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1 INTRODUCTION

1.1 PROJECT OVERVIEW

Underground storage of natural gas is regarded as an important option for Turkey. With increasing gas consumption, underground storage is needed to balance peak demand with approximately constant gas supply.

BOTAŞ, (Turkish Petroleum Pipeline Corporation) proposes to construct an Underground Natural Gas Storage Facility approximately 200 km south of Ankara in the central part of Turkey, approximately 40 km south of Tuz Golu (or "Salt Lake"): an extensive 162,000 ha salt marsh in the central region of Turkey (Refer to Figure 1 for project location)

The Tuz Golu Basin Underground Natural Gas Storage Project (UNGSP) will create a series of underground gas storage caverns by controlled fresh water dissolving of portions of the extensive underground natural salt formations existing at approximately a depth of 1000 m. A geological screening procedure identified Tuz Golu, as the highest priority Turkish site, where salt caverns could be created. It is a favorable site because: (a) it is not far from Ankara, (b) it is close to the Kayseri-Konya-Seydisehir section of existing Eastern Anatolia Natural Gas Main Transmission Line (approximately 19 km) and (c) an extensive formation of pure rock salt with suitable dimensions and mechanical characteristics is available (d) it is the least seismically active region in Turkey.

To establish the technical feasibility of the Tuz Golu salt structure, BOTAŞ evaluated seismic characteristics of the site, mechanical characteristics of the salt cores, and hydrological requirements for leachate water supply and brine disposal. A detailed environmental impact assessment (EIA) study was conducted to satisfy Turkish Environmental regulatory requirements. The EIA was officially approved by the Ministry of Environment and Forestry (MoEF) on 19.08.2003.

1.2 PROJECT DESCRIPTION

The salt domes are located at approximately 700 m depth, have a thickness of 700-1500 m, and will be leached using fresh water supplied from the Hirfanli Dam (see Section 1.2.1(a) below). The brine (solution) resulting from leaching operations will be discharged to a well defined and officially approved area within Tuz Golu (see Section 1.2.1(b) below).

It is planned to open 12 caverns each having approximately 500,000 m³ of volume and with a natural gas storage capacity of approximately 80×10⁶ m³ (with maximum



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compression, 205 bar) While some of the caverns are opened (construction activity) on one hand, it shall be initiated to store natural gas into the caverns already opened (operation activity) on the other hand. During storage of natural gas, the natural gas shall be compressed by means of compressor and injected to the caverns. In future years, new caverns can be opened if modifications in the national natural gas policy of Turkey recommend such an option.

Completion of the construction phase is expected to take approximately 10 years and the project economic lifetime is estimated to be 50 years.

1.2.1 Key project components

(a) Fresh Water Supply Line

Fresh water will be used for leaching the salt caverns. Initially, local groundwater was considered for the fresh water source to open caverns as groups of 2. BOTAŞ later on, to speed up the project implementation, decided to open caverns as groups of 4 instead of 2, which doubles the fresh water demand of the project. However, groundwater shortage was one of the major concerns raised during the first Public Consultation Meeting. As a consequence, BOTAŞ (although there exist no problem for allowance of such an amount of water from groundwater resources by DSI) revised the project design to utilize Hirfanli Dam reservoir located 115 km from the project site as a fresh water source. DSI (State Hydraulic Works), the authority responsible for the water resources allocation in Turkey, provided their official approval for use of the required $10-12 \times 10^6$ m³/yr water from Hirfanli Dam.

Hirfanli Dam, constructed in 1960, is one of the major multi-purpose dams in Turkey, which is used for energy and irrigation. It receives an annual inflow of approximately 2400×10^6 m³/yr. The water demand of the project, $10-12 \times 10^6$ m³/yr, is less than %0.5 of the inlet flow to the dam reservoir. Therefore, DSI stated that they have no difficulty in supply of this amount of water over the project life and, in addition the existing and future energy and irrigation based projects will not be affected adversely.

Water will be transported by an underground pipeline of approximately 115 km to the project site. The pipeline will be transferred to DSI after the completion of the project to be used for water supply and/or for the irrigation, which will be beneficial for the local people.



