

[2] Eurostat website: http://epp.eurostat.ec.europa.eu/tgm/table.do?tab=table&init=1&language=en&pcode=tsisc010&plugin=1

available), indicating the greater inequality regarding household income distribution in Turkey compared to the EU average.

### 14.3.4 *Future Baseline*

In recent years, there have been improvements in the area of labour laws, child labour and health and safety regulations and it is expected that these positive trends will continue.

However the issue of income inequality is more difficult to address and it is unlikely that significant improvements will arise in the future due to the nature and socio-economic context of the Turkish economy (compared to the more developed economies of Europe).

## 14.4 IMPACT ASSESSMENT AND MITIGATION

### 14.4.1 *Compliance with Employment Laws and Regulations and IFC Performance Standard 2: Labour and Working Conditions*

The gap analysis presented in Table 14-1 indicates that there are some gaps between Turkish labour laws and IFC Performance Standard 2. These gaps are in the areas of:

- handling of grievances;
- contracted workers;
- management of supply chain.

ATAŞ is committed to complying with all relevant national employment and labour laws and to addressing the identified gaps between Turkish law and IFC PS2.

ATAŞ will prepare a specific *Project Policy Document* which will outline all the policies and procedures which will be implemented on the Project. This document will be given to all ATAŞ employees and also subcontractors and contractor employees when they join ATAŞ.

The Project Policy Document will be sent to Lenders for comment prior to the commencement of any construction activities and the hiring of the construction workforce. Compliance with this Policy Document will be audited annually under the ESMP see (Annex D) and the results will be made available to Lenders.

### 14.4.2 *Child and Forced Labour*

ATAŞ will not employ nor permit any subcontractor to employ any child labour (persons under the age of 18 years old) or use forced labour and will comply fully with the relevant provisions of relevant conventions and other international standards.

The Project will not add to Turkey's child or forced labour workforce.

### 14.4.3 *Equitable and Ethical Terms and Conditions of Employment*

ATAŞ will ensure that a fair and just wage is paid to all construction and operational workers on the Project.

The range of employment provided by the Project and associated income payments are not expected to increase the current level of inequity in incomes in Istanbul. The majority of the construction workforce is expected to be skilled and semi-skilled labourers at the lower end of the income scale, but they will be paid a fair and just wage in compliance with all relevant labour laws and regulations and the requirements of PS2.

### 14.4.4 *Acceptable Standards and Management of Worker's Accommodation*

A small workers compound may be established to house specialist workers during construction. This will be designed and operated in accordance with the provisions of PS2 and also the relevant guidelines within the guidance document *Workers' Accommodation: Processes and Standards: A Guidance Note by IFC and the EBRD* [1]. A brief overview of key provisions is provided below.

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[1] http://www.ifc.org/ifcext/sustainability.nsf/AttachmentsByTitle/p_WorkersAccommodation/$FILE/workers_accomodation.pdf

### *Key Provisions of IFC & EBRD Workers Accommodation Guidance*

This guidance document provides guidance and benchmarking standards on a range of topics related to the provision and management of worker's accommodation. The topics covered are:

► General living facilities (including topics such as drainage, heating, ventilation, lighting, water, sanitation, waste disposal);

► Room/dormitory facilities (including bed arrangements and storage facilities);

► Sanitary and showering facilities;

► Canteen, cooking and laundry facilities;

► Food safety and nutritional standards;

► Medical facilities;

► Leisure, social and telecommunication facilities;

► Management of the accommodation;

► Community relations and consultation;

► Fees and charges for the facilities and services;

► Health and Safety onsite;

► Accommodation and local community security;

► Workers' rights, rules and regulations;

► Workers' consultation and grievance mechanism.

The key principles of note regarding the provision of worker's construction compounds are:

- Workers' must enjoy their fundamental human rights and freedom of association in particular. Workers' accommodation arrangements should not restrict workers' rights and freedoms.

