TABLE OF CONTENTS

FIGURES

TABLES

4. Alternatives

4.1 Introduction

EBRD Performance Requirement 1: Environmental and Social Appraisal and Management specifies the need for assessment of feasible alternative configurations for a project:

"The ESIA will include an examination of technically and financially feasible alternatives to the source of such impacts, including the non-project alternative, and document the rationale for selecting the particular course of action proposed."

For the Öksüt Project ("the Project"), the following are the key activities and features for which a number of alternatives have been evaluated:

- Mining Alternatives;
- Ore Processing Alternatives;
- Heap Leach Pad Location Alternatives;
- Waste Rock Dump Location Alternatives;
- Water Supply Alternatives;
- Power Supply Alternatives;
- Access Road Alternatives.

This chapter also describes the "no project" scenario under which the Project would not take place.

4.2 The "No Project" Scenario

Under the "no project" scenario, mining licenses would not be granted, no approvals application would be made or granted and the Project would therefore not be delivered. Table 4-1 below provides a summary of the Project versus no project scenario for key social, economic and environmental indicators.

Table 4-1: Comparison of the No Project and With Project Scenarios

Impact Category	No Project Scenario	With Project Scenario
Fiscal and National Economic Impacts	No revenues to national government. No opportunity to add further mine development to economy of Turkey.	Revenues to national government. Further enhancement of mining as key contributor to national economy in Turkey.
Socio-Economic Impacts	No direct negative impacts on local communities. Lost opportunity for employment and skills enhancement.	Some minor impact on local communities in terms of access to grazing land and visual impacts. Important opportunity for local employment, skills enhancement and diversification of local economy
Environmental Impacts	No environmental impacts. No consumption of natural resources (e.g. water).	Minor environmental impacts associated with land take and habitat loss. Sustainable and managed consumption of natural resources (e.g. water).

Under the scenario of the Project proceeding, there would be some environmental and social impacts at the local level. There are however, considered to be outweighed by the potential positive economic effects the Project would have at both the local and national levels.

4.3 Mining Alternatives

4.3.1 Mining Method

Open pit mining was selected for the Project based on the grade of the resources, the size of the deposit and the proximity of the ore to the surface.

Underground mining is a much higher cost method per unit of material mined and therefore, it requires much higher concentrations of gold to make it economically viable. It can be cost effective when high grade ore is deep underground and open pit mining would require significant amounts of overlying waste rock to be removed to access the ore. Table 4-2 presents a comparison of the Project Reserve grades with other operating gold mines in Turkey. Although the list is not exhaustive, it demonstrates that the Project compares well with other open pit operations in terms of grade and that the other open pit mines in Turkey are significantly lower grades than the underground operation at Efemcukuru. Additionally, the ore bodies at the Project are very near to the surface which makes it highly amenable to open pit surface mining.

Table 4-2: Reserve Grades in Turkish Gold Mines

Property	Reserve Grade (g/t)	Mine Type
Öksüt	1.38	Open Pit
Copler	2.06	Open Pit
Kisladag	0.69	Open Pit
Efemcukuru	7.23	Underground

4.4 Ore Processing Alternatives

4.4.1 Use of Cyanide

Cyanide leaching for gold recovery has become the standard recovery method for gold in non-alluvial deposits such as Öksüt. No other chemical provides the same gold recovery, process robustness and low operating costs as cyanide, usually in the form of sodium cyanide.

For any gold project, leaching with cyanide is tested first and to check whether there are specific factors which exclude its use, such as high levels of naturally occurring carbonaceous matter, which rapidly adsorbs the gold dissolved and prevents its subsequent recovery. Tests have shown that cyanide leaching will be highly effective at Öksüt.

A number of processes and reagents other than sodium cyanide have been used historically for the recovery of gold. Gravity concentration and amalgamation with mercury have long been in use, but bioaccumulation and other highly significant environmental and health and safety issues associated with mercury use at any scale make this process untenable in a modern mining operation. Sodium hypochlorite, sodium thiosulphate, bromine, and chlorine were all used commercially prior to 1880 for some limited types of gold ores. However, the development of the cyanidation process in the late 1880s and early 1890s provided a simple, low-cost alternative that was effective on a much wider range of ore types. Cyanide has been used to recover approximately 80% of the gold produced internationally since that time, and approximately 92% of the gold produced in the last 20 years. Most of the remaining gold production in this time period has been as a by-product from flotation concentration and smelting of base metals such as copper, with very small amounts still produced by amalgamation and gravity concentration methods.

Although the workplace health and safety procedures and general environmental management practices for handling cyanide are well established, such measures do have an attendant economic and risk management cost which must be borne by the mining operation. In an effort to improve the economics of the extraction process, major mining companies have been working for many decades to develop acceptable alternatives to the sodium cyanide for gold extraction.

Numerous other reagents have been identified as possible alternatives to cyanide in addition to those in use prior to the development of cyanidation. Some have been subject to extensive study, including ammonium thiosulphate, hypochlorite/chloride and thiourea. Only limited research has been done on many of the other possible reagents due to factors such as their high cost, harsh operating requirements, or a poor understanding of their basic chemistry.

All identified alternatives that could currently be viewed as potentially viable are either less effective, more costly, require more extreme operating conditions (e.g. high temperatures, very acidic/low pH processing environments), necessitate high concentrations and large volumes of various reagents, and/or present risks to health or the environment equal to or greater than use of cyanide, especially when the need to transport large volumes of less effective reagents is considered. A systematic evaluation of alternative reagents to cyanidation has been developed by Gos and Rubo ("The Relevance of Alternatives Lixiviants with Regards to Technical Aspects, Work Safety and Environmental Safety"[1]

Gos and Rubo compared cyanide with thiourea, thiosulphate, thicyanate, bisulphide, ammonia and Halogens. A summary of each alternative is provided below.

Table 4-3: Alternatives to Cyanide Considered by Gos and Rubo

Alternative	Comments
Thiosulphate	Thiosulphate is considered by some to be an attractive alternative to cyanide. However, the process chemistry is complex and the reagent consumption rate is high. The gold-thiosulphate complex is approximately 10 orders of magnitude weaker than the gold-cyanide complex. The process also requires ammonia, which is toxic to aquatic life and has significant handling and storage issues. Moreover, there are currently no satisfactory commercial-scale techniques for recovery of metallic gold from thiosulphate leach solution. Detoxification by oxidation would be very expensive due to the high chemical oxygen demand. Recyclability is at best limited due to the decomposition of thiosulphate to sulphate and sulphide. The LD50 and LC50 values are high; thiosulpahte is a reducing agent with the potential to reduce the oxygen concentration in any natural waterway. In addition, highly toxic sulphide and bisulphide are spontaneous decomposition products of thiosulphate.
Thiourea	Thiourea has been investigated as a possible alternative to cyanide, but has several significant drawbacks. The gold-thiourea complex is approximately 15 orders of magnitude weaker than the gold-cyanide complex. Leaching with thiourea must be done at a pH of 1 to 2, necessitating special handling equipment and materials, and substantially increasing operating costs and workplace health and safety risks. More important, however, is the fact that thiourea is a suspected carcinogen and therefore is not an option without the institution of complex and extensive engineering and health and safety program controls. Thiourea is intrinsically unstable and decomposes rapidly to substances that are unable to leach gold and has a toxicity profile that is no more favourable than cyanide. If the oxidation potential is not high enough, the ammonium ion and thiocyanante is formed in significant quantities. This decomposition would also limit its recyclability, although a complete detoxification would seem to be possible but extremely expensive.
Thiocyanate	Thiocyanate can leach gold in the pH range of 1-3 at higher temperatures (up to 85oC). The low pH and high temperatures would indicate high CAPEX and OPEX. The availability of thiocyanate may also be a restriction and if thiocyanate had to be detoxified, a considerable oxygen demand would be necessary, which would increase further OPEX.

[1] http://technology.infomine.com/enviromine/publicat/cyanide.pdf

Alternative	Comments
	Advantages of thiocyanate are that the LD50 is high, classified as a slight water contaminant and the ecotoxicity data is favourable. No large scale application is known for thiocyanate.
Bisulphide	Bisulphide has been proposed as a leaching agent. The process is more suitable for bio-oxidised ores, because a sulphate ion source is required for bisulphide generation. Long retention time and a closed system would be required because of the use of H_2S, which would result in a high capex. The detoxification cost would be very high because of the high chemical oxygen demand. In reference to safe handling, H_2S has a similar TLV as cyanide and H_2S is classified as a water contaminant. No large scale application is known for bisulphide. In conclusion, bisulphide does not offer technical advantages over cyanide nor does it have such favourable lethal toxicity and ecotoxicity data to warrant a more favourable classification with regard to safe handling or environmental damage in case of a spillage.
Ammonia	Leaching gold with ammonia must be conducted at a temperature in excess of 100°C and 1.7 to 7.9 bar, which presents very difficult operational and process engineering issues. The gold-ammonia complex is at least 11 orders of magnitude weaker than the gold-cyanide complex. As previously noted ammonia is toxic to aquatic life and has significant handling and storage issues. High temperature and pressure means high CAPEX and OPEX. Kinetics are substantially better than cyanide. The system would have to be closed to prevent the emission of ammonia. Ammonia has a similar TLV to cyanide and is classified as a water contaminant. Ammonia and leaching agents containing ammonia or the ammonium ion cannot be considered to be a leaching agent that has a more favourable profile regarding toxicity or exposure considerations than cyanide.
Halide systems	Various halide systems [iodine/iodide, chlorine/chloride (including the "Haber" process), bromine/bromide] have been evaluated as potential alternatives to cyanide leaching. Several of these systems are useful for recovering gold from gold-rich materials such as copper refinery slimes, but have significant shortcomings when applied to the leaching of gold ore. The gold-halide complexes are not stable, and require a level of chemical and process control not economically achievable in a gold ore leaching facility. Additionally, halides are typically toxic to aquatic life and have a wide range of storage and handling issues associated with them. The handling of chlorine and bromine has very low TLV, lower than cyanide. Chlorine is classified as a water contaminant; bromine is a strong water contaminant.
Bio-leaching	Some scientists hope that bacterial leaching ("bioleaching")of gold ores (as opposed to the use of bioleaching as a pre-treatment before cyanidation) will one day prove to be a viable alternative to the use of cyanide for a limited range of ore types. However, while this technique has generated interest at laboratory and pilot scales, little progress has been made in its full-scale industrial application.

The assessment summarised above indicates that despite the fact that cyanide is not an ideal reagent for gold extraction it is substantially better than any alternatives when viewed under BAT (Best Available Technique) criteria. Until a new reagent is proven more effective in all respects for gold extraction, it must be concluded that cyanide is BAT for gold extraction. A comparative environmental assessment of the leaching options has therefore not been undertaken on the basis that alternatives cannot be classed as BAT and are therefore not viable.

