ACACIA MINE OPERATIONS
GÖKIRMAK COPPER MINE
Preliminary Mine Closure Plan
2017

Document Number	**ACACIA-2017-E&S-AECOM-PLN-204**
Disclosure Date	**29.09.2017**
Prepared By	**Environment & Social Department, AECOM Consultant**

Table of Contents

Figures

Tables

1. Scope and Purpose

Preliminary Mine Closure Plan ("Closure Plan") has been prepared to provide a framework for sustainable closure of the Gökırmak Copper Mine. The closure scenarios included in this plan are based on the field and desktop work done during the baseline and modeling studies within the scope of the Environmental and Social Impact Assessment (ESIA) studies.

This Plan discusses main performance goals and an implementation schedule applicable to interim closure of the Project. It explains how reclamation cost calculation was made and how often should this plan updated.

Acacia Maden İşletmeleri ("AMI") expects to rehabilitate disturbed areas within the Gökırmak Copper Project ("GCP") area ("Project Area") to a level suitable for the land-use options discussed in this section. The closure plan will use acceptable technologies and methodologies suited to the West Black Sea region of Turkey, where the Project Area is located.

As a matter of fact, reclamation practices, technologies, and methodologies are and will continue to subject to change. Reclamation practices are under constant investigation by government, industry and public. Therefore reclamation plans must be, within the context of existing regulations, dynamic and capable of changing with the input of new information, ideas and techniques.

This section provides general information on how AMI expects the Project Area will be rehabilitated. Prior to actual mine closure, this plan and estimated rehabilitation costs should be revised based on the actual conditions and legal requirements that exist at that time.

When practical, reclamation work will start during the operation of the mine and process plant, however, final reclamation will commence immediately and completed within two – three years of permanent cessation of mining and milling operations where affected land cannot practicable to be reclaimed concurrently.

Following reports have been reviewed in order to compile information with regard to technical aspects of the closure objectives for the GCP.

- Gökırmak Copper Project - Hydrogeological Impact Assessment Final Report (AECOM, July 2017),
- Gökırmak Copper Project – ESIA Disclosure Package Vol-I: Environmental Impact Assessment Report (AECOM, May 2017),
- Gökırmak Copper Project – ESIA Disclosure Package Vol-II: Social Impact Assessment Report (SRM, May 2017),
- Results of Mass Balance / PHREEQC Modeling of the Open Pit Sump and Lake at the Gökırmak Copper Project, Kastamonu, Turkey (Geochemico, July 2017),
- Results of Mass Balance / PHREEQC Modeling of the Waste Rock Dump at the Gökırmak Copper Project, Kastamonu, Turkey (Geochemico, May 2017),
- PHREEQC Modeling of the Kepezkaya Tailings Storage Facility Seepage at the Gökırmak Copper Project, Kastamonu, Turkey (Geochemico, June 2017),
- ARD/ML Characterization of Rock Samples By Static Testing, Gökırmak Copper Project, Kastamonu (Geochemico, December 2016),
- Final Report on Geochemical Characterization by Kinetic Testing of Lithologies at the Gökırmak Copper Project, Kastamonu, Turkey (Geochemico, December 2016).
- Gökırmak Copper Project – Feasibility Study (Acacia Maden İşletmeleri AŞ, June 2017).

2. Description of the Project Area

2.1 Project Overview

The mine site lies within the boundaries of Hanönü District which is located at an air distance of 50 km east of the Kastamonu Province. The mine will be operated as an open pit, where the ore will be excavated, crushed and milled, then will be concentrated with flotation process to produce copper concentrate.

The Project has an estimated operation phase of 12 years and 4 months (including top soil stripping and mine production). The resource is reported as 24.45 Mt at an average 1.64% Cu. At a cut-off grade of 0.3% Cu, of the 24.45 Mt, measured resource is 3.33 Mt at 2.04% Cu or 68,000 tons of Cu, indicated resource is 20.34 Mt at 1.58% Cu or 321,000 tons of Cu and inferred resources is 0.78 Mt at 1.7% Cu or 13,000 tons of Cu.