- Housing standards must include special attention to minimum space allocated per person, supply of safe water in the workers' dwelling in such quantities, adequate sewage and garbage disposal systems and appropriate protection against heat, cold, damp, noise, fire, and disease-carrying animals, and, in particular, insects.

- For facilities located in hot weather zones, adequate ventilation and/or air conditioning systems must be provided. Both natural and artificial lighting must be provided and maintained in living facilities.

- A separate bed for each worker must be provided. The practice of "hot-bedding" should be avoided. The minimum space between beds should be 1 metre. Double deck bunks are not advisable for fire safety.

- Canteen, cooking and laundry facilities must be built in adequate and easy to clean materials. Canteen, cooking and laundry facilities are kept in a clean and sanitary condition. If workers wish to cook their own meals, kitchen space will be provided separate from sleeping areas.

- There must be management plans and policies especially in the areas of overall operation of the facility, health and safety (with emergency responses), local community and security.

- A security plan including clear measures to protect workers against theft and attack is implemented. Security staff must be checked to ensure that they have not been implicated in any previous crimes or abuses.

- Processes and grievance mechanisms for workers' to articulate their grievances must be provided and clearly explained to workers. Such mechanisms must be in accordance with PS2.

- Community representatives must be provided with an easy means to voice their opinions and to lodge complaints to the management. There must be a transparent and efficient process for dealing with community grievances, in accordance with PS1.

ATAŞ will undertake an audit of design and implementation of the worker's compound against the checklist in the EBRD & IFC guidance document:

- prior to construction of the accommodation (i.e. an audit of the design);

- prior to its opening;

- on an annual basis (each year after opening).

These audits will be undertaken by an independent third party. Any defects or issues (where relevant) identified in the audits will be addressed and then re-assessed for compliance within one month of the audit.

### 14.4.5 *Workers Grievance Mechanism*

ATAŞ will develop a specific workers' grievance mechanism to provide a transparent and easily accessible way for workers to raise and address grievances. This will operate in the same way as the Project grievance procedure described in Chapter 15.

# *15 PROJECT ENVIRONMENTAL AND SOCIAL MANAGEMENT SYSTEM*

## *15.1 INTRODUCTION*

This chapter describes the arrangements ATAŞ proposes to make to manage the environmental, health, safety and social impacts and risks of the Project in conformance with applicable laws and regulations of Turkey and international standards[1]. These arrangements will be set out in an Environmental and Social Management System (ESMS) for the Eurasia Tunnel Project. The ESMS will be designed to comply with the requirements of ISO14001[2] in accordance with the requirements of the BOT Contract with DLH.

Each of the Partners in ATAŞ operates existing management systems certified to relevant standards as identified in Table 15-1.

[1] Of particular relevance is the IFC´s Policy on Social & Environmental Sustainability, April 2006 and related Performance Standards and Environmental, Health and Safety Guidelines.

[2] International Standardisation Organisation; *"ISO 14001:2004: Environmental Management Systems _ Requirements with Guidance for Use"*

*Table 15-1 Existing HSE Certifications of each JV Partner*

| Joint Venture Partner | Type of MS | Certification |
|---|---|---|
| SK Engineering & Construction Co., Ltd. (SK E&C) | Environmental MS | ISO 14001:2004 |
| | | BS EN ISO 14001:2004 |
| | | KS A 14001:2004 |
| | Quality MS | ISO 9001:2000 |
| | | BS EN ISO 9001:2000 |
| | | KS A 9001:2001 |
| HAN SHIN Construction Co., Ltd. | Quality MS | KS A 9001:2001 |
| | | ISO 9001:2000 |
| | Environmental MS | KS A 14001:2004 |
| | | ISO 14001:2004 |
| YAPI MERKEZİ İNŞAAT VE SANAYI A. Ş. | Quality MS | ISO 9001:2008 |
| | Environmental MS | ISO 14001:2004 |
| | Occupational Health and Safety MS | OHSAS 18001:2007 |
| KUDONG Engineering & Construction Co., Ltd. | Quality MS | KS A 9001:2001 |
| | | ISO 9001:2000 |
| | Environmental MS | KS A 14001:2004 |
| | | ISO 14001:2004 |
| | Occupational Health and Safety MS | OHSAS 18001:2007 |
| Samwhan Corporation | Quality MS | ISO 9001:2000 |
| | Environmental MS | KS A ISO 14001:2004 |