As a Centerra-owned business, OMAS will conform to the International Cyanide Management Code (ICMC) and will be independently certified and audited. OMAS has considered different options for transporting and handling cyanide and has chosen a method which reduces the potential risks, called the Cyplus System. This is described further in Section 5.17.1. OMAS, in conjunction with its cyanide supplier[2], will develop a Cyanide Management Plan which includes worker safety, emergency response, employee and contractor training and transportation. Prior to completion of the Cyanide Management Plan, a Cyanide Management Framework (OMAS-ESMS-CN-PLN-001) has been prepared by OMAS setting out key approaches and commitments related to cyanide management.

4.4.2 Heap Leach Processing

The Project contains near surface oxide ore bodies in both the Keltepe and Güneytepe deposits. As a result, Project development focused on using the heap leach processing method which is a low cost method for processing oxide ore.

Although the contained gold grades in the resources and reserves are relatively high, the contained gold is insufficient to justify the additional capital cost associated with a more capital intensive process involving grinding ore prior to gold leaching in a processing plant, which would provide enhanced gold recovery. Heap leach processing provides the minimum land disturbance and leaves only the heap leach pad and leached ore along with the waste rock dump as legacies post-mining. A grinding/ leaching process would require the construction of a tailings management facility, which would be problematic to locate giving the terrain around the deposits and the proximity of several local villages.

The oxide nature of the ore (i.e. containing no sulphide minerals that carry gold) precludes processing via flotation to generate a concentrate. Mineralogical analysis has shown the gold to be very fine, also precluding gravity concentration.

For these reasons, the heap leaching ore processing method will be adopted as the most environmentally robust and cost-effective approach.

4.5 Heap Leach Pad Location Alternatives

In December 2013 engineers from SRK undertook a site visit to identify potential sites for the heap leach pad (HLP).

Three potential HLP sites were identified in the area around the proposed mine site as summarised in Table 4-4 and illustrated in Figure 4-1.

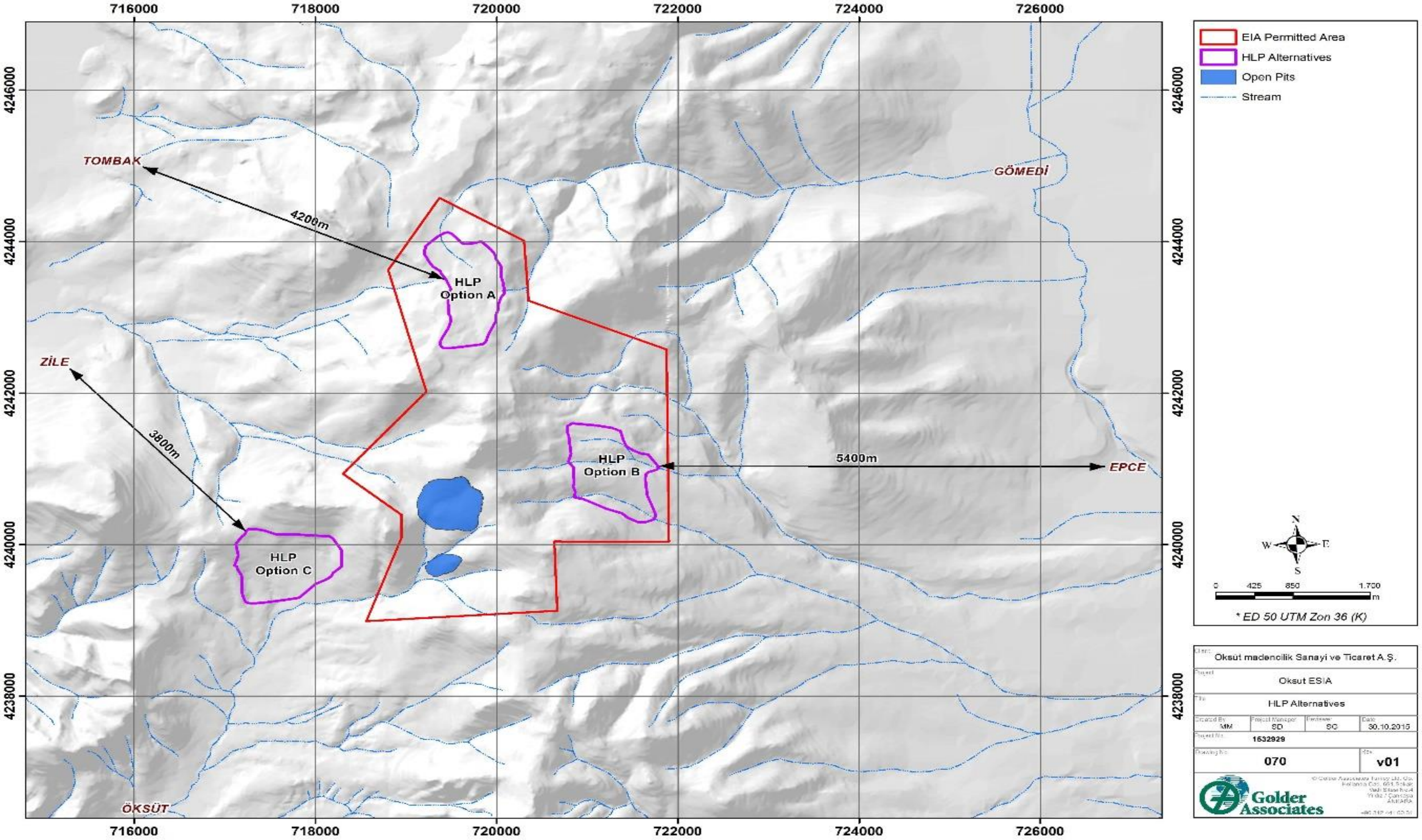
Table 4-4: Optional HLP Locations

Option	Description
Option A	▪ Located 2 km north of the mine, at an elevation of approximately 100 m above the surface of the open pits. ▪ No utilities are present in the general area. ▪ Located in License No. is 82469, which is a license area outside of the mine. ▪ The area is gently sloping and consists mainly of thin soils over bedrock. ▪ One groundwater seep was noted, with no active stream flows observed; however, there are surface drainage features. ▪ The area is located near the crest of a topographic ridge, so minimal surface water diversion would be expected. ▪ The land is used mainly as grazing and there appears to be no other commercial use of the land. ▪ Because of its secluded location, the site would have minimal visual impacts on the local communities.
Option B	▪ Located approximately 2 km east-northeast of the mine, at an elevation of approximately 50m below the surface of the open pits. ▪ Would require crossing a ridge with an approximate elevation gain of 100 m. ▪ No utilities are present in the general area.

[2] All cyanide suppliers being considered by OMAS are ICMC certified.

Option	Description
	▪ Located in License No. 82468, which is the same area as the proposed mine. ▪ Area is gently sloping and consists mainly of thin soils over bedrock. ▪ No groundwater seeps or active stream flows were observed however, there are surface drainage features. ▪ The area is located mid slope on a flatter bench area and a surface water diversion would be expected. ▪ The land is used mainly as grazing and there appears to be no commercial use of the land. ▪ Due to its secluded location, the site would have minimal visual impacts on the local communities.
Option C	▪ Located approximately 2 km west-southwest of the mine, at an elevation of approximately 300 m below the surface of the open pits. ▪ No utilities are present in the general area. ▪ Located in License No. 82468, which is the same area as the proposed mine. ▪ Area has steeper slopes than Options 1 and 2. ▪ Land is used mainly as farmland. ▪ The site is located above the neighbourhood of Öksüt and would be highly visible.

Figure 4-1: Optional HLP Locations



Using information from the site visit and the drawings developed for the Project, a ranking system was developed to assess the potential HLP options for the Project. The ranking system included capital cost, operating cost, and Health, Safety, Environmental and Community (HSEC) aspects. Each site was scored out of 100 (the higher the score the more favourable the site) for each aspect[3]. The selection criteria, scores and final rankings are provided in Table 4-5 below.

Table 4-5: HLP Selection Criteria

	Ranking Criteria	Option A	Option B	Option C
30% Weighting	CAPEX	**27**	16	20
	OPEX	**27**	22	10
	HLP Footprint Area (ha)	**100**	90	90
	HLP Volume and Shaping	**100**	20	50
	Geotechnical Condition	50	50	50
	Drainage Basin Area (ha)	**100**	10	10
	Borrow Source Available	90	90	90
	Cycle Times	**100**	90	75
	Maximum Ore Depth (ft)	**100**	20	**100**
40% Weighting	Distance (m)	**100**	74	10
	Fuel Consumption	90	75	**100**
	Property/Land Ownership	**100**	**100**	0
	Potential Impacts to Water Resources	60	**100**	47
	Biodiversity Risks	**75**	50	50
	Social Licence	**50**	**50**	20
	Severance of Public Access	50	**100**	50
	Public Health & Safety Risk	50	**60**	15
	Total Score	**80**	69	53

Based on the results of this ranking system, it was recommended that Option A be adopted in the design:

- **Option A:** Option A scored the highest in the ranking with a score of 80, primarily because it possessed the most preferred capital and operating costs parameters, such as having the smallest HLP footprint area, regrading volume, drainage area, cycle time and maximum ore depth. It was closest to the mine, and had the second lowest estimated fuel consumption for each haul truck cycle. It is located on Treasury land and posed the lowest biodiversity risk.

- **Option B:** Option B scored second highest in the ranking with a score of 69, primarily due to having the most preferred score for HSEC parameters, such as being located on Treasury land, having the least impact on water resources, severance of public lands and health and safety risks.

- **Option C:** Option C scored lowest in the ranking study with a score of 53. It scored relatively high for the capital and operating cost parameters, when considering the HLP area and regrading volume, haul truck cycle time and fuel consumption. However, it generally scored the lowest from a HSEC perspective due to private land ownership and close proximity to Öksüt village, with corresponding concerns regarding water resources, social licence and health and safety issues.

[3] Ranking methodology is provided in Öksüt HLP Ranking memo from SRK Turkiye to Centerra, 13 December 2013.

4.6 Waste Rock Dump Location Alternatives

During the initial phases of mine design, three waste rock dump (WRD) locations were considered as illustrated in Figure 4-2.

Table 4-6 summarises the WRD site selection process[4]. After extensive investigation, Option 2 was considered the best location for the WRD based on the following:

- The average slope of the ground for Options 1 and 3 is 30% whilst at Option 2; the average slope of the ground is 15%; for WRD stability Option 2 is considered the best option.
- Both Option 1 and Option 3 do not have the capacity to take the planned Life of Mine (LOM) waste tonnage on their own, hence if Option 2 is not considered as the optimal WRD site, then both Option 1 and Option 3 would have to be used as WRD sites over the LOM thus creating two WRD sites instead of one over the LOM; Option 2 is considered as the optimal waste dump site in terms of LOM tonnage capacity.
- Both WRD Option 1 and Option 3 can be seen from both Öksüt Village and other western villages. Option 2 is not visible from the western villages, and is only slightly visible from the eastern side from the Epçe-Gümüşören road; Option 2 is the optimal choice based on least visual impact.
- Whilst Option 2 will incur an additional cost of US$36.5M over the LOM due to the longer haulage distance compared with Option 1 and Option 3, in terms of rehabilitation at mine closure, it will be more efficient to rehabilitate one mine WRD rather than two.