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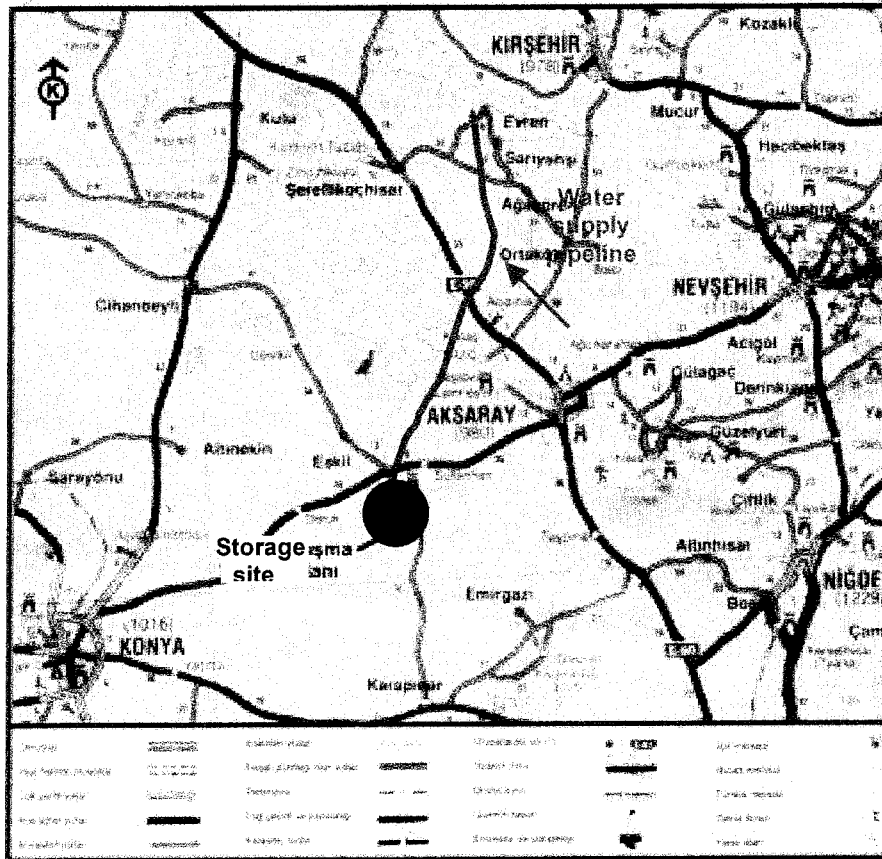
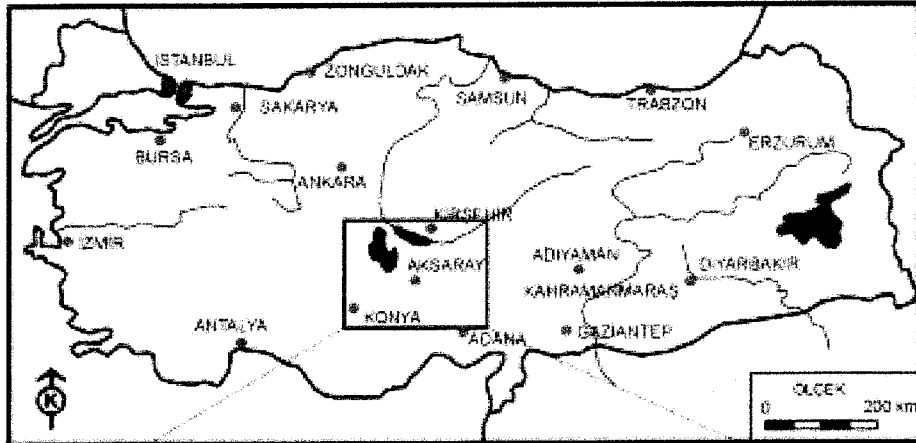


Figure 1. Proposed Location of Project Site and Water Supply Pipeline



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(b) Brine Discharge Line

Brine generated as a result of salt deposit leaching (1.120m³/hr), will be discharged to Tuz Golu via brine discharge line approximately 39 km long. Brine discharge is not expected to have significant adverse impacts on Tuz Golu due to several reasons described below;

- Tuz Golu is underlined by the same salt formation as the project site where the leaching operations will be performed. The lake continuously receives groundwater flows, which contribute brine through natural leaching of these salt formations that exist in Tuz Golu Basin. Thus the creation of the salt storage caverns through leaching is essentially providing the same quality inlet flow, albeit with a man-made process.
- Secondly, the brine will be discharged to the area officially designated by MoEF and Ministry of Agriculture as unproductive in terms of agricultural activities and salt harvesting. In addition, the discharge area was approved by the Council of Experts including MoEF during the EIA process, after determining that no species of interest exist within the discharge area.