The Project Management System will be based on SK E&C's existing Environmental Management System. This commits the company to:

- Encourage Positive Behaviour;
- Plan, Organize and Communicate;
- Apply Standards and Procedures;
- Develop Competency and Well-being;
- Manage Subcontractors and External Relations;
- Manage Hazards and Risks;
- Manage Change;
- Manage Incident Response;
- Learn from Experience;
- Audit and Review.

The proposals for the Environmental and Social Management System are set out in the remainder of this chapter:

- Section 15.2 - Project Environmental and Social Policy
- Section 15.3 – Responsibilities and Resources
- Section 15.4 – Environmental and Social Management Plan (a ESMP is presented in Annex D)
- Section 15.5 – Resettlement Policy (a Resettlement Policy Framework is presented in Annex D);
- Section 15.6 – Grievance Process
- Section 15.7 – Monitoring, Audit and Evaluation
- Section 15.8 – Stakeholder Engagement.

## *15.2 PROJECT ENVIRONMENTAL AND SOCIAL POLICY*

ATAŞ will develop a written Policy to address all environmental, health and safety and social impacts and risks in accordance with the following principles:

- risks and impacts will be managed in a manner consistent with the IFC Performance Standards;
- the project and all related activities will be carried out in a manner that that "no harm" is done to people;
- negative impacts will be avoided where possible, and if unavoidable, they will be reduced, mitigated or compensated for appropriately;
- the Project will comply with all environmental, health and safety, labour and social legislation and regulations applying to its activities;
- the Project will ensure that measures are taken to mitigate adverse impacts and provide benefits, such that environmental, health, safety and social impacts do not exceed those described in the ESIA Report for the Project;
- the Project will engage with and consult affected communities on an on-going basis.

This Policy will be agreed and formally adopted by ATAŞ prior to commencement of construction of the Project. A copy will be provided to every employee of the company and will form part of the contract with all contractors and sub-contractors engaged in activities associated with design, construction or operation. The Policy will also be made available to the public on the Project website (www.avrasyatuneli.com).

Key Performance Indicators for the Environmental and Social Policy:

- Environmental, Health and Safety Policy adopted by ATAŞ senior management;
- Policy includes a statement of commitment to the principles described above;
- Communication of the policy to all Project personnel, contractors and sub-contractors and to external stakeholders;

## 15.3 *RESPONSIBILITIES AND RESOURCES*

### 15.3.1 *Overall Responsibility*

Overall responsibility for the ESMS will lie with the Board of ATAŞ who will establish and maintain an organisational structure that defines roles, responsibilities, and authority to implement the ESMS. This will include the designation of in-house personnel during the different phases of the Project as described below.

A number activities will be carried out by third-parties including design firms, surveyors, and construction contractors. All these activities will be undertaken under contract with ATAŞ and will be supervised by ATAŞ who will ensure that all contracts include terms and conditions requiring Contractors to adopt management systems which comply with ISO14001 and with the environmental and social requirements set out in the ESMP. ATAŞ will designate senior managers responsible for management of suppliers and contractors and all suppliers and contractors will be required to demonstrate appropriate skills, qualification and/or working experience.