The 122.5 million LCM waste rock (with the swell factor in consideration) generated during the lifetime of the Project as a result of stripping operations is planned to be stored at the Çorakoğlu WRD. The WRD is planned towards North of the pit, in close proximity since the main criteria for site selection of the waste rock dump areas is minimization of impacts caused by haulage distance such as extent of topography alteration and air emissions, as well as economic factors associated with fuel consumption and time. Çorakoğlu WRD will cover approximately 119.59 ha area and the haulage distance from the pit to this area will be approximately 2 km in average (Figure 2-1).

The tailings from the Process Plant will be deposited within two Tailing Storage Facilities (TSFs), which are located on the north side of the Gökırmak River. The Kepezkaya TSF will be located approximately 1.5 km northeast of the Hanönü town center while the Bağdere TSF is located about 2 km southeast of the town center. The Kepezkaya TSF has a capacity of 5 million m^3 which will operate during the first 5 years of the Project whereas the Bağdere TSF has a capacity of 8 million m^3 and will operate in the remainder of the Project's life. Both TSFs will be lined with clay and a geomembrane, and equipped with decant and leachate collection systems. The Project includes the following project units (Figure 2-1).

- Open Pit;
- Çorakoğlu Waste Rock Dump;
- Process Plant;
- Kepezkaya Tailings Storage Facility;
- Bağdere Tailings Storage Facility;
- Gökırmak River Diversion System; and
- Other auxiliary facilities (administrative buildings, explosive magazine, etc.).