(c) Natural Gas Branch Line

Surplus natural gas that arises during summer months shall be taken from Kayseri–Konya–Seydisehir section of existing Eastern Anatolia Natural Gas Main Transmission Line that passes at approximately 14 km north of the project site via a branch line (40" diameter), stored in these caverns and then returned to the national grid when the demand arises.

(d) Surface Facilities

Surface facilities comprised of surface leaching and gas facilities will be constructed. The major components of Surface Facilities are;

For Leaching Process

Cavern site
Leaching Plant
Freshwater supply plant
Brine distributor
Pumps
Water flow measurement units
Blanket unit
Control building

For Storage Process

Compressor station
Heater
Cooler
Dehydration Unit
Metering station
Storage wells
Filtering unit
Glycol regeneration plant
Condensate receiver plant



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1.3 Environmental Impact Assessment (EIA) Process

An EIA for the project was prepared in strict accordance with Turkish Environmental Legislation and was approved by the Turkish Ministry of Environment and Forestry (MoEF). An EIA supplement (EIA Annex) was also prepared by BOTAS to address the change in fresh water supply and additional information requirements needed to satisfy World Bank EA policies and procedures (OP/BP/GP 4.01). Thus the Turkish EIA and the EIA Annex together fully satisfy both Turkish and World Bank EA requirements.

Public consultation for the Turkish EIA was conducted at Sultanhani Municipality on 27.03.2003 and a second public consultation for both the Turkish EIA and the EIA Annex was conducted at Ağaçören Municipality (close to the water supply line) and Sultanhani Municipalities on 24.03.2005. A Turkish language version of the EIA documents, including EIA Annex was disclosed locally at Aksaray Provincial Directorate of Environment and Forestry and BOTAŞ web site on (The English language version was sent to the World Bank on 27.05.2005 and deposited in the World Bank Infoshop.

An independent Turkish Environmental Consultant accredited by MoEF prepared the EIA study on behalf of BOTAŞ. It was approved by MoEF in 2003. The water supply modification scenario required BOTAŞ to supplement the EIA by preparing an "EIA Revision Report" according to the Turkish EIA Regulation, which was approved by MoEF in 2004. Differing from the EIA Annex prepared to comply with World Bank requirements, only the project description and the new water supply scenario were included in this EIA Revision Report since Turkish EIA Regulation does not require EIA for the water supply pipeline projects.

1.4 BASELINE ASSESSMENT

Present environmental resources within the project site were assessed by site investigations performed by the EIA project team. Comprehensive site studies were conducted to determine the local air, water and soil quality and the biological resources.

The project site and its vicinity are mostly flat (slope %1-3), with an average altitude of 1000 m. The area extending from west and north parts of Sultanhani to Tuz Golu is marshland. There are also small settlements in the vicinity of the project site and these areas are used as "plateaus" where animals are grazed between April and October.

In order to determine seismic characteristics of the region, studies were carried out within an area of 73 km². The project site is located in one of the most stable regions in Turkey, which has the least seismicity: an earthquake in the project site is most unlikely



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to occur, thus the risk of failure from an earthquake is low. In addition, an internationally recognized seismic expert assessed the situation and determined that the depth and strength of the salt domes, make the failure probability extremely low, and introduce a risk no greater than similar installations world-wide.

The factors taken into account in the course of the selection of the proposed project site are listed below:

- Its proximity to the main pipeline (Kayseri-Konya-Seydisehir section of Eastern Anatolia Natural Gas Main Transmission Line);
- Its convenience in natural cavern formation and drainage processes;
- Being the lowest risked region regarding the Turkey's seismicity;
- Possessing water resources that are used for other purposes;
- Very low agricultural potential in the region.

1.4.1 Air Quality

There are no significant emission sources within the project site and its vicinity. Since the project region is a rural area, present air quality depends upon emissions that originate from sources used for heating purposes (i.e. coal) and soil. There are not many settlements within the project site and its vicinity; the only existing problem is dust emissions during dry and windy conditions due to the dispersion of clayey soil when dried up.