In addition, the ESMS will provide for the following:

- commitment by Senior Management of the necessary human and financial resources, on an ongoing basis throughout the BOT Contract period, to achieve effective and continuous conformance with the Policy;
- communication of commitments, roles and related responsibilities to the Project team and external stakeholders;
- ensuring employees and contractors with responsibility for activities relevant to the Project's social and environmental performance have the

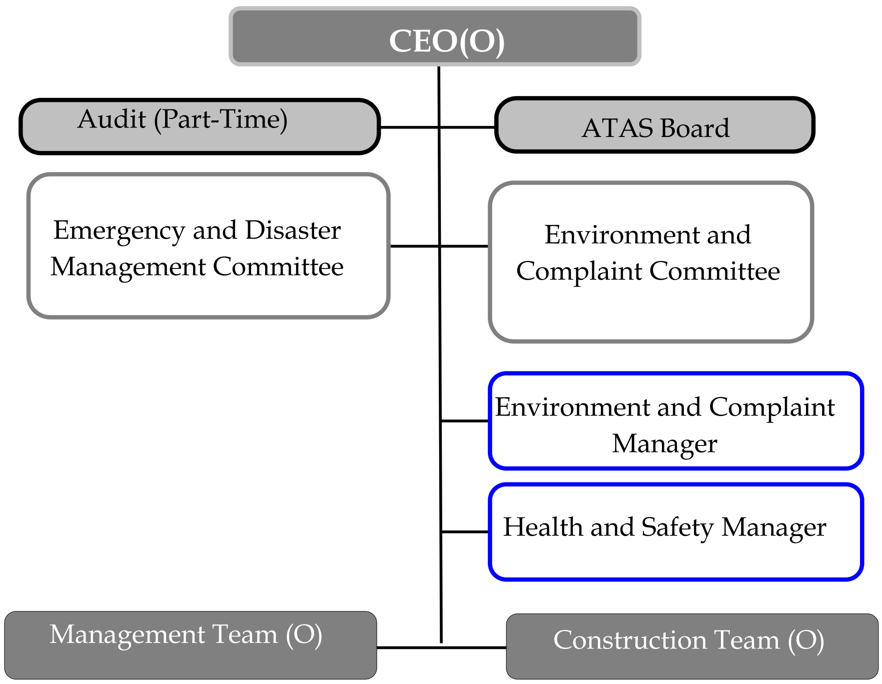
necessary skills and knowledge to perform the work either through existing skills and experience or by provision of training;

- ensuring the Project is kept up to date with information on relevant Turkish legislation, regulations, standards  and guidelines Turkey and on international best practice;
- ensuring employees and contractors involved with the Project are made aware of the social and environmental aspects of the Project and the specific obligations under the ESMP by provision of induction and awareness training;
- ensuring employees and contractors receive comprehensive H&S training at the beginning of an appointment, and thereafter on a regular basis throughout the entire construction period. Special safety instructions will be provided for temporary workforce.

### *15.3.2 Construction Phase*

During the period of Detailed Design and Construction ATAŞ will designate responsible persons and teams for environmental and social management as shown in Figure 15-1.

*Figure 15-1 Organization during Construction*



Their assigned tasks and responsibilities are set out in Table 15-2.

*Table 15-2 Roles and Responsibilities during Construction*

| Function | Task |
|---|---|
| Environment and Complaint Manager | o Overall responsibility for Environment and Complaint Handling and Community Communication<br>o Overall responsibility for Community affairs and supervising issues related to affected communities during construction<br>o Supervising environmentally and socially relevant activities during construction<br>o Carrying out regular inspections during construction<br>o Supervising sub-contractor's activities to ensure that environmental requirements are met during construction (e.g. based on sub-contractor's ESMP)<br>o Ensuring that corrective measures will be taken, if necessary<br>o Reporting to Committee on a regular basis, and to CEO monthly |
| Health and Safety Manager | o Overall responsibility for Health & Safety of workers, visitors and the public |
| Emergency Disaster Management Committee | o Establishing the channel for communication with communities and identifying rapid solutions<br>o Acting to prevent damage caused by natural disasters and human accidents<br>o Life saving and emergency repair, prevention of secondary damage |
| Environment and Complaint Committee | o Operations, organization and supervision of the Environmental Management Plan.<br>o Operating management system complying with ISO 14001<br>o Identifying community leaders and responsible civil servants to participate in a local liaison group chaired by the CEO |