Table 4-6: Waste Dump Selection Criteria

Criteria	Option 1	Option 2	Option 3	Comment
Stability	x	✓	x	15% slope
LOM Capacity	x	✓	x	Additional capacity
Visual Impact	x	✓	x	No visual impact
LOM Cost	✓	x	✓	Additional US$ 37 million
Mine Rehabilitation	x	✓	x	Better for Rehabilitation

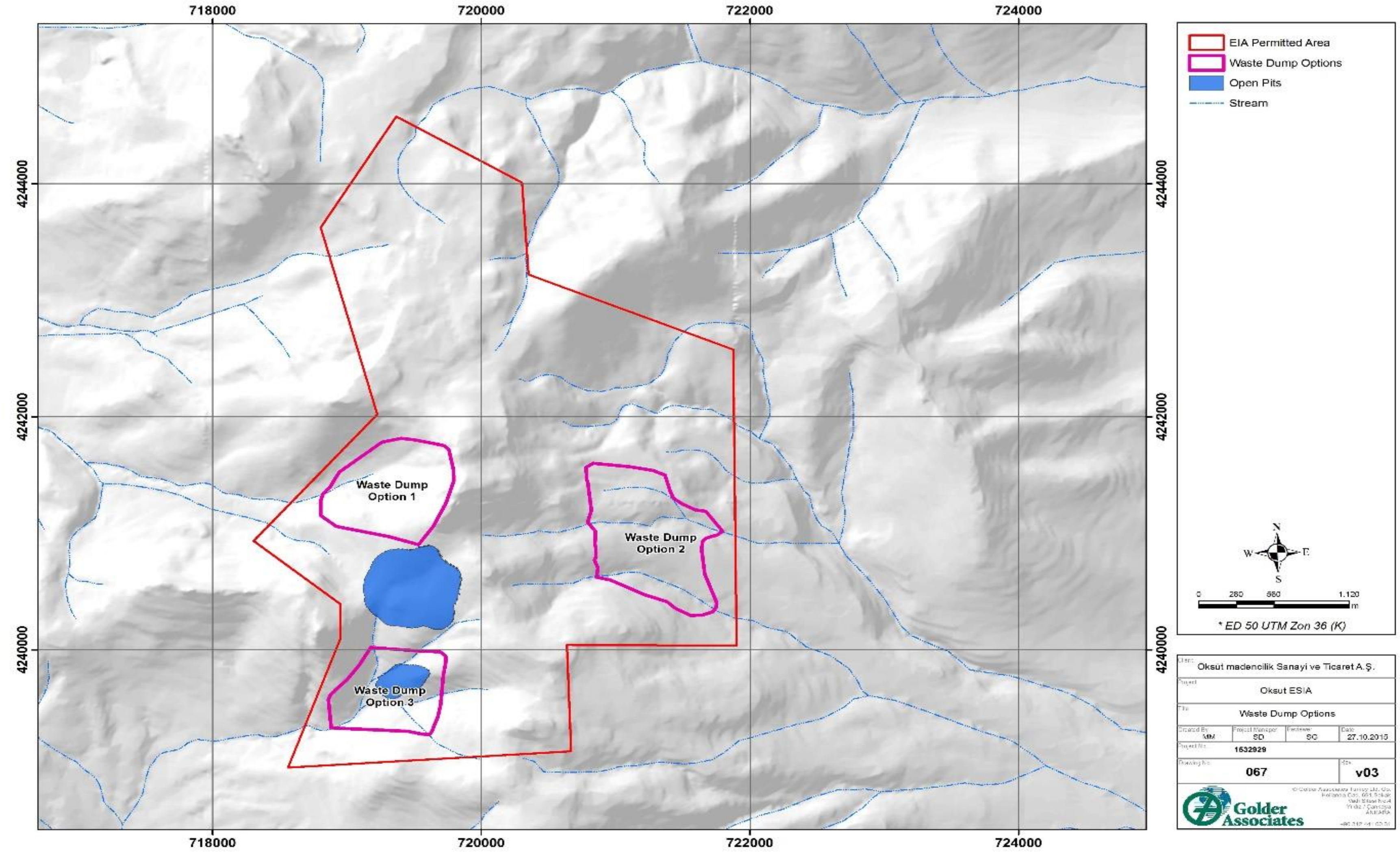
Option 1 is located on both forestry land and pastureland, Option 2 is located on pastureland and Option 3 on forestry land. All locations are grazed during the summer.

All options have surface drainage features. Option 1 is situated on a spring that supplies the Zile water distribution line, whilst Option 2 is in an area where no groundwater seeps or active stream flows were observed. Options 1 and 3 are approximately 2.5 km from Zile and Öksüt respectively, whilst Option 2 is 5.3 km from the closest village (Epçe). Option 2 has more favourable topography over the other two options.

Option 2 was considered the optimal choice as it minimises the risks of WRD development over the LOM even though it results in a higher operating cost for the Project.

[4] Sensitive biodiversity features and the potential for critical habitat within the EIA Permitted Area were not identified during the national EIA process and were first identified during more detailed surveys carried out during the summer 2015.

Figure 4-2: Alternative Waste Rock Dump Locations



4.7 Water Supply Alternatives

4.7.1 Introduction

Water is considered one of the most critical aspects of the Project in relation to environmental and social management. OMAS is committed to working with communities throughout the project lifecycle to ensure that the community is not negatively impacted by Project use of water and that best water management practices are applied by all users.

Water is generally scarce in the Project Area, with competing water demand from agricultural, potable and industrial users. In recent years, the nearby Sultan Sazlığı wetland has become adversely affected by water scarcity, and State Hydraulics Works Department (DSI) has made investments to sustain the ecosystem in the wetland and the agricultural activities in the region. The main investments include:

- construction of the Zamantı tunnel to bring water from the Zamantı River to the Develi catchment area;
- construction of irrigation channels for agricultural activities;
- construction of flood control channels for diverting water from the Erciyes Mountain to the Sultan Sazlığı wetland;
- supporting the agricultural community for effective use of water are some of the other important activities implemented in the region.

4.7.2 Hydrocensus of Local Water Supplies and Users

The groundwater within and in the near vicinity of the Project site is abstracted using both deep and shallow wells. Water for agricultural irrigation and community water supply is collected in cisterns (called "depots") built on top of existing springs and wells. OMAS has undertaken a regional hydrocensus to identify surface and groundwater resources. A map showing water utilisation in the local area is presented in Figure 4-3 below.

All water sources within and in the near vicinity of the project site were identified and information on current water use by local communities was gathered. As a result of these studies, 322 water sources were identified. At the same time, the water supply lines to the nearby Villages were identified.

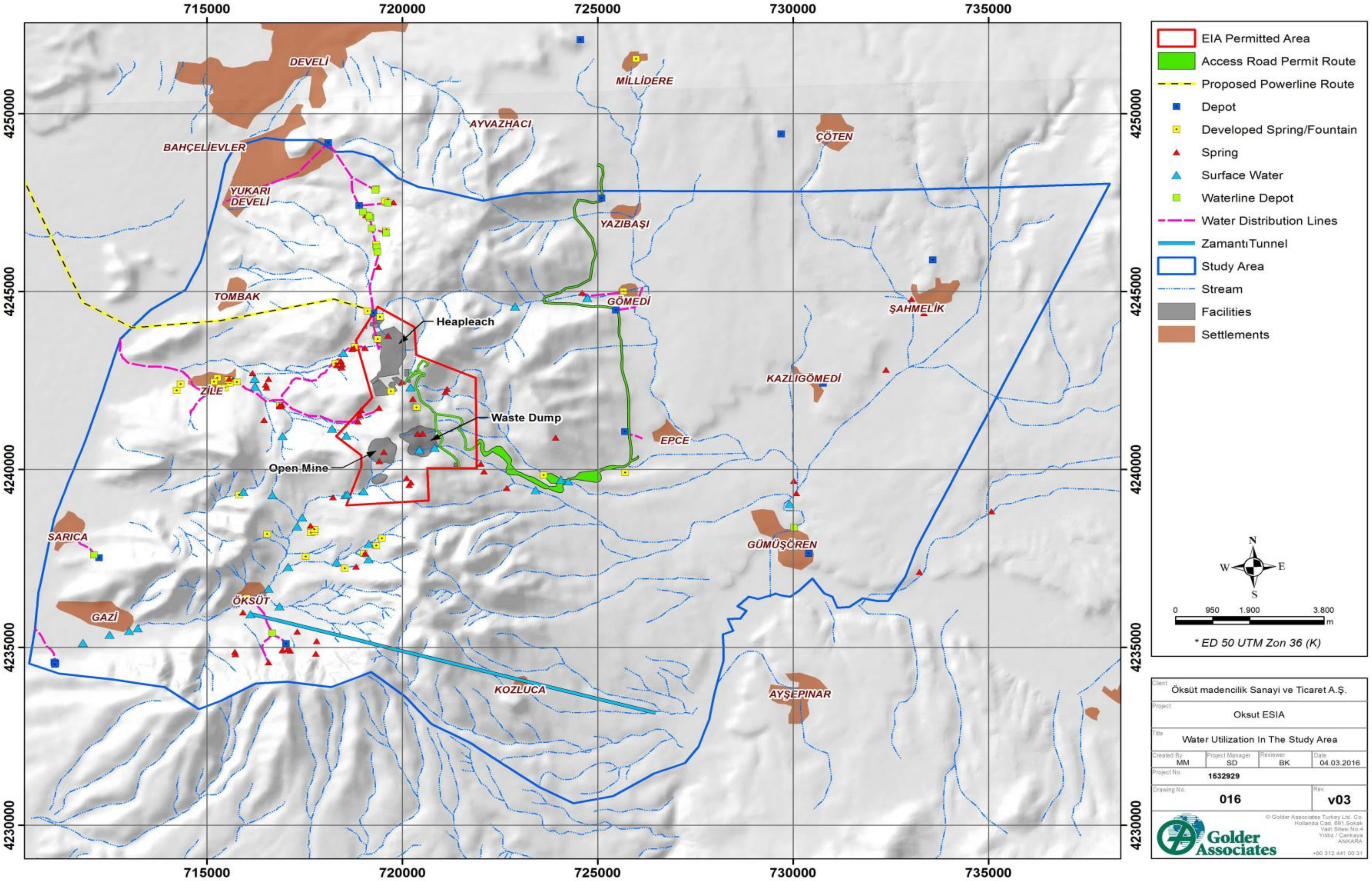
Uses of the water resources identified in the region are listed below:

- **Acısu Springs:** There are a number of small and large springs near Zile and the mineral water from these springs are considered by local people to have health benefits[5].
- **Zamantı Tunnel**: Built by the DSI. It has been planned that annually 102.83 hm^3 of water be transferred from the river Zamantı to the Develi plain and, by using the groundwater in the plain as well, an area of total 36,591 hectares irrigated.
- **Gıcık Tunnel Water Supply:** The water obtained through the Gıcık tunnel (which was opened to drain the groundwater encountered during the construction of the Zamantı tunnel) is being transferred to a different pipeline at the outlet of the Zamantı tunnel and used to supply water to the district of Develi. With the encounter of the fault zones in the course of the tunnel construction, approximately 1,000 L/s of water discharged into the tunnel. This level has now dropped to the levels of 100-150 L/s over a period of approximately 10 years and is routed by the Municipality of Kayseri and the State Hydraulics Institute as drinking water to Villages and sub-provinces.