1.4.2 Water

There exist no surface water source within the vicinity of the project site. One of the major surface water resources of the region is Tuz Golu, located approximately 40 km north of the proposed project site.

1.4.3 Soil

General properties of the soil in the project site, distributions of soil groups, land use conditions, slope and erosion degrees were examined during EIA studies. Accordingly, the soil of project site is covered by III. Class (Suitable for cultivation of appropriate types of crops with special protection measures. Generally, require special care when used for agricultural purposes), dry agriculture (fallowing), pasture and brushwood field. There exist limited agricultural activities at the project site and its vicinity.



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1.4.4 Noise

Ambient noise levels were measured at 12 locations in vicinity of the project site considered to be sensitive receptors (settlements close to the project site). The highest background noise levels were measured to be 89.6 dBA at Bucak Plateau during the measurement on February 18-19, 2002, and 89.3 dBA (daytime) at Sultanhani Municipality settlement area during the measurement on November 29, 2000. These noise levels are known occur due to traffic, announcements and animals.

The average daytime values recorded at the nearest locations to the proposed project site were 39.2 dBA at Rasimusagi plateau and 52.5 dBA at Omeraga plateau. These values are considered as typical values for rural areas, at which the noises originate from natural sources and manual activities, rather than mechanical (e.g., industrial and infrastructure) sources.

1.4.5 Flora and Fauna

Endemic and/or rare species were identified in the general region of the Tuz Golu Basin. Species under protection by Bern Convention exist in Tuz Golu Basin. For each of the species under protection, the requirements of the particular laws, regulations and treaties have been reviewed and all specifications will be followed during construction and operation.

The wetlands in the vicinity of the brine discharge pipeline and Tuz Golu are important as a "migratory bird route" and this area is designated as a "Special Environmental Protection Area". About 15 km of brine discharge pipeline route passes through this zone. However, the important bird species do not live in this area. They may be found individually or in small colonies as part of their migration pattern. To minimize any effect to migratory birds, construction of the 15 km section of brine discharge pipeline will be restricted to the period of lowest or no migration activity (July-September)

The Hirfanli dam section, where fresh water pipeline route starts is on the border of a bird wintering area (Tufted duck, Pochard, Red-crested Pochard, White-headed duck, Coot and water birds) and migratory route (Ruddy shell duck). Construction of this section will be carried out between July and August to minimize any effects on migratory and wintering birds and their habitats.

Tuz Golu Basin

Tuz Golu Basin is the water catchment area covering the lake itself, the rivers feeding the lake and other the lakes related with it. Although exact borders are not certain, the area of the basin is around 530,000 hectare with a rough estimation. Since the basin is



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a very large area, it is better to discuss the fish species found within the close vicinity of the project components. The small water bodies located within the close vicinity of the project area do not represent a creek type characteristic. Tuz Golu is almost totally dry in the summer and besides, the feeder creeks generally cannot reach the lake in summer months. Thus, with no source of fresh water during the summer, the resulting lake salinity from net evaporation provides an extremely hostile environment for fish habitat, as well as being extremely inhospitable for any plant growth.

There are three main rivers namely Karasu, Pecenek and Insuyu feeding the lakes in the basin, all of which are fresh water. Fish species mentioned in the EIA Report were not observed during field surveys carried out on April 2001. However based on the literature, these species are possibly found in Insuyu River, at approximately 100 km north of the project site (*Phoxinellus crassus* found in 1960 and *Aphanius chandrei* found in 1944). The high salinity of the lake and lake basin (including the discharge area) prevent these species from migrating to these sites.

As a result, the proposed project site (including surface facilities and brine discharge area) is poorly inhabited and poorly vegetated with any significant flora and fauna.

1.5 ENVIRONMENTAL IMPACTS

The EIA identified a number of potential impacts associated with both construction and operation phases of the project.

All pipelines will be buried. Therefore key potential impacts are construction of the fresh water pipeline, brine discharge line, and natural gas connector line. There are also potential impacts associated with construction of surface facilities for gas processing, drilling operations and leaching operations.

Operation activities are limited to gas injection and withdrawal so few potential operational impacts are identified. Major concerns are related to safety risks for workers and populations at the storage site and along the gas pipeline route.

The potential Project impacts during construction and operation phases are outlined in Tables 1&2 respectively.