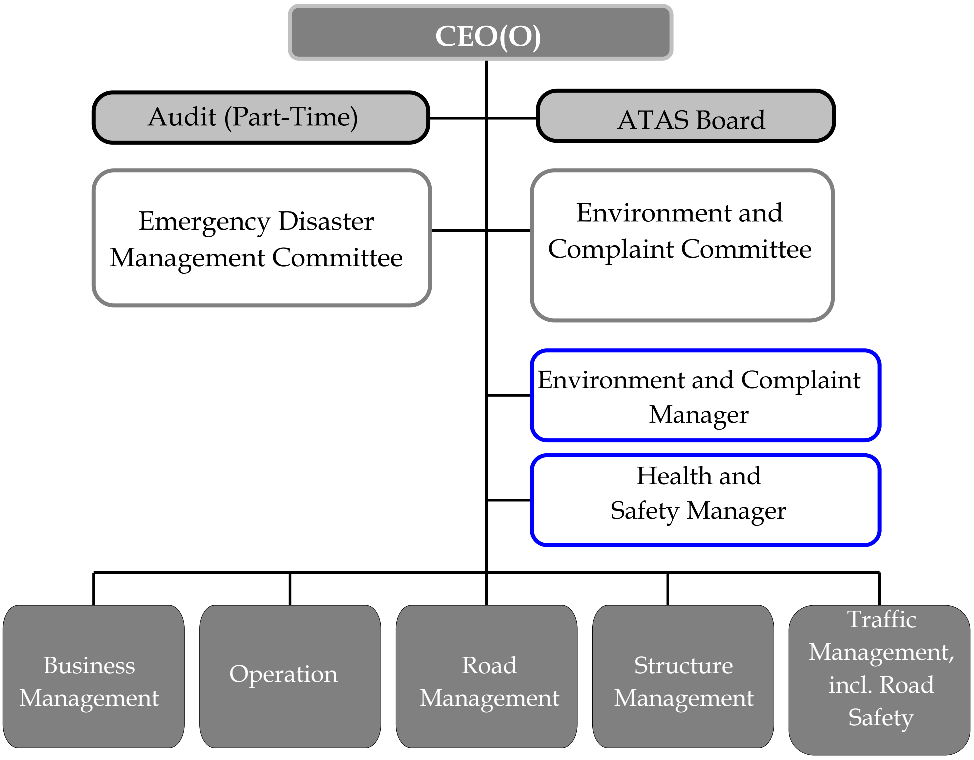
Further officers with day-to-day responsibilities will be assigned for specific tasks, including management of Contractors.

Roles and responsibilities will be communicated to the relevant personnel and the rest of ATAŞ and information on key posts will be made available to external stakeholders on the Project website.

### *15.3.3 Operation Phase*

During operation of the Project when ATAŞ will be responsible for the tunnel, ATAŞ will designate committees and persons responsible for environmental and social management as shown in Figure 15-2.

*Figure 15-2 Organization during Operation*




The assigned roles and responsibilities will be as set out in Table 15-3.

*Table 15-3 Tasks and Responsibilities during Operation*

| Function | Task |
|---|---|
| Business Management | o Establish annual business plan<br>o Establish short and medium term financial plan<br>o Make, assign and adjust budget<br>o Recruit and manage personnel<br>o Train employees and provide employment benefits<br>o Manage asset, supplies and purchases<br>o Business PR, Company PR and Advertising<br>o Accounting, reporting and audit |
| Operations | o Collect tolls and run toll plaza<br>o Receive and handle complaints<br>o Manage toll plaza facilities and toll collectors |
| Environment and Complaint Manager | o Overall responsibility for Environment and Complaint Handling<br>o Overall responsibility for Community affairs and supervise issues related to affected communities during construction<br>o Supervising environmentally and socially relevant activities during operation<br>o Carrying out regular inspections during operation<br>o Supervising contractor activities to ensure that the environmental requirements are met during operation<br>o Ensuring that corrective measures are taken, if necessary<br>o Reporting to Committee on a regular basis, and to the CEO on a monthly basis |
| Health and Safety Manager | o Overall responsibility for Health & Safety related issues of employees |
| Emergency and Disaster Management Committee | o Preventing and responding to accidents caused by natural disasters (rainfall, strong wind or snowfall) and taking initial action for rehabilitation.<br>o Life saving in the event of human accidents such as traffic accidents, structural collapse and fire, and preventing secondary damage.<br>o Organizing procurement team, repair team and safety contact team with CEO as a chairman |
| Environment and Complaint Committee | o Operating, organising and conducting supervision according to the Environmental Management Plan.<br>o Operating management systems complying with ISO 14001<br>o Identifying community leaders and responsible civil servants to participate in a local liaison group chaired by the CEO |