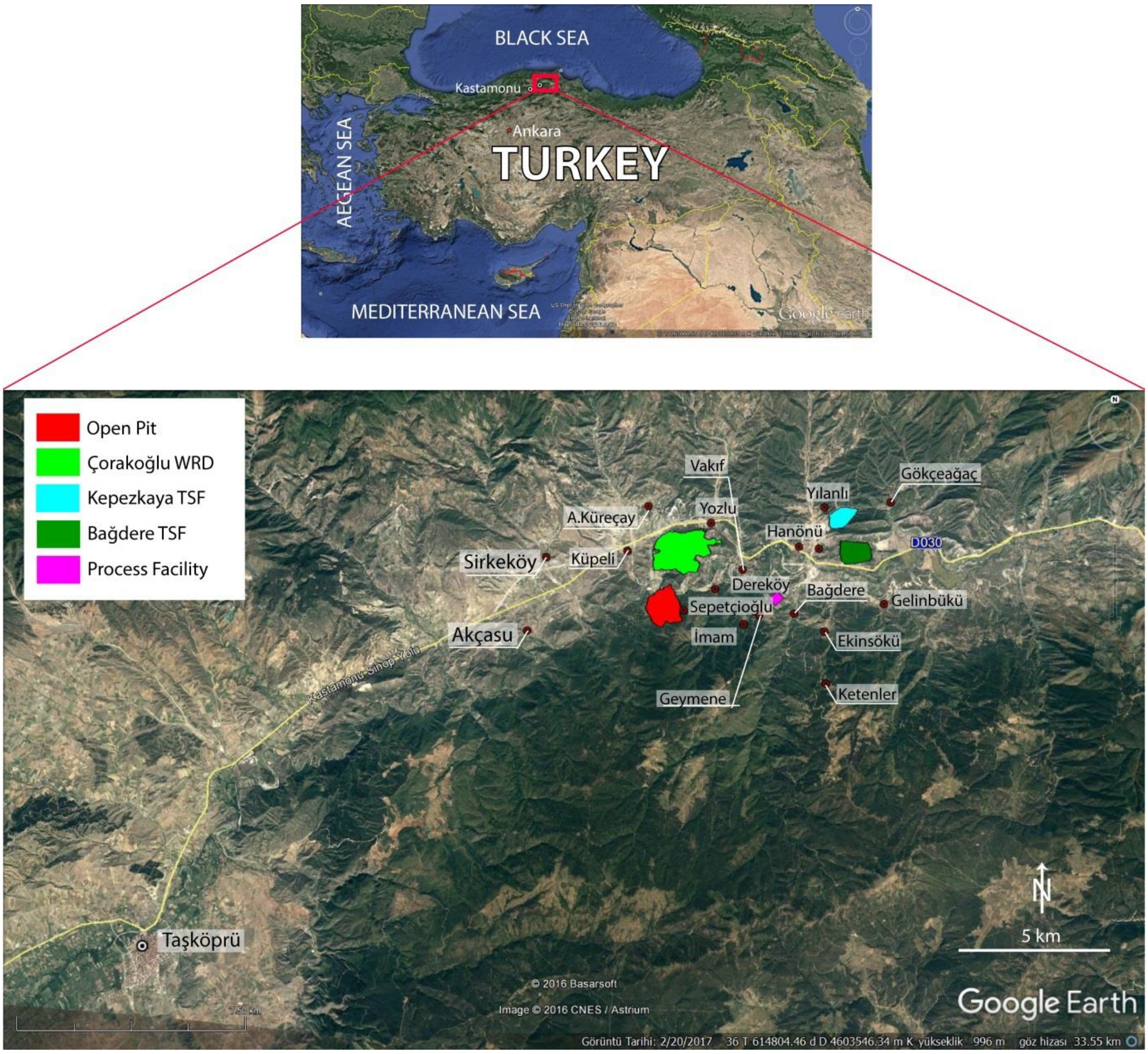


Figure 2-1 Layout of Project Units

2.2 Topography

The study area is located on a steep and undulating topography with an altitude ranging from 350 m at the eastern part around the Gökırmak River to 1799 m at the northern part of the study area. The altitude of the project units range from 880 m to 430 m in the Open Pit, 620 m to 436 m in the Çorakoğlu WRD, 602 m to 452 m in the Kepezkaya TSF, 530 m to 411 m in the Bağdere TSF, and 660 m to 528 m in the Process Plant area.

2.3 Population Characteristics

An extensive social impact assessment (SIA) study has been carried out by SRM to identify the current social status of the region. Based on the assessment report (SRM, 2016), the population growth rate of the province is greater than the Turkish average. Yet, the net migration rate of 11.6 per mille indicates that there is a tendency of migration from the province. The population density is around 1/3 of the national average.

As of 2014, Kastamonu province’s population was 368,907. With its population of 3,976, Hanönü comprises approximately 1% of the province, while Taşköprü comprises around 11% with a population of 38,775.

According to TUIK’s Address-Based Population Registration System data, the total population of 5 affected residential areas in 2014 was 2,232. The area with the largest population size among these areas was the central neighborhood of Hanönü with a population of 1,717. The total population of 7 residential areas neighboring these areas was 656, whereas the population of the remaining 11 residential areas in Hanönü district was 1,101.

All 4 neighborhoods (Vakıf, Geymene, Hanönü central and Gelinbükü) in the district center have water supply network. Bağdere village is connected to the water supply network as well. Gökçeağaç village, on the other hand, has a 50-tonne water reservoir. The village is connected to water supply network. Küreçayı also has a 50-tonne water reservoir. The mukhtar pointed out that they chlorinate the reservoirs themselves. The village is connected to water supply network.

2.4 Climate and Meteorology

The Project Area being located in the eastern part of the Kastamonu province is influenced by continental climate of Central Anatolia and mild and rainy climate of Black Sea region. The area is characterized by rainy seasons throughout the year, with cold and snowy winters and mild summers.