[5] Water Quality testing by OMAS has shown that the water quality is likely to be harmful to human health. This is discussed further in *Chapter 10: Water Resources*.

- **Epçe and Şahmelik Irrigation Cooperative Wells:** Approximately 5 million m^3/year of water has been drawn from the cooperative's production wells to irrigate a total area of 7 million m^2 under the responsibility of the cooperative.
- **Community Drinking Water Supply Sources:** All of the communities in the vicinity of the project site obtain their potable water from groundwater (seeps, springs collected and stored in depots). Besides these sources, communities use groundwater wells to meet their water demand which increases during the summer months.

Figure 4-3: Hydrocensus Points, Surface Water Points and Community Water Supply Lines



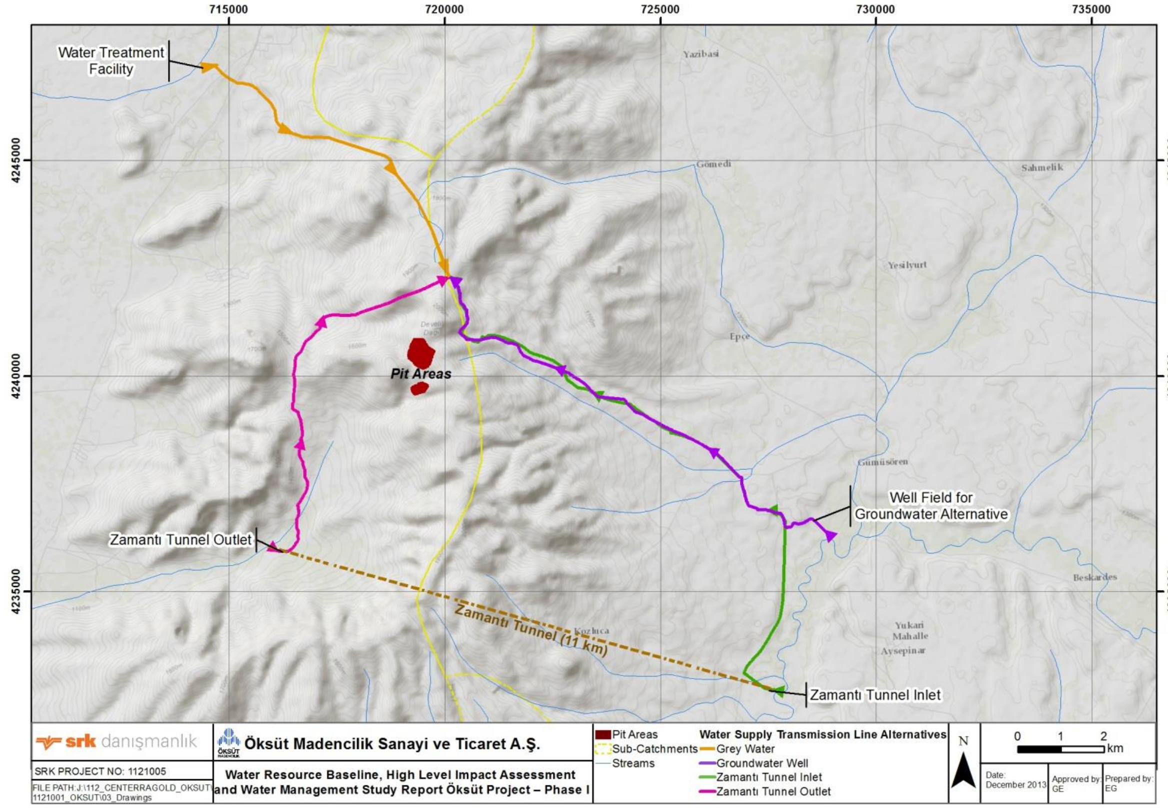
4.7.1 Preliminary Economic Assessment (PEA)

Given the existing water challenges in the region, initially five water supply alternatives for the Project were identified and analysed and these are shown in Table 4-7 Figure 4-4 below.

Table 4-7: Mine Water Supply Alternatives – PEA Stage

No	Source Location	Type of collection	Location	Evaluation
1	Zamantı tunnel	Direct collection from tunnel outlet	Öksüt Village	Zamantı Tunnel was constructed to transfer water to Sultan Sazlığı wetland. The permitting procedures for abstracting water from the tunnel is complicated. Social concerns are valid. **The alternative was rejected before further analysis.**
2	Acısu Creek	Direct collection from creek	Acısu Village	Acısu Creek catchment outlet has limited amount of water (approximately 7.2 L/s) that could not sustain the predicted mine water demand. Potentially high impacts on the adjacent water users can be expected. **The alternative was rejected before further analysis.**
3	Grey water from Develi Waste Water Treatment System (DWWTS)	Direct collection from plant outlet	Develi	Effluent water quality will need to meet the mine operation water quality requirements. Major risk is foreseen in relation to the reliability of effluent water quality. **The alternative was rejected before further analysis.**
4	Zamantı tunnel inlet	Direct collection from tunnel inlet	Gümüşören Village	Zamantı Tunnel was constructed to transfer water to Sultan Sazlığı wetland. The permitting procedures for abstracting water from the tunnel are complicated. Social concerns are valid. **The alternative was considered to be the most feasible option and used as the water source in the PEA report**.
5	Alluvium hydraulically connected to Zamantı	Ground water wells	Gümüşören/ Ayşepınar Villages	An abstraction location in closer distance than the inlet of the tunnel would be easier to permit than from the direct abstraction from the Zamantı River/Tunnel. An abstraction point within the Zamantı River alluvium would be selected. **The alternative was evaluated during the feasibility stage and eliminated due to permitting challenges.**

Figure 4-4: Water supply alternatives during the PEA stage



Two of the alternatives (Zamantı Tunnel outlet and Acısu Creek) were rejected as water supply options after the initial review. For the purpose of the PEA assessment, sourcing water from the Zamantı tunnel inlet was considered as the most feasible option with a conclusion that further studies should be conducted during the feasibility stage. Considering the challenging permitting process of Zamantı Inlet alternative, OMAS decided to further investigate abstracting water from wells drilled in Gümüşören alluvium during the feasibility stage.

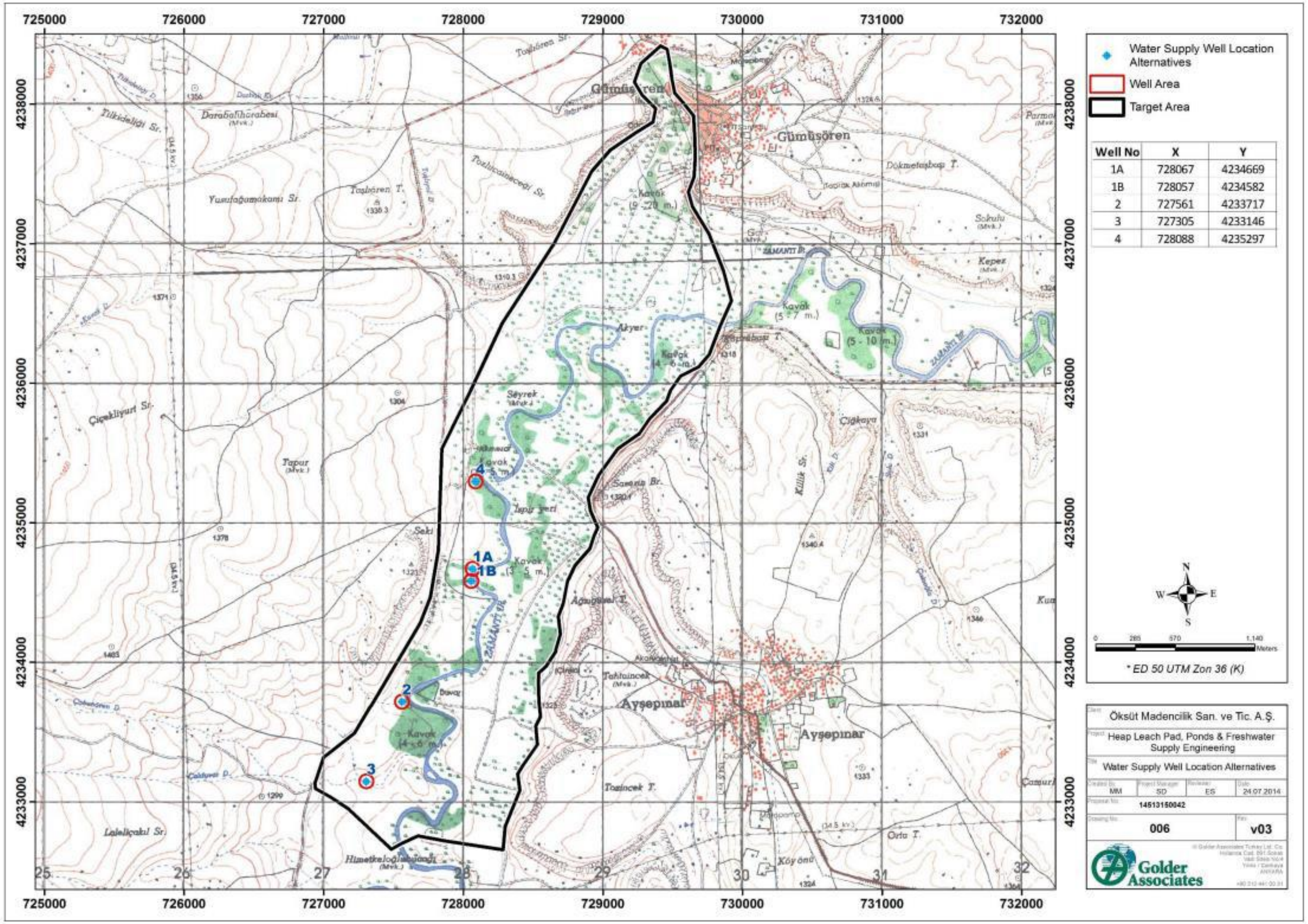
4.7.1 Evaluation of suitable water supply alternatives during the Feasibility Stage

The scope of work for the feasibility stage level water supply investigations was developed based on a design value of 35 L/s as the Project fresh water requirement.

Zamantı Alluvium Shallow Aquifer and Zamantı River

The exploration started with the Zamantı Alluvium which was identified during the PEA study. A detailed reconnaissance of the area selected for the water supply study was conducted in July 2014 and potential targets for water supply wells were identified. Four potential suitable drilling locations in the area of the Zamantı River alluvial aquifer upstream from the Zamantı Regulator were selected for the pumping tests to evaluate long-term yield of the shallow alluvial aquifer, as shown in Figure 4-5.