Key Performance Indicators for responsibilities and resources:

- Statement of management commitment and definition of roles and responsibilities;
- Provision of information on the Project web-site;
- Written confirmation of awareness and training programmes related to environmental and social management for Project workers and contractors depending on individual function within the Project and training needs.

## 15.4 *MANAGEMENT OF IMPACTS*

Details of all measures planned to avoid, reduce or compensate for adverse environmental and social impact and to provide benefits where possible will be set out in a detailed Environmental and Social Management Plan (ESMP).

The ESMP will address the full life-cycle of the Project from detailed design through to operation for the period of the BOT Contract[3]. A ESMP is presented in Annex D1. This will continue to be developed in scope and detail as the design of the Project is developed and detailed plans are made for construction and operation. It will also be kept up to date to address changes in requirements from new legislation, standards and guidance and to incorporate any requirements emerging form further licences or other approvals required to permit design, construction or operation of the Project.

International standards and guidelines relevant to the ESMP include the Performance Requirements of the EBRD and the Performance Standards of IFC). Other relevant documents include IFC General EHS Guidelines; IFC EHS Guideline for Toll Roads; IFC EHS Guideline on Construction Materials Extraction; IFC Good Practice Note: Addressing the Social Dimensions of Private Sector Projects; and Workers' Accommodation: Processes and Standards: A Guidance Note by IFC and the EBRD.

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[3] Closure and decommissioning are not considered as the tunnel is envisaged to remain in operation for the foreseeable future.

The ESMP is structured to identify:

- the required action;
- the reasons for its adoption and the desired outcome (*eg* achievement of a required environmental quality standard, protection or satisfactory reinstatement of a feature, disposal of waste in accordance with a defined approach);
- the basis for the action (*eg* legislation, guidance or Project ESIA commitment);
- responsibility for implementation and resources required (including detailed work procedures and financial resources);
- the timing of the action and any deadline for completion;
- indicators of successful implementation;
- how success will be monitored or audited and any requirements for reporting;
- any additional information, including contingency arrangements in event of non-compliance.

The ESMP is organised in three main sections relating to:

- Design;
- Construction;
- Operation.

Within each section actions are grouped by topic, for example: noise, air, water, waste, cultural heritage, biodiversity, land use, etc. Where appropriate more detailed work plans and procedures will be developed to address specific topics as identified in the ESMP.

Appropriate requirements from within the ESMP will form part of the conditions of contract with suppliers and contractors engaged on the Project.

### *15.5 RESETTLEMENT POLICY FRAMEWORK*

A key aspect of the environmental and social management of the Project will be the management of acquisition of land required either temporarily or permanently for construction and operation. This includes land acquired by voluntary agreement, land acquired by involuntary acquisition in accordance with Turkish law, and land transferred between public agencies. Expropriation of land and property will be undertaken by DLH. ATAŞ will work with DLH to apply a framework of actions designed to manage this process in accordance with international best practice[4].

A Resettlement Policy Framework is set out in Annex D2. This sets out the basis on which land will be acquired and the procedures that will be followed to ensure appropriate treatment of affected parties.

### 15.6 COMMENT MANAGEMENT AND GRIEVANCE PROCEDURES

In accordance with international best practice a processes will be set up through which any person or organisation can submit comments to or complain about any aspect of the Project. These processes are described in the Stakeholder Engagement Plan for the Project which is available as a separate document.