Long term meteorological data is required in order to determine meteorological characteristics in the Project Area. A series of meteorological stations collecting long term data have been established by the State Meteorological Organization (DMI) at Kastamonu, Devrekani, Taşköprü and Hanönü/Gökçeağaç. The closest meteorological station to the Project Area in operation is the Devrekani Meteorological Station, which is located approximately 50 km west of the area. In 2014, an automated meteorological station was established in Taşköprü region (station id: 18522) by DMI, but as representing the data of a relatively short operation period. Thereby, the measurements recorded at this station were not considered within the scope of this study. A site specific weather observation station was established in the Project Area on December 16, 2015. The station started data collection on December 18, 2015 and has so far been measuring meteorological data at 15-minute intervals.

Figure 2-2 shows the locations of the meteorological stations around the Project Area while Table 2-1 provides the basic information for the stations.

Figure 2-2 Location of the Meteorological Stations

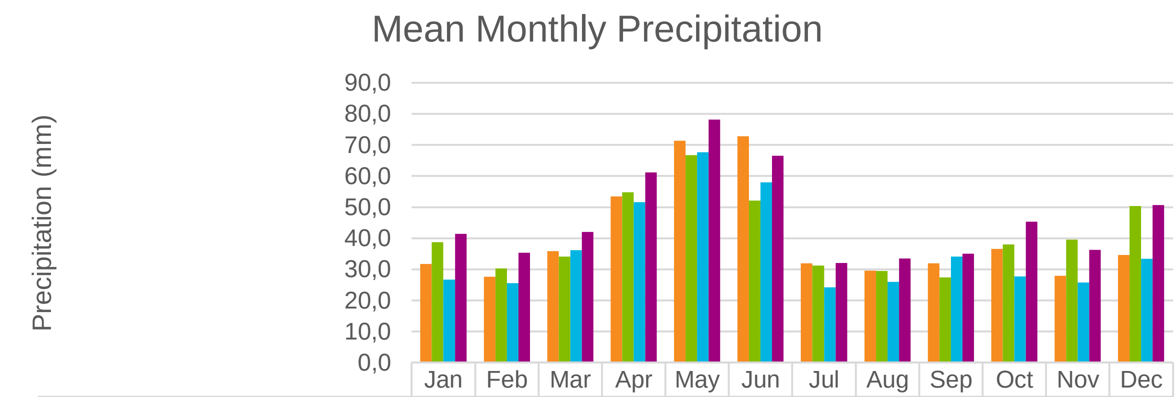
Table 2-1 Information about Meteorological Stations

Station ID	Station Name	Organization	Elevation (m)	Operating Period	Coordinates (UTM)	
					Easting	Northing
17074	Kastamonu	DMİ	800	1950 - present	564862.27	4580233.08
672	Gökçeağaç (Hanönü)	DMİ	475	1968 - 1984	622162.24	4610105.84
729	Taşköprü	DMİ	520	1955 – 1980 2012 - present	602043.30	4594341.64
17618	Devrekani	DMİ	1050	1965 - present	569543.16	4605658.08
001	Acacia Station	Acacia Maden	540	2015-present	617687.46	4608195.34

2.4.1 Precipitation

In order to assess the precipitation characteristics around the Project Area, meteorological stations having long-term data, namely, Kastamonu, Gökçeağaç, Taşköprü and Devrekani stations, were used. The precipitation measurements at these stations were conducted for the period of 1950-2015 for Kastamonu, 1968-1994 for Hanönü, 1956-1980 for Taşköprü and 1965-2011 for Devrekani station.