All potential impacts have been analyzed and are readily managed through internationally accepted standards of good engineering practices and procedures which will be followed in design, construction and operation of the gas storage and pipeline distribution systems for water, leachate and gas respectively. Potential impacts associated with the brine discharge into Tuz Golu have been determined to be insignificant, since the effluent will be providing water to Tuz Golu in the same manner



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and of the same quality as is naturally supplied from the groundwater sources currently feeding the lake. The Environmental Management and Monitoring Plan (EMP) includes cost effective mitigation measures for each identified potential impact. The EMP also includes details of the implementation period monitoring requirements and institutional arrangements for effective environmental management. Reference should be made to the EMP for further details.



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Table 1. Summary Table of Impacts-Construction Phase

CONSTRUCTION	IMPACT	PROPOSED MITIGATION MEASURE
Pipeline and Surface Facilities	Excavation/ loss of top-soil	Excavation material will be re-used for trench backfilling and land restoration The vegetative topsoil will be stored properly (by protecting with nylon covers against soil loss related to precipitation) and used for revegetation and landscaping.
	Dust generation due to excavation, material storage, handling and transport	Excavated material will be protected from wind and rain (e.g. using nylon covers and compaction with binding materials) All transportation vehicles that will carry excavation material will be covered The speed of the vehicles will be restricted with 30 km/hour on unpaved roads. Dust prone areas will be regularly watered.
	Solid waste generation	Domestic solid wastes and construction wastes will be collected and disposed to the Municipal Solid Waste Disposal area of the nearest Municipality.
	Wastewater generation	Domestic wastewater will be collected in a lined (impermeable) septic tank and removed by the nearest Municipality With the start of operation, septic tank will be replaced by package treatment plant. No industrial wastewater will be generated. Any hydrostatic test water will be discharged to the nearest water body after settling. Various washdown waters (only including suspended solids, oil and grease) will be collected via a distinct line and sent to package wastewater treatment plant after the removal of suspended solids, oil and grease. Waste/residual oils from oil change of the machinery and vehicles will be onsite discretely and given to a firm licensed by MoEF.



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Table 1.Cont'd

CONSTRUCTION	IMPACT	PROPOSED MITIGATION MEASURE
Pipeline And Surface Facilities	Noise and vibration due to site preparation and construction activities	<p>No explosives to be used unless required during the construction activities</p> <p>The activities that generate noise will be limited with the hours 06:00 a.m-07:00 pm, and no work will be carried out on official holidays.</p> <p>Employees will be provided with special helmets, earphones or earplugs against noise.</p> <p>The maximum noise levels that workers can subject to will not be exceeded during the construction activities</p>
	Transportation	<p>No access roads will be constructed unless necessary and approved by BOTAŞ.</p> <p>The existing roads will be used to the greatest extent.</p>
	Impacts on flora	<p>In the event that the species protected as per the BERN Convention and the "Vulnerable" species according to Turkish Red Data Book are found, they will be managed in accordance with the Bern Convention specifications.</p> <p>The seeds of these species shall be taken and moved to the similar habitats or protected ex-situ in botanic gardens and greenhouses under the control of universities.</p> <p>These species, found in the vicinity of the site, shall be clearly marked and in no way be collected, chopped and taken off their roots.</p> <p>The construction activities will be limited within the construction corridor.</p>



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Table 1.Cont'd

CONSTRUCTION	IMPACT	PROPOSED MITIGATION MEASURE
Pipeline And Surface Facilities	Impacts on fauna	<p>The construction activities will be limited to the construction corridor.</p> <p>Any rare and endangered species will be managed in accordance with the national or international regulations and treaty requirements</p> <p>Construction activities will take place during periods when no migratory bird flight are occurring periods (refer to EMP)</p> <p>A fauna expert shall be employed during the site activities.</p>
	Impacts on Cultural and Natural Assets	<p>No cultural and natural heritage is present on the project site and its vicinity.</p> <p>Turkish chance find procedures will be followed (i.e. cease activities, consult with authority and protection in situ if possible)</p> <p>A cultural expert will remain on-site to issue government if procedures are followed.</p>
	Handling & usage of explosive/hazardous and toxic materials	<p>Any explosive material will be kept in locked containers.</p> <p>The fuels to be used by the work machines will be purchased from companies with valid operating permits If storage is required, then fuels or hazardous liquids will be stored in properly designed tanks situated on impermeable (e.g. concrete) surfaces with bund to contain any leaks.</p>
Drilling Activities	Oily Waste Waters generation	<p>A wastewater pool with an impermeable lining using geo-membrane will be constructed and an oil trap will be placed in the channel entering to the pool in order to separate oil and petroleum from the wastewater. These wastes will be removed from the area by a firm licensed by MoEF.</p>