Figure 4-5: Potential targets for water supply wells at Gümüşören/Ayşepınar



Meetings were held after the pumping tests with the State Hydraulic Works (DSİ) in Kayseri to learn their position regarding drilling monitoring wells within the Gümüşören alluvium. It was indicated that there would be permitting challenges. The following was discussed:

- Evaluation of the information collected on the shallow Zamantı valley aquifer indicated that the depth of the alluvium is limited (max 12 m) and several wells would need to be drilled to supply 35 l/s to the project.
- The alluvium is hydraulically connected to the Zamantı River and wells will abstract water from the river.
- Most of the land has been expropriated by DSI, as there are several hydropower projects downstream of Zamantı River.
- There is a flood risk in the alluvium plane and completion of the Gümüşören Dam has the potential to reduce the flow of the Zamantı River during the filling of the reservoir of the dam.
- There were social concerns regarding the use of surface water.

Epçe Deep Aquifer

Considering the potential technical, social and permitting challenges associated with the Zamantı Option, a new target for water supply investigations was identified in the Epçe area; and the water search study expanded to the Epçe Village region.

DSI has multiple groundwater wells drilled in an agglomerate in Epçe which are in continuous operation for half of the year during dry season (May to September) to supply water for the irrigation cooperative (location shown in Figure 4-6). Due to having a proven high yielding aquifer, groundwater exploration was conducted in the bedrock option of the agglomerate aquifer in Epçe. The primary criteria of selecting well locations were:

- to be outside of the irrigation cooperative boundary;
- to keep the distance between DSI irrigation wells to minimise impacts;
- to stay close to the Project Area and existing road and powerline to reduce the pumping operation and construction costs.

Two drilling target areas in Epçe were selected outside of the irrigation boundary and drilling was initiated. A 10 day long constant rate pumping test was conducted in each test well. After completion of each test, the water level was monitored until full recovery was achieved. The long-term test rate was selected at around 35 L/s for the pumping well E1TW1 at the test location 1, and around 40 L/s for the pumping well E2TW1 at the test location 2. Based on the results of the two long-term tests, the pumping wells E1TW1 and E2TW1 it was concluded that two wells would produce a combined volume of over 60 L/s fresh water for the Project. The well locations are illustrated in Figure 4-7 below.

Evaluation of Epçe deep aquifer and Zamantı alluvium shallow aquifer Water Supply Alternatives

An evaluation of two main water supply alternatives including Zamantı River Shallow Alluvium Aquifer and Epçe Region Deep Agglomerate Aquifer were made in relation to land use, social, technical and permitting issues and are summarised in Table 4-8.

Table 4-8: Epçe deep aquifer and Zamantı alluvium shallow aquifer Water Supply Alternatives

Criteria	Epçe Region Deep Agglomerate Aquifer	Zamantı River & Alluvium Aquifer
Technical	▪ Deep & thick aquifer – high potential ▪ 3-4 km shorter pipeline route ▪ Lower construction and power costs ▪ Very close to main highway and powerline ▪ No risk of flooding	▪ Limited alluvium thickness, low yield aquifer fed directly from Zamantı River ▪ Longer pipeline route ▪ Higher construction and power costs ▪ Risk of flooding and difficult maintenance ▪ On-going Gümüşören Dam construction

Criteria	Epçe Region Deep Agglomerate Aquifer	Zamantı River & Alluvium Aquifer
	▪ Sustainable aquifer and potential to abstract more water if necessary ▪ Good quality water-no treatment required	▪ Some treatment and sediment removal would be required
Land Use	▪ Wells located on Private Land (acquired by OMAS) ▪ Pipeline route is on governmental land	▪ Most of the land within the Zamantı Alluvium is already expropriated by DSI ▪ Pipeline route crosses several private land parcels and will require land acquisition
Social	▪ Close to Epçe Irrigation Area and operating DSI wells	▪ Several villagers use surface water for irrigation purposes ▪ Several hydropower projects at the downstream of the Zamantı River, ▪ Located within the Zamantı Tunnel Reservoir which is constructed to transfer water to Sultan Sazlığı wetland. ▪ Pipeline route cross several private land
Permitting	▪ Low Permitting Risk (Water usage permits granted by DSI)	▪ High Potential of Permitting Risk

The Epçe agglomerate aquifer was chosen as the preferred option for potential groundwater source for the project due to its proximity, size of the aquifer and flow regime. The abstraction capacity of each pumping well was calculated by using the pumping test rate, and the projection of the drawdown in each pumping well after 100 days of pumping. 70% of the available drawdown for each well was used to calculate the sustainable yields. Key information on sustainable yield calculations is presented in Table 4-9.

Table 4-9: Sustainable Yield Calculations for Epçe Water Supply Wells

Well ID	Pumping Test Rate	Drawdown Projection at 100 days	Specific Capacity of the Well	Safety Factor	Available Drawdown	Sustainable Yield
	L/s	m	L/s/m	-	m	L/s
E1TW1	35.0	17.5	2.0	0.70	16	22.4
E2TW1	29.6	36.0	1.1	0.70	53	40.8

Based on the results of the two long-term tests, the pumping wells E1TW1 and E2TW1 were confirmed as the water supply for the Project. The two wells were estimated to have a sustainable yield of over 60 L/s compared to the Project water demand of 35 L/s.

Consultation in Epçe

Over thirty consultation meetings were undertaken by OMAS with community members and authorities throughout the water supply study. These included twenty-one community consultation and awareness meetings in the Epçe tea house and mosque. Further information is provided in *Chapter 6: Stakeholder Consultation and Engagement*.

Figure 4-6: Well locations at Epçe

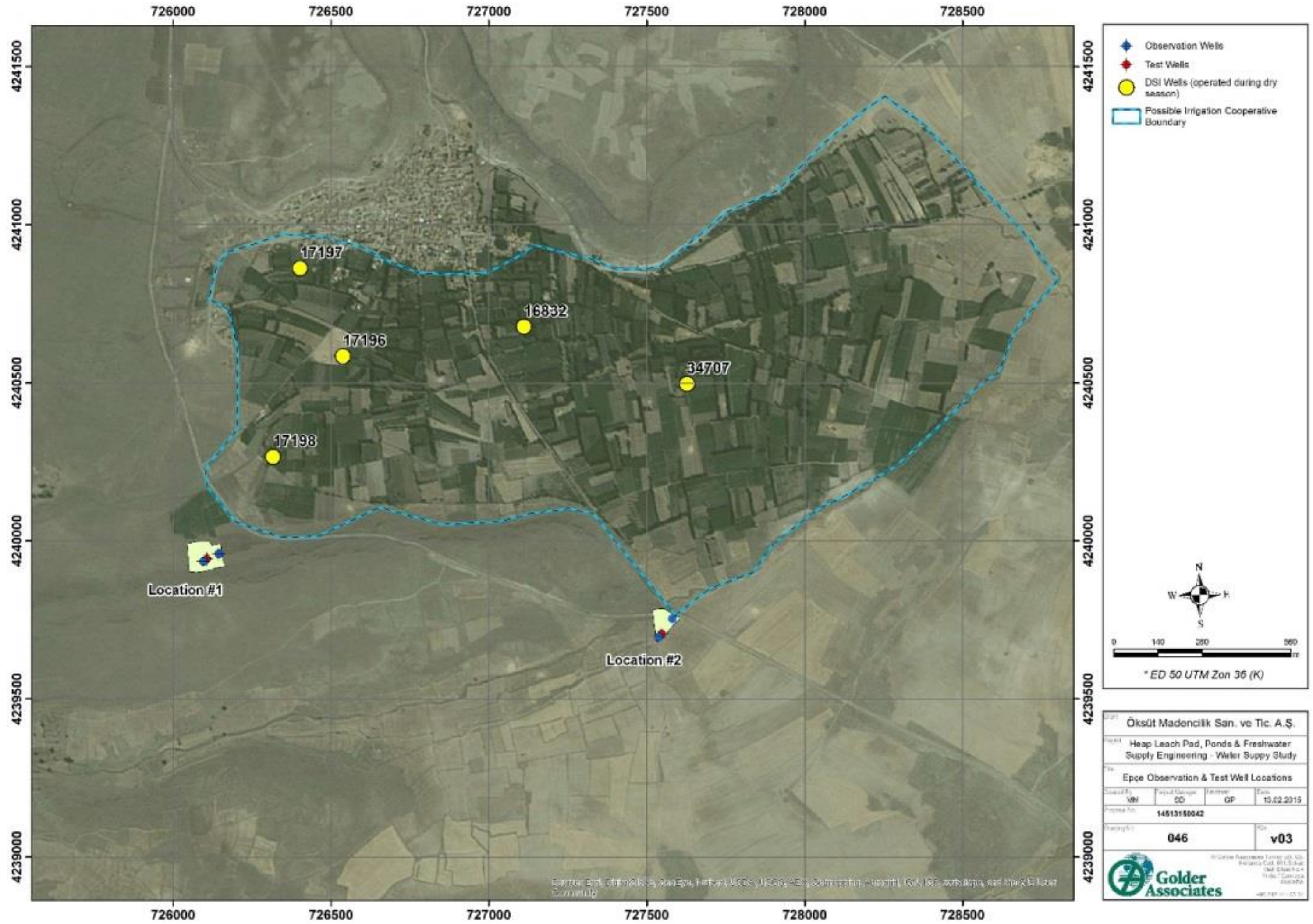
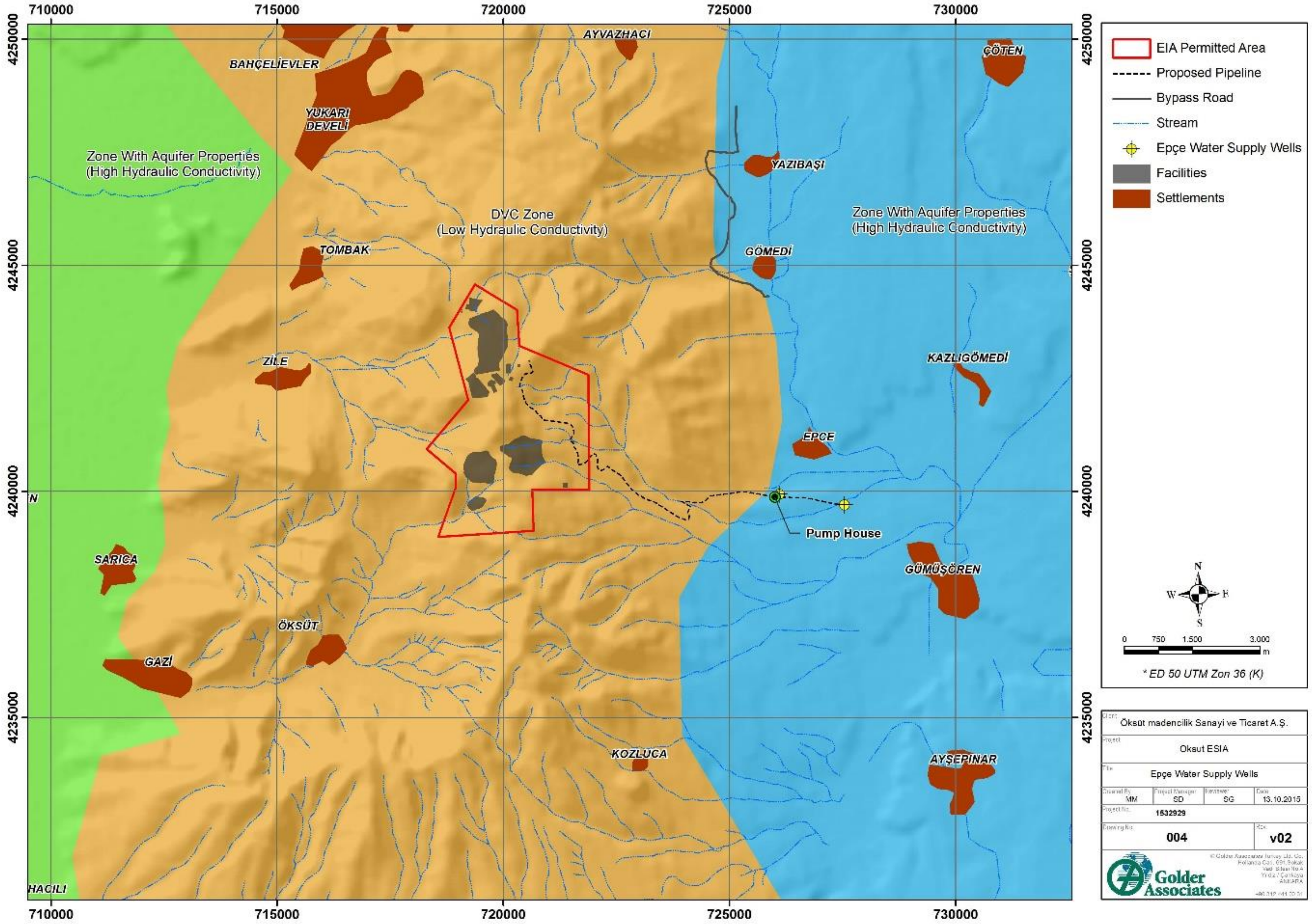