The calculated mean annual precipitation values for Kastamonu, Gökçeağaç, Taşköprü and Devrekani stations are 484.95 mm, 448.4 mm, 450.44 mm and 539.30 mm, respectively. Mean monthly precipitation values measured in these stations are given in Figure 2-3. According to Figure 2-3, measured precipitation values show seasonal variations, where maximum mean precipitation occurs in April to June, and minimum mean precipitation occurs in summer.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
17074-Kastamonu Station	31,7	27,7	35,8	53,5	71,4	72,8	32,0	29,6	31,9	36,6	27,9	34,6
672-Hanönü/Gökçeağaç Station	38,7	30,3	34,1	54,8	66,8	52,1	31,2	29,4	27,4	38,0	39,6	50,4
729-Taşköprü Station	26,7	25,6	36,2	51,6	67,7	58,0	24,2	26,0	34,2	27,8	25,7	33,4
18522-Devrekani Station	41,5	35,3	42,0	61,2	78,2	66,6	32,1	33,5	35,1	45,3	36,3	50,7

Figure 2-3 Mean Monthly Precipitation Values Measured In the Meteorological Stations

2.4.2 Temperature

The long-term temperature values were recorded at the Kastamonu and Devrekani meteorological stations. The distribution of the mean monthly temperature values measured at these stations is given in Figure 2-4. As seen from this figure, temperatures show seasonal variations. The minimum monthly temperatures are below 0°C and observed in winter, while maximum monthly temperatures are approximately 15 - 20°C and observed in summer.

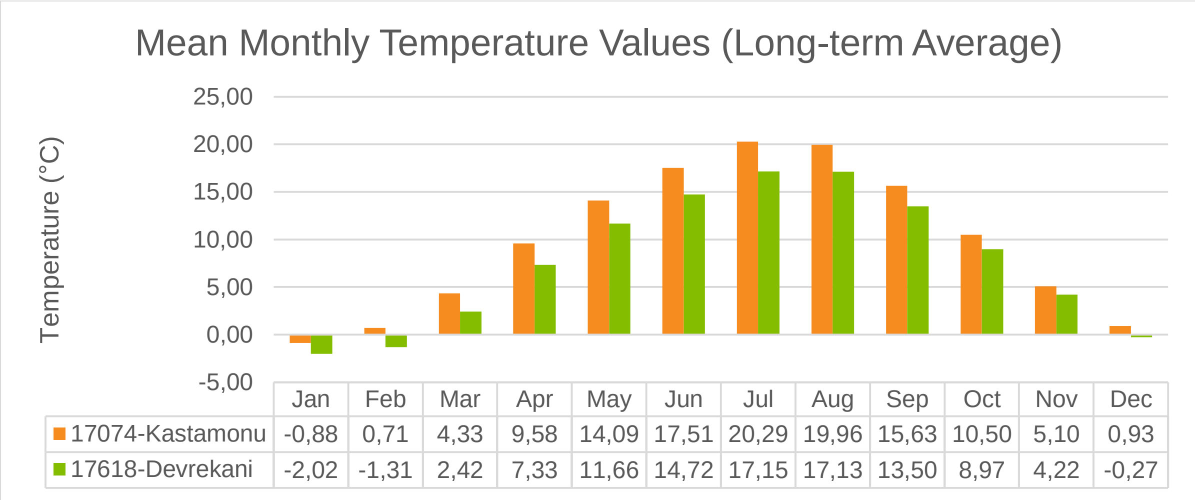


Figure 2-4 Distribution of Long Term Mean Monthly Temperature Values

2.4.3 Relative Humidity

The monthly average values of relative humidity were measured at the Kastamonu and Devrekani meteorological stations (Figure 2-5). The average relative humidity values vary between % 60 - 65 in July and August, and % 80 in January and December.