In summary, the *Comment Management process* will be used to manage communications by external parties which do not constitute complaints, such as questions and suggestions about the project and about the management of environmental and social issues; contacts from regulators; etc. It will ensure that all comments and suggestions are given due consideration and, where appropriate, a timely response is provided to the stakeholder explaining how the Project proposes to respond. This might be by providing further information, changing working methods or revising the design. Where the Project is unable to take up a suggestion, the reasons for this will be explained.

The *Grievance Procedure* will be used to manage complaints from stakeholders, such as those who are of the view that they have been harmed in some way or that their rights have been infringed. Examples of grievance issues could include:

- lack of timely response to input/comments given during the planning and development of the Project;
- inadequate compensation for property damage during construction activities;

[4] As set out in IFC Performance Standard 5: Land Acquisition and Involuntary Resettlement

- disturbance due to excessive noise or other nuisance during construction or operation;
- unfair treatment of workers or unsafe working conditions.

Every complaint, enquiry, comment or other contact with the Project from any external party or worker about any part of the process of the Project implementation will be formally registered as soon as it is received and managed as either a comment or a grievance.

Contacts will include those made by letter, email, fax, telephone call or visit. Each contact will be recorded on a Comment or Grievance Form (see the Stakeholder Engagement Plan for samples) with:

- a unique Contact reference number;
- the name and contact details of the person or organisation making the contact (unless they request anonymity);
- the date received;
- how the contact was made (*eg* by phone or in person);
- the name of the person recording the contact;
- the details of the complaint, enquiry or comment;
- the action to be taken by the Project (*eg* refer to Environment and Complaint Manager, refer to XYZ for response and action);
- the deadline for a response to be given.

A copy of the Grievance Form will be given to the individual if the contact relates to a complaint or grievance.

All contacts will be recorded in a Contact Log and will be tracked through to satisfactory resolution by the Environmental and Complaints Manager.

All subsequent actions taken in relation to each Contact will be recorded on the Comment or Grievance Form until such time as the contact is resolved. The contact will then be recorded in the Contact Log as closed.

An initial response to all grievances and complaints will be made by an appropriate person within ATAŞ within 5 working days and ATAŞ will seek to resolve grievances within one month. If this is not possible the complainant will be kept advised of progress on a regular basis.

ATAŞ will aim to respond to all other enquiries and comments within two weeks.

The Comment and Grievance Procedures will be free, open and accessible to all and comments and grievances will be addressed in a fair and transparent manner. Information about the procedures, who to contact and how, will be made available on the Project website. In particular all workers will be informed of the Grievance Process and new workers will be informed when they join the Project. Information on Contact Points will be posted on staff information boards and on site information boards.

The Environment and Complaints Handling Manager will have overall responsibility for the Comment and Grievance Procedures throughout the life of the project, and will ensure that external stakeholders and workers are aware of the procedures and that all contacts are handled promptly and responded to in an appropriate and timely manner. A report will be provided to the Environment and Complaints Handling Committee once each month and the Committee will review progress with resolution and take action where this is not achieved in accordance with the deadline for responses. The Committee will report quarterly to the Board on operation of the procedures.

Construction contractors and sub-contractors will be required to operate the same system and address contacts in the same manner and according to the same standards. They will be required to provide a report to the Environment and Complaints Handling Committee on a monthly basis reporting all contacts and how they have been addressed.

A summary of the operation of the Comment and Grievance Procedures will be reported annually on the Project Website. This will maintain the confidentiality of individual persons/organisations involved.

As noted above further details of these procedures are set out in the Stakeholder Engagement Plan.