Figure 4-7: Project Water Supply



4.8 Power Supply Alternatives

4.8.1 Power Source

Preliminary estimates of required power consumption estimated that the Öksüt Project will have total power requirements in the range of 7 to 9 megawatts (MW).

The project initially considered two possibilities for power supply during conceptual and feasibility studies:

- power supply through onsite diesel generators;
- power supply from national grid.

The power supply alternative through diesel generators was deemed inefficient and not sustainable because of high fuel costs and environmental emissions. This would also have the advantages of minimising on-site emissions and the number of fuel truck movements required to supply the Project site.

4.8.2 Powerline Route

OMAS contacted the local power supply and distribution company KACETAŞ to investigate connection alternatives to the national grid. KACETAŞ suggested a connection from Gazi Kule switchyard to the mine site. However, further technical studies have proved this connection is not technically feasible.

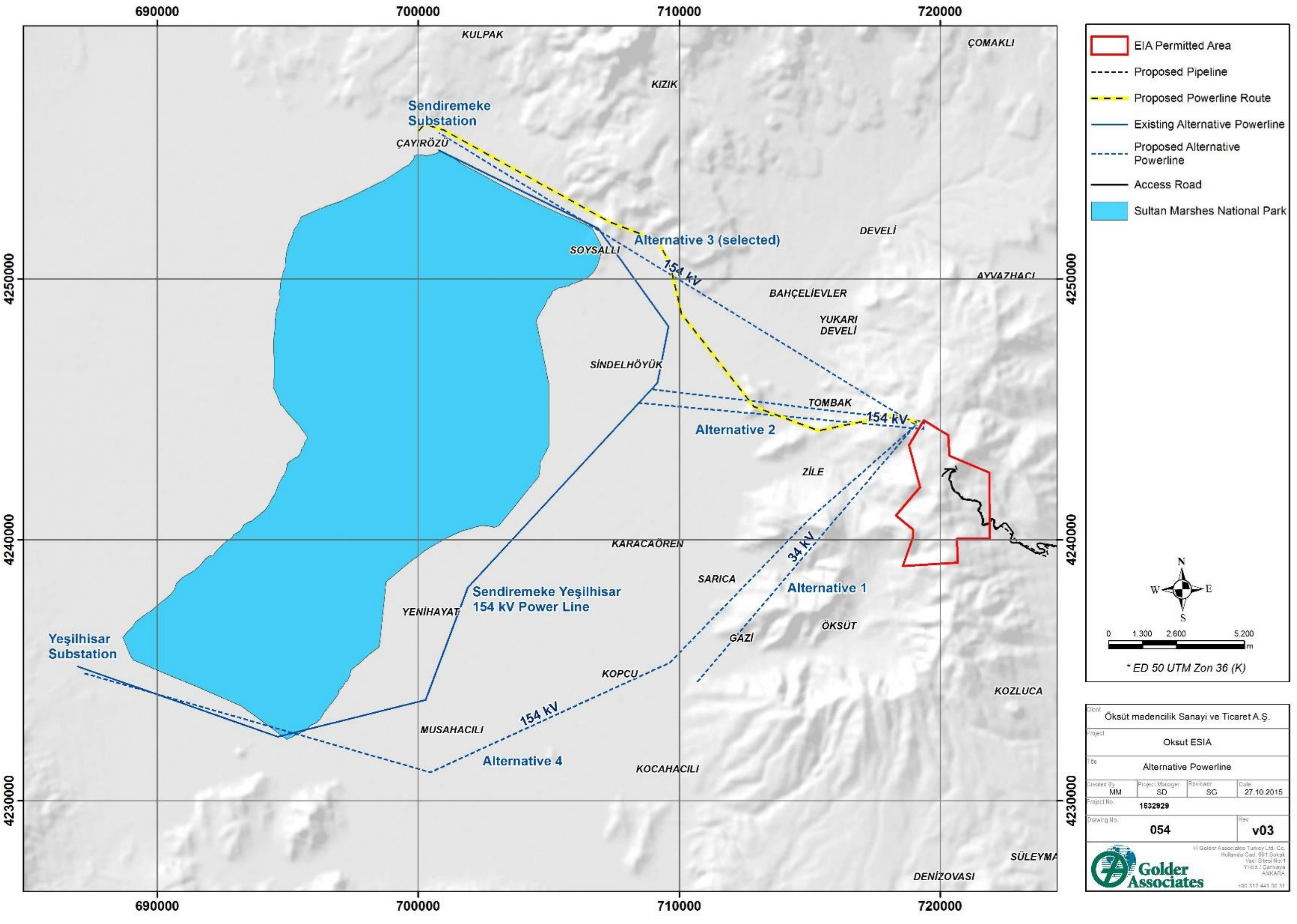
OMAS then contacted the Turkish Electricity Transmission Corporation (TEİAŞ), which is Turkey's national power supply company, to evaluate the other alternatives with a technical study on connection line options load flows prepared by a third party consultant.

Based on the TEİAŞ network, the connection alternatives were defined as:

- Yeşilhisar substation (380/154 kV) to Sendiremeke substation (154/31.5 kV).
- Sendiremeke Substation (154/31.5 kV).
- Yeşilhisar substation (380/154 kV).

These alternative connection routes are illustrated in Figure 4-8 below.

Figure 4-8: Alternative powerline connections



TEİAŞ evaluated these alternatives and decided the powerline would be established from Sendiremeke Substation (154/31.5 kV) to the mine site as summarised in Table 4-10 below.

Table 4-10: Power Supply Alternatives

No	Source Location	Type of connection	Location	Evaluation
1	Gazi Kule Switchyard connection 31.5 kV Power (fed through Sendiremeke 154 /31.5 kV substation with a 25 powerline)	Tie In to 31.5 kV local power distribution	Gazi Quarter	The local infrastructure is not able to provide an efficient power supply. The voltage drop will decrease the efficiency of the power use and will result in operational problems.
2	Yeşilhisar substation (380/154 kV) to Sendiremeke substation (154/31.5) kV Power Line	Tie In directly to the Transmission Line	Sindelhöyük Village	The local infrastructure is not able to provide an efficient power supply. The voltage drop will decrease the efficiency of the power use and will result in operational problems.
3	**Sendiremeke Substation (154/31.5) kV**	**Connection to Sendiremeke Substation**	**Çayırözü**	**The connection will meet the requirements of the project site. This is the TEİAŞ preferred option[6]**
4	Yeşilhisar (380/154 kV) substation	Connection Yeşilhisar substation	Yeşilhisar Town	The connection will meet the requirements of the project site. The connection distance is longer than Sendiremek connection and not favoured by TEİAŞ. (regulation stipulates for the closest connection)

4.8.3 Preferred powerline option

As per Turkish Regulations, the local authority and TEİAŞ decide on the final route of the powerline from Project site to Sendiremeke substation. TEİAŞ is also the responsible party for the preparation of the national EIA for the construction and operation of the new powerline and will acquire the EIA permit from local authorities after the preparation and submission of the EIA report to MoEU. OMAS has influenced the route selection process wherever possible.

Two alternative routes (Figure 4-9 and Figure 4-10) between the Project site and Sendiremeke substation were considered by the national EIA consultant Selin, who prepared an Environmental Preliminary Study Report in September 2015[7]. Alternative 1 is 22.87 km long and has 7 turning points. Alternative 2 is 21.6 km long and has 8 turning points.

[6] Whilst OMAS understands that the Sendiremeke Substation is situated just to the north of the Sultan Sazlığı wetland, it was the decision of TEİAŞ to use this substation.

[7] 154 kV Sendiremeke Substation - Öksüt Mining Substation, Energy Transmission Line Environmental Preliminary Study Report, Selin 2015.