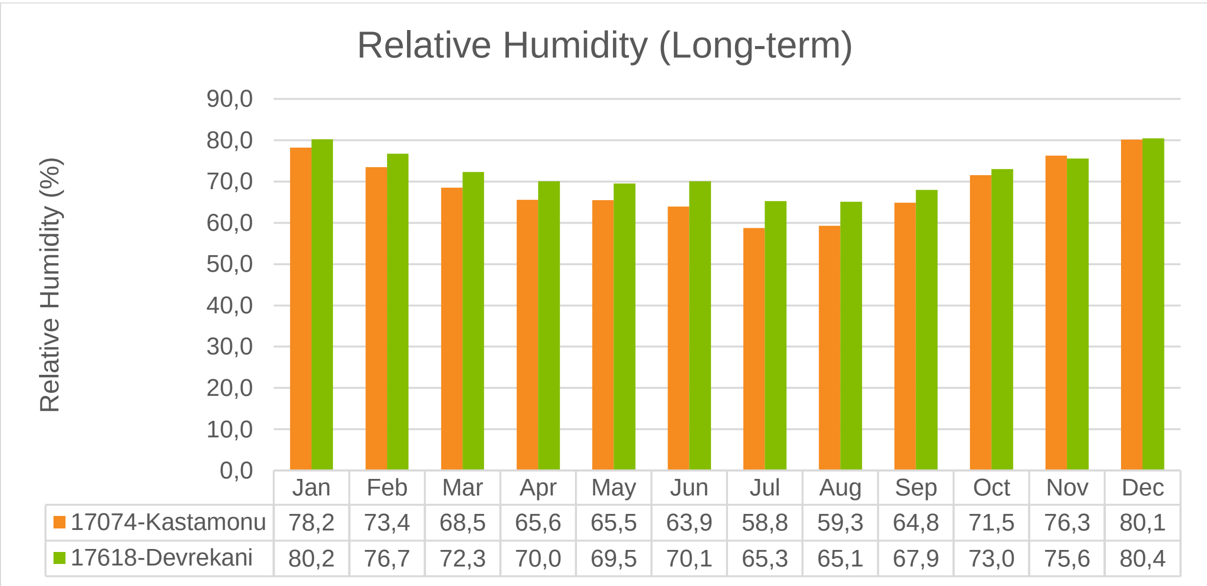


Figure 2-5 Distribution of Mean Monthly Relative Humidity Values

2.4.4 Evaporation

The evaporation values were measured at the Kastamonu and Devrekani meteorological stations (Figure 2-5) for the period of 1950 – 2016 (where 1955-1957 and 1966 is missing) and 1981 – 2011, respectively. These stations record evaporation data for the period between April and October. Hence evaporation data is generally missing for November – March period. The monthly average evaporation values measured at these stations are shown in Figure 2-6. As seen from this figure, evaporation values vary seasonally; maximum and minimum monthly evaporation values are observed in July and October, respectively.