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Table 1.Cont'd

CONSTRUCTION	IMPACT	PROPOSED MITIGATION MEASURE
	Impacts on Groundwater due to leakage	Casing is placed until reaching the non-leaking formation and the drilling operations are carried out in this casing. Only water based bentonite-clay mud will be used.
	Formation Wastes and Drilling Muds	They will be stored separately from other solid wastes and removed from the area by a firm licensed by MoEF after drying and solidification Mud pits (impermeable) will be opened for the temporary storage of the formation wastes and drilling mud The drilling area and the surrounding of the mud wells will be surrounded with a wire mesh fence and entrance will be locked.
Leaching Operations	Sludge disposal from brine settling tanks	The solid particles (>200 µm) will be kept in settling tanks. The sludge coming from the tanks that will be cleaned at definite times with hand will be collected with mobile containers and disposed to the Municipal Solid Waste Disposal area of Sultanhanı Municipality.
	Sludge disposal from brine settling tanks	The solid particles (>200 µm) will be kept in settling tanks. The sludge coming from the tanks that will be cleaned at definite times with hand will be collected with mobile containers and disposed to the Municipal Solid Waste Disposal area of Sultanhanı Municipality.
Brine discharge / impacts on lake water quality	Brine discharge / impacts on lake water quality	Discharge location is in unproductive/arid area (ecologically, and agriculturally, no salt production and determined based on the official maps and site investigations) of Lake It is estimated that the discharge plume will remain within the boundaries of the unproductive area for the complete duration of the leaching operation. The plume will be monitored to assure these estimates are valid.



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Table 2. Summary Table of Impacts-Operation Phase

OPERATION	IMPACT	PROPOSED MITIGATION MEASURE
Surface Facilities and Natural Gas Pipeline	Noise (Compressors, etc.)	Installation of silencers to the entry and exit of the cooling fans Procurement of low sound emanating backup motor, pump and compressors Limitation of truck transportation merely with hours of daylight if required
	Fire	A fire protection system will be available at site (Fire detectors sensitive to heat, smoke and flame. Nonautomatic fire extinguishing systems will be available in the site against fire as well)
	Leakage and explosion	In case of leakage of natural gas in closed areas, the area will be immediately ventilated in accordance with best international practice.
	Health, Safety Risks	Education on; <ul style="list-style-type: none"> • Site security • Environmental protection • First aid • Fire fighting • Health and occupational safety • Risk assessment will be given to the personnel employed.
	Waste generation	Domestic solid wastes will be collected and disposed to the Municipal Solid Waste Disposal area of Sultanhanı Municipality. With the start of operation, septic tank will be replaced by package treatment plant. The discharge water will be used for watering green areas.
	Accidents and Sabotage	Parameters such as pressure, temperature and flow rate will be monitored continuously at certain locations on the line and the caverns, abnormal conditions will be reported to the authorities. Line valves susceptible to pressure will be shut down automatically



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1.6 PUBLIC CONSULTATION

The first public consultation has been performed on 27.03.2003 at Sultanhane Municipality with the participation of local people and governmental organizations. The second public consultation has been performed on 24.03.2005 at Aaçören and Sultanhane Municipalities. The records of both the first and the second public consultation meetings are included in EMP Section-D.

A number of concerns raised during the first public consultation as groundwater usage for leaching operations, since there is a water shortage and the possible impacts on irrigation, seismicity of the area, and brine discharge impacts on Tuz Golu. These issues were fully addressed in EIA Report in details. In addition, the public concerns played an important role in BOTAŞ' decision on selection of the water resource. Taking public concerns into consideration, BOTAŞ revised the project design and decided to utilize Hirfanlı Dam reservoir as fresh water resource.

During the second public consultation, the major concerns were the duration of the construction activities and job opportunities for local people. BOTAŞ representatives stated that the local manpower would be preferred during the construction activities. Local people were also informed that the agricultural activities would not be negatively affected.