Figure 4-9: Alternative 1 Sendiremeke substation to Project site

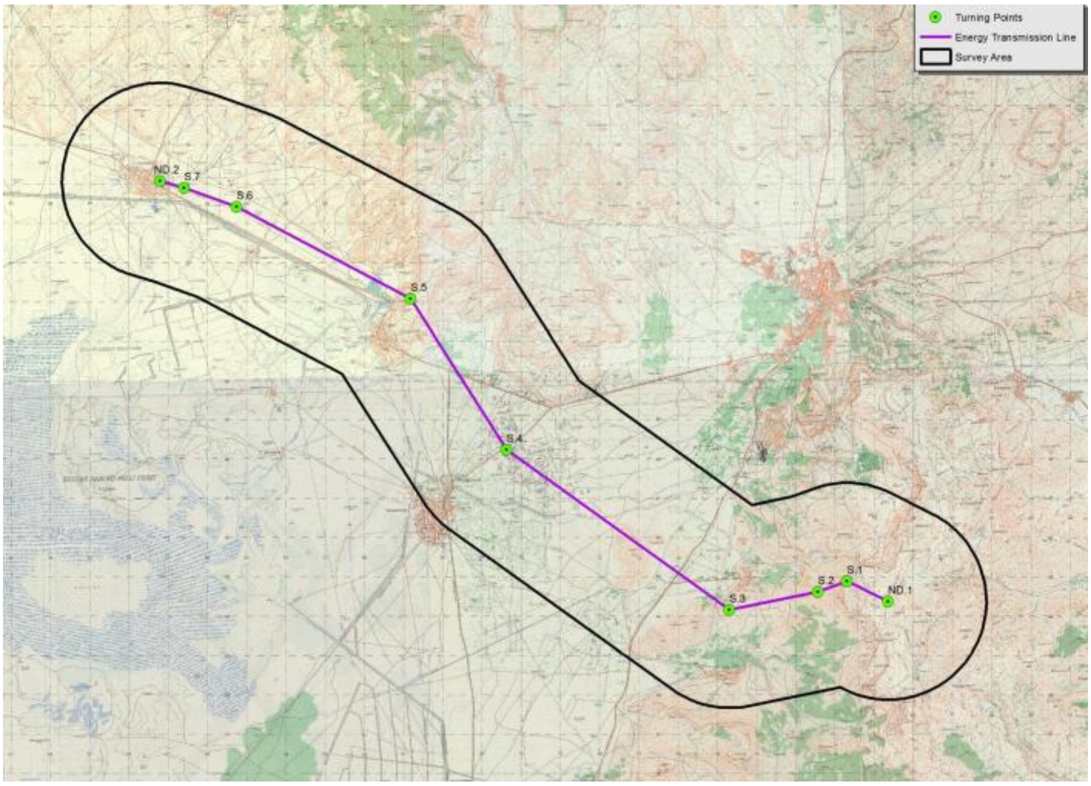
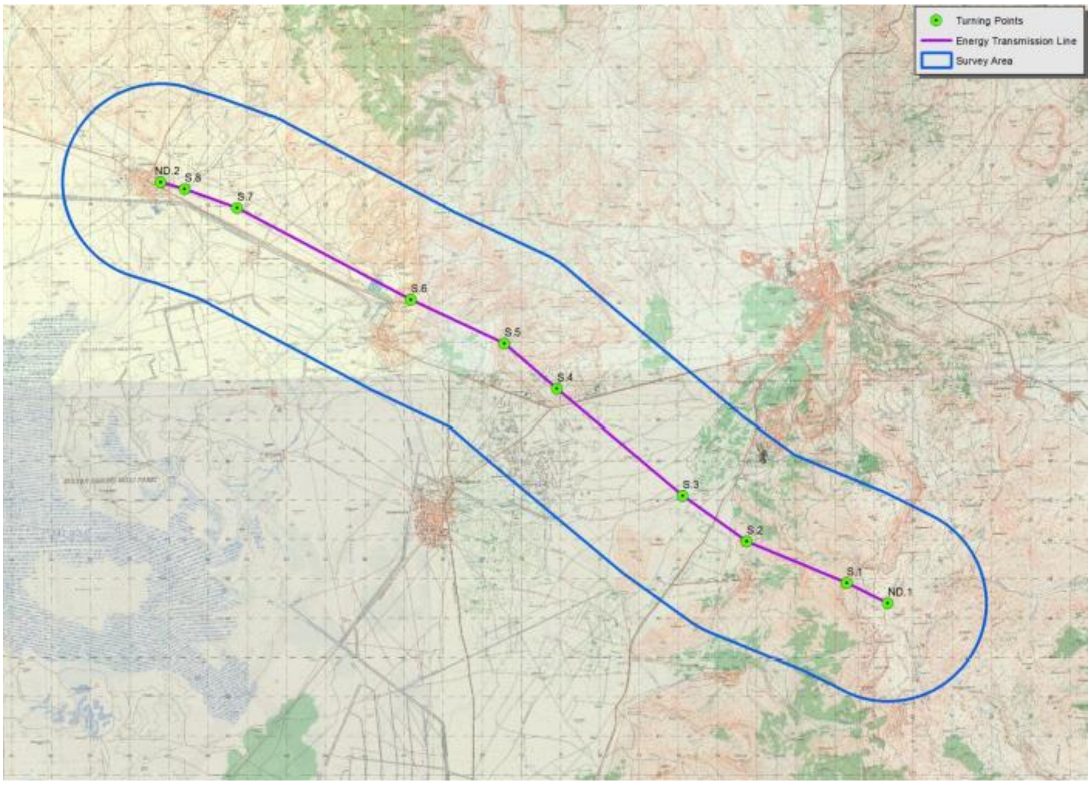


Figure 4-10: Alternative 2 Sendiremeke substation to Project site



Selin visited a number of institutions to collect data and also undertook site visits. The Preliminary Study Report considers a 3 km study area and considers environmental and ecological concerns; topographical constraints; land ownership constraints; local authority concerns; and technical requirements to construct and operate the powerline. A comparison of the two alternative routes taken from the Selin Preliminary Study Report is provided in Table 4-11 below.

Table 4-11: Powerline route alternatives evaluation

Subject	Alternative 1	Alternative 2
Archaeological Sites	No archaeological sites along route. 6 archaeological sites in the survey area.	No archaeological sites along route. 8 archaeological sites in the survey area.
Natural Protected Areas (Wetlands, Wildlife Development Area, National Parks, Natural Monuments etc.)	The route survey areas both pass over Sultan Sazlığı wetland.	
Tourism Areas	No tourism areas.	There is a tourism facility area and ecotourism area in the survey area, located approximately 2 km away from the route.
Agricultural areas	The routes both pass over rain-fed and irrigated agricultural areas.	
Consolidation (agricultural) areas	The routes both pass over consolidation project areas of Tombak, Sindelhöyük, Soysallı, Çayırözü and Güneyaşağı Villages.	
Forest areas	The routes do not pass over forest areas.	
Surface water resources	There are rivers crossing both routes and in their survey areas.	
Dams/Ponds, Small Lakes, Weir and HEPPs	There are no hydraulic projects near either route.	
The licensed areas by Energy Market Regulatory Authority	There are not any licensed areas (power plant areas).	
Settlement areas	Both routes pass over 3 settlement units of Çayırözü Village	
Urban Development Area	The route passes over urban development area between turning points S.4 –S.5.	There is not any urban development area on the route and in its survey area.
Organized Stockbreeding Area	There is no organized stockbreeding area on the route and in its survey area.	The route passes over an organized stockbreeding area between turning points S.4 –S.5.
Organized Industrial Zones/Areas	There are not any Organized Industrial Zones/ Industrial Areas.	
Radar stations	There are no radar stations.	
Transmission Lines	There is a154 kV Energy Transmission Line and 380 kV Energy Transmission Line in the survey areas of both routes.	
Natural gas/Crude oil Pipelines	There are no pipelines.	
Roads and railways	The routes both pass over existing and a planned highway. There are not any planned or existing railways on the either routes and in their survey areas.	
Irrigation channels	The route passes over an irrigation channel.	There are not any irrigation channels on the route and in its survey area.

Alternative 1 is longer than Alternative 2; however it was also assessed as having the following advantages:

- Alternative 1 is further away from Develi and will therefore be less likely to be affected future development of the city.

- Alternative 1 (from the starting of the S4) is parallel to an existing powerline. Therefore maintenance can be done concurrently.
- The permissions of the existing powerlines provide a model for the proposed Alternative-1 route.

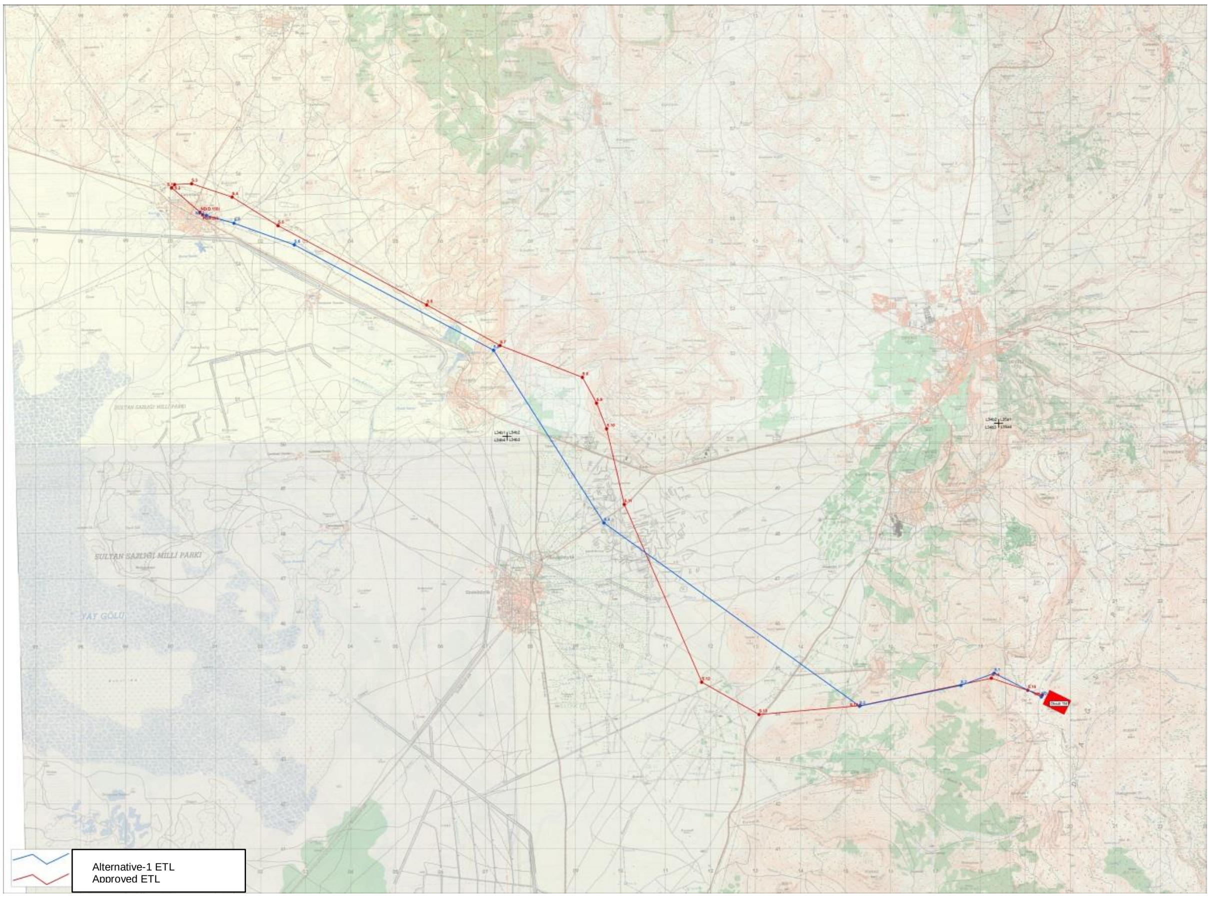
Alternative 1 was chosen as the preferred route as it was considered to have less land use impacts or the potential for impacts to future development.

TEİAŞ experts then visited the powerline route and implemented the following changes to revise the route:

- The feeder direction of Sendiremeke Substation is positioned to the northwest. The starting direction was changed and 4 new poles (S1, S2, S3, and S4 of revised route) were added to the route for providing connection of the route to the substation.
- The revised route was relocated to the north to move it as far as possible from the Sultan Sazlığı National Park whilst sustaining parallelism to the existing powerlines.
- The S4 and S5 poles were routed around an orchard and settlements.

The comparison map of Alternative 1 and the revised route is provided in Figure 4-11. The revised route was approved by TEİAŞ on 29.10.2015 and Selin started the national EIA process in October 2015. The project application folder was submitted to the MoEU on 16.11.2015.