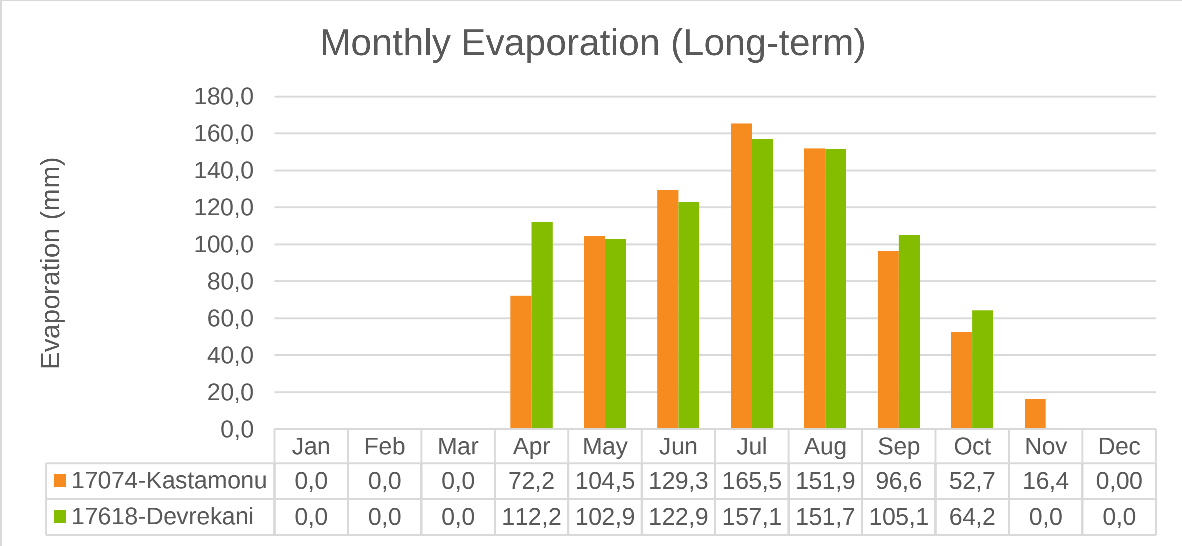


Figure 2-6 Distribution of Long-Term Average Monthly Evaporation Values

2.5 Geology

The geology of the study area was obtained from 1:25000 scaled geological map prepared by General Directorate of Mineral Research and Exploration (MTA), and discussions on the regional and local geology was derived from geological reports prepared by Acacia (AMI, 2013) as well as geological booklet prepared by MTA (MTA, 2007).

2.5.1 Regional Geology

The study area consists of igneous, metamorphic and sedimentary rock units whose ages range between Mesozoic-Quaternary. Among these, pre-Upper Jurassic igneous and metamorphic lithologies form the basement rocks of the study area, whereas the post-Upper Jurassic sedimentary and volcanic rocks constitute the cover units overlying the basement rocks. The geological map of the study area is given in Figure 2-7, whereas the generalized columnar section is shown in Figure 2-8.

2.5.1.1 Stratigraphy

Elekdağ Metaophiolite

The Elekdağ Metaophiolite is mainly characterized by eclogite, serpentinized ultramafics, gabbro, diabase, basalt and pelagic sedimentary rocks. The Elekdağ Ophiolite consists of, at the bottom, ultramafic tectonites characterized by peridotites composed predominantly of olivine and pyroxene. Towards upper levels, the degree of serpentinization increases, which lead to the occurrence of serpentinites.

Bekirli Formation

The Bekirli Formation is mainly characterized by phyllite, pelitic schist, paragneiss and calc-schist, marble, metaserpentine, metadiabase, meta-gabbro and metachert blocks embedded in the metaclastics. The formation includes at the bottom quartz- and mica-rich phyllite, metasiltstone and metasandtone. The Bekirli Formation tectonically overlies the Elekdağ Metaophiolite. It is conformably overlain by the Akgöl Formation.

Akgöl Formation

The Akgöl Formation consists mainly of slate, phyllite, shale and sandstone. The formation includes at the bottom black shales which passes upwards an alternation of shale-siltsone-sandstone. These lithologies pass to clayey limestone and micritic limestone at the upper levels of the formation. The shales are blackish and very fine-grained. The clayey limestone and micritic limestone, on the otherhand, form rigid lithologies and they occur as blackish, thin-bedded lithologies. The age of Akgöl Formation can be regarded as Triassic-Liassic based on the fossil content of the formation and cross-cutting relationship with the Kastamonu Granitoid.

Kastamonu Granitoid

The granitoid is characterized by igneous rocks of variable composition including granite, granodiorite and tonalite. These rocks generally form a rough topography, although they exhibit a gentle morphology where the weathering is intense. These igneous rocks occur as whitish, pinkish-colored, generally fine- to medium-grained bodies and display equigranular and porphyritic textures. The age of granitoid can be regarded as Middle Jurassic on the basis of cross-cutting relationship, stratigraphic position and radiometric age dating.

Bürnük Formation

The Bürnük Formation is mainly characterized by alternation of conglomerate, sandstone and mudstone. The formation displays a reddish appearance in general. The clasts appear to have been derived from metamorphics, ophiolite, spilitic basalt, quartzite and shale. The conglomerates are poorly sorted and well-rounded. Bedding is not apparent. The age of Bürnük Formation can be regarded as Upper Jurassic based on the fossil content and stratigraphic position.