Key Performance Indicators for Comments and Grievances:

- The Comment and Grievance Procedures will be elaborated and information posted on the Project website including contact persons
- Contractors and Sub-contractors will be required to adopt the same system
- All Contacts will receive an initial response within 2 working days and all grievances and will either be resolved within one month or the complainant will be informed of the programme for dealing with their complaint
- An Annual Report will be posted on the project website on operation of the procedures

## *15.7 STAKEHOLDER ENGAGEMENT*

ATAŞ has developed and will implement a Stakeholder Engagement Plan (SEP) to ensure an ongoing process of dialogue is established with affected parties and the general public about the environmental and social issues during implementation of the Project. This Plan builds upon the Consultation Programme already initiated as part of this ESIA described in Section 1.3.9. The SEP is available as a separate document.

During construction and operation of the Project the SEP provides for:

- regular liaison with neighbourhood Muhtars, district councils and the municipal authority to keep them advised of the project programme, progress and planned activities;
- timely and appropriate disclosure of information about planned activities to Project neighbours and the local community prior to and during construction including, in particular, information about any disruptive activities such as transport of abnormal loads or noisy activities;
- timely and appropriate disclosure of information regarding any significant changes in the Project, for example local re-alignment of the route or changes in the construction programme;
- timely and appropriate information about any non-routine activities during operation that could cause disruption, for example major maintenance or repair works;

- clear information about Emergency Planning arrangements for the local community explaining what they need to do in the event of an incident affecting the Project.

Information will be disseminated through the Project website, supplemented with use of newspapers, TV and radio, local newsletters/leaflets, posters, emails, direct mailings and other forms of communication. Communications will be designed specifically to reach the relevant stakeholders in a culturally appropriate manner and will be freely accessible.

Details of the Contact Point for all grievances and other enquiries will be distributed widely throughout the Project area and posted on the Project website.

Key Performance Indicators for Stakeholder Engagement:

- Public Consultation and Communication Plan in place and published on the TKJV Project website;
- Local residents/Stakeholders are aware of the Project and in particular the planned schedule of activities most likely to affect them (e.g. local construction dates) – as evidenced by spot-check interviews.

## *15.8 MONITORING AND AUDIT*

Effective environmental and social management requires that compliance is monitored to demonstrate success. Plans for monitoring specific impacts and mitigation measures are identified in the ESMP in Annex D.

ATAŞ will require contractors and subcontractors to undertake weekly site inspections during construction to check that all measures are being implemented. Where this is not the case, corrective actions will be identified and checked for implementation at the next inspection.

In addition to this routine monitoring, ATAŞ will undertake regular audits of compliance with the ESMS and overall implementation of the ESMP. The Environment and Complaints Manager will be responsible for managing the audit programme and will report to the Environment and Complaints Handling Committee.

Audits will be undertaken by qualified specialists in accordance with IFC Performance Standard 1 for a "Category A" Project. The first ESMS Audit will be completed within six months of signature of the BOT Contract and audits will be completed at least annually thereafter.

The ESMP Audit results will be documented in a report which will be reviewed by the Committee and a summary provided to the Board. Audit Reports will also be made available to regulatory authorities and to lenders, as requested and appropriate. Summary results will also be disclosed to the public via the Project web site.

The Audit will include:

- implementation of the management arrangements set out in the Project ESMS including allocation of responsibilities and resources, training and the Grievance Process;
- implementation of and compliance with mitigation and monitoring measures set out in the ESMP;
- implementation of corrective actions identified through the weekly site inspections;
- implementation of the Resettlement Policy Framework;
- compliance with legislative and regulatory requirements and standards, including any licences and permits and obligations arising from these.

Where issues are identified from the audit they will be analysed to identify their root cause, and appropriate corrective and/or preventive measures will be initiated and tracked through to completion.

Audits will address the performance of both ATAŞ and any contractors and subcontractors.

If the audits reveal weaknesses in the ESMS or ESMP, these will be revised to prevent recurrence of the problem.

Key Performance Indicators for ESMP Monitoring and Audit:

- Monitoring and Audit Plan in place
- Weekly site inspections completed
- Engagement of qualified external experts to undertake at least annual ESMS Audits
- Corrective and preventive actions identified and implemented as needed
- Submission of Audit Reports to lenders and distribution of a summary via the Project web-site.

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