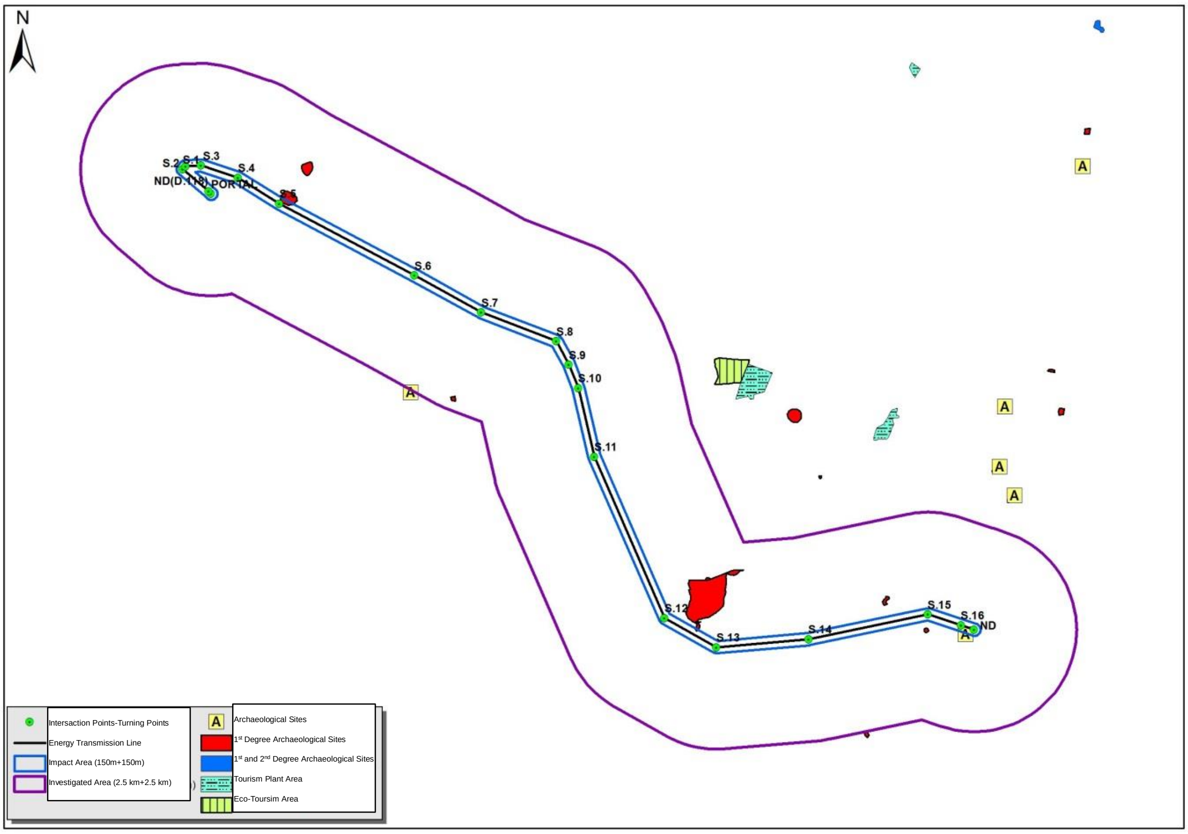
Figure 4-11: The Comparison Map of Alternative-1 and the Approved Route



The MoEU appointed Commission Members, who defined the national EIA format and visited the powerline site. The Kayseri Directorate of Regional Cultural Heritage Protection Board (RCHPB) is a Commission Member and pointed out an unregistered archaeological site (1st degree) on the approved route and requested that the route was revised. TEİAŞ experts rerouted the approved route to the south to avoid the unregistered archaeological site and the 2nd revised route (Figure 4-12) was approved by TEİAŞ on 03.12.2015.

A public participation meeting was undertaken in December 2015 and the EIA Report was submitted to the MoEU in February 2016.

Figure 4-12: Revised Powerline Route



4.9 Access Road Alternatives

The Project Area is located at an elevation of approximately 1,800 m, in an area of high relief with mountains and valleys. In the valleys below, the mine site is located near to the villages of Öksüt approximately four kilometres south-southeast, Zile approximately 4 km to the east, the town of Develi approximately 10 km north-northwest, and the village of Epçe approximately 10 km east. The existing roads in the region are located in the adjacent valleys and are generally paved and well maintained.

During the exploration phase a small agricultural track from the village of Zile and a service track from Yukarı Develi have been used to provide access to the mine site. Apart from use as service roads to enable access for pre-construction activities, these roads are not suitable for access to the Project site during construction and operations. The track from Zile has been hazardous and inaccessible during periods in the winter.

OMAS has evaluated other potential access routes to the Project site based on a number of criteria:

- Length of new road construction required;
- Direct access to the national road network;
- Gentle slope angles;
- Minimum number of bends on the access road (required for steep slopes to reduce road angles);
- Maximum attention not to pass through privately owned lands;

- Minimum disruption to existing land use.

Due to physical constraints (in that there were no feasible routes to the west), the main access route orientation was selected as the “east access”.

A number of different options were considered along the Develi-Taşçi Road:

- At the northern end of the road, close to the junction with the Develi-Tomarza Road;
- Between the northern end of the road and Yazıbaşı;
- Close to the village of Epçe.

Advantages and disadvantages of these options are set out below.

Table 4-12: “Eastern” Access Road Options

Route Option	Advantages	Disadvantages
Northern End	▪ Close to major transport route ▪ Avoids passing through local villages	▪ Disrupts access to farmland and pastureland ▪ Steep road slopes to access Project site ▪ Significant cut and fill required ▪ Significant new road length requiring construction (>15 km)
Yazıbaşı	▪ Relatively close to major transport route (3 km)	▪ Requires use of existing local road ▪ Disrupts access to farmland and pastureland ▪ Steep road slopes to access Project site ▪ Significant cut and fill required ▪ Significant new road length requiring construction (>10 km)
Epçe	▪ Some distance from major transport route (10 km) ▪ Limited slopes to access Project site ▪ Can be co-located with water supply pipeline from Epçe ▪ Minimises new road construction length (8.2 km)	▪ Requires use of existing local road passing through local villages ▪ Disrupts access to farmland and pastureland

The access route adjacent to Epçe was considered to be the “best” option in terms of ease of access to the Project site in terms of minimising the road length to be constructed and minimising road gradients. However, it was considered unacceptable for Project traffic to travel through the small villages of Yazıbaşı and Gömedi. The solution was to build a 6.7 km long bypass road to the west of the villages for Project traffic, as shown in Figure 4-11 below.

Additional feasibility studies identified that the Project would need to update the existing public road between Gömedi and Epçe. Cadastral surveys showed that this upgrade would impact private land parcels adjacent to the public road. OMAS re-routed the access road so that the preferred route runs parallel to the existing public road, but on pastureland, for which a permit can be sought and therefore reducing impacts to private land owners. The pastureland permit corridor along the preferred access road route is shown in Figure 4-14.

Throughout the access road route selection process, OMAS has undertaken consultation and engagement with *muhtar’s* and residents of Yazıbaşı, Gömedi and Epçe. Further information is provided in *Chapter 6: Stakeholder Consultation and Engagement*.

Figure 4-13: First plans for Access Road and Bypass

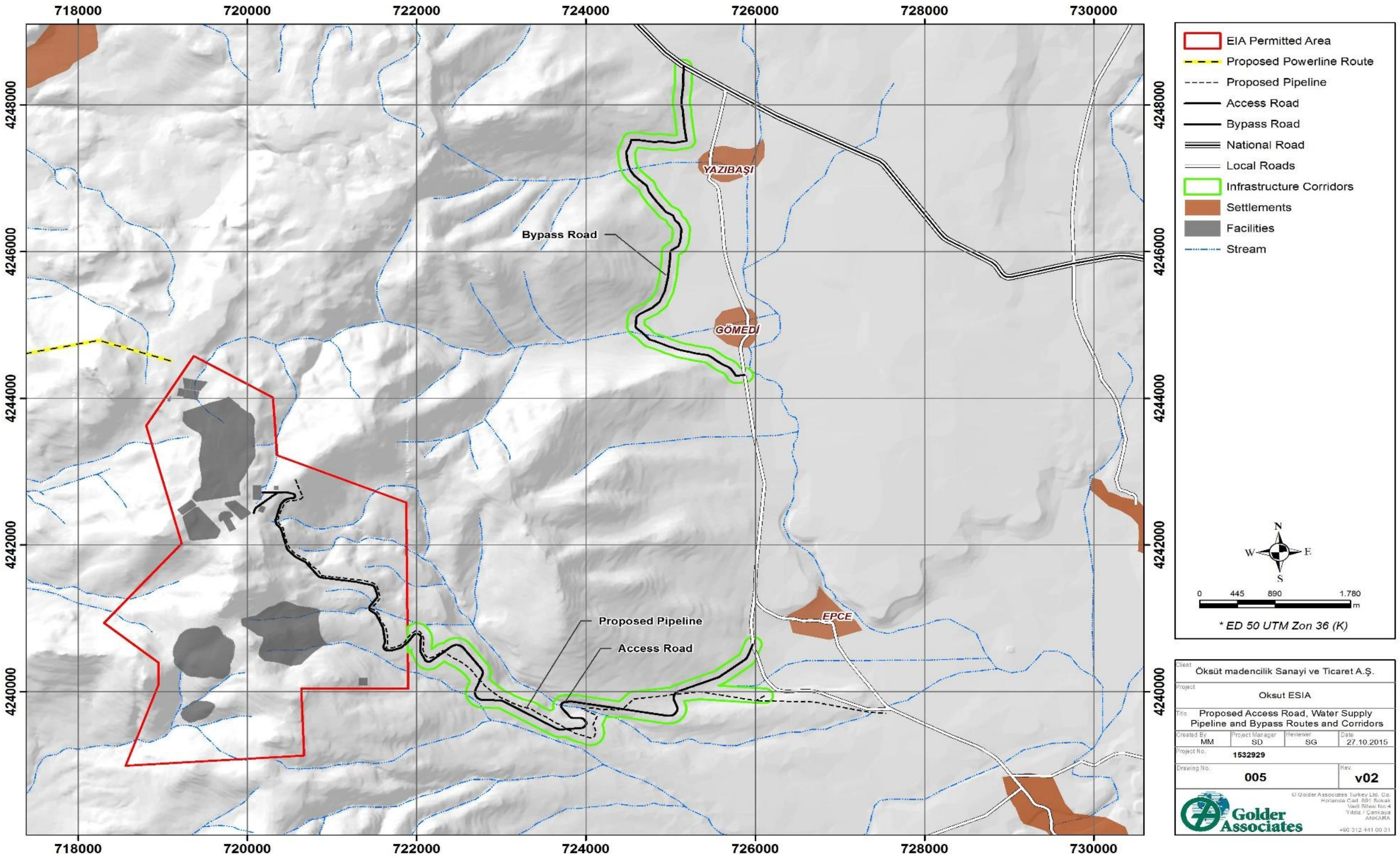


Figure 4-14: Access Road Preferred Route