İnaltı Formation

The İnaltı Formation is chiefly composed of neritic limestone. The formation includes, at the bottom, whitish to grey, mostly thick-bedded recrystallized limestones with abundant calcite veins. These lithologies pass upwards to grey- to dark-grey colored, generally medium-bedded limestones with shale intercalations. The age of the İnaltı Formation can be regarded as Upper Jurassic-Lower Cretaceous based on the fossil content of the unit.

Ulus Formation

The Ulus Formation is mainly characterized by shale, siltstone, sandstone and subordinate conglomerate. The sandstones occur as brownish to grey, medium- to thick-bedded lithologies, whereas the shales and siltstones form grey-colored, thin-bedded layers. The lower levels of the formation comprise gravel-sized clasts derived from the İnaltı Formation. The age of the Ulus Formation is Lower Cretaceous based on the fossil content and stratigraphic position.

Kapanboğazı Formation

The Kapanboğazı Formation is mainly composed of thin- to medium-bedded clayey limestone, micritic limestone, cherty limestone and chert. The Kapanboğazı Formation conformably overlies the Ulus Formation. The age of the formation can be regarded as Upper Cretaceous based on the fossil content.

Cankurtaran Formation

The Cankurtaran Formation is characterized by alternation of claystone, siltstone, sandstone, sandy limestone and conglomerate with limestone blocks and volcanic intercalations. The volcanics, which are mainly observed at the lower parts of the formation, are differentiated as “the volcanic member”. The Cankurtaran Formation is chiefly composed of brownish to greenish, thin- to medium bedded claystone, sandstone and clayey limestone. The age of Cankurtaran Formation can be regarded as the Campanian-Maastrichtian based on the fossil content.

Akveren Formation

The Akveren Formation consists mainly of limestone, clayey limestone, marl, claystone, siltstone and sandstone with volcanic intercalations. The limestone beds occurring at the upper levels of the formation contain cherts. The Akveren Formation conformably overlies the Cankurtaran Formation and passes gradually to the Atbaşı Formation at the top. The age of Akveren Formation can be regarded as Maastrichtian-Lower Paleocene based on the fossil content.

Atbaşı Formation

The Atbaşı Formation is mainly composed of marl and shale with limestone intercalations. The formation starts with alternation of burgundy-colored, thin-bedded marl and beige-colored, thin- to medium-bedded sandstone, which is followed by thick-bedded reddish brown marl. The upper levels of the formation consist of alternation of medium- to thick-bedded marl and brownish, thin-bedded sandstone. The Atbaşı formation rests conformably over the Akveren Formation and passes gradually to the Kusuri Formation at the top. The age of Atbaşı Formation can be regarded as upper Paleocene-lower Eocene based on the fossil content of the formation.

Kusuri Formation

The Kusuri Formation is characterized by alternation of marl, sandstone and limestone. The formation is mainly composed of brownish to greenish, thin- to medium-bedded shale-marl-sandstone alternation. The lower levels of the formation contain wedges and lenses of conglomerate-sandstone alternation. The Kusuri Formation conformably overlies the Atbaşı Formation. It is unconformably overlain by the Sinop Formation. The age of Kusuri Formation can be regarded as middle Eocene based on the fossil content of the formation.

Sakızdağı Formation

The Sakızdağı Formation is chiefly composed of alternation of mudstone, sandstone and conglomerate. The formation includes at the bottom, alternation of reddish mudstone and yellowish brown conglomerate, conglomeratic sandstone, sandstone and claystone. These lithologies pass to whitish to greenish marl, claystone and siltstone upwards in the sequence. These parts contain thin gypsum and coal layers. The Sakızdağı Formation unconformably overlies the Atbaşı, Cankurtaran and Kapanboğazı Formations. The age of the formation can be regarded as upper Oligocene-Miocene based on the stratigraphic position.

Alluvium

The unit consists of deposits of meandering and braided river and flood plain and mainly deposited along the river channel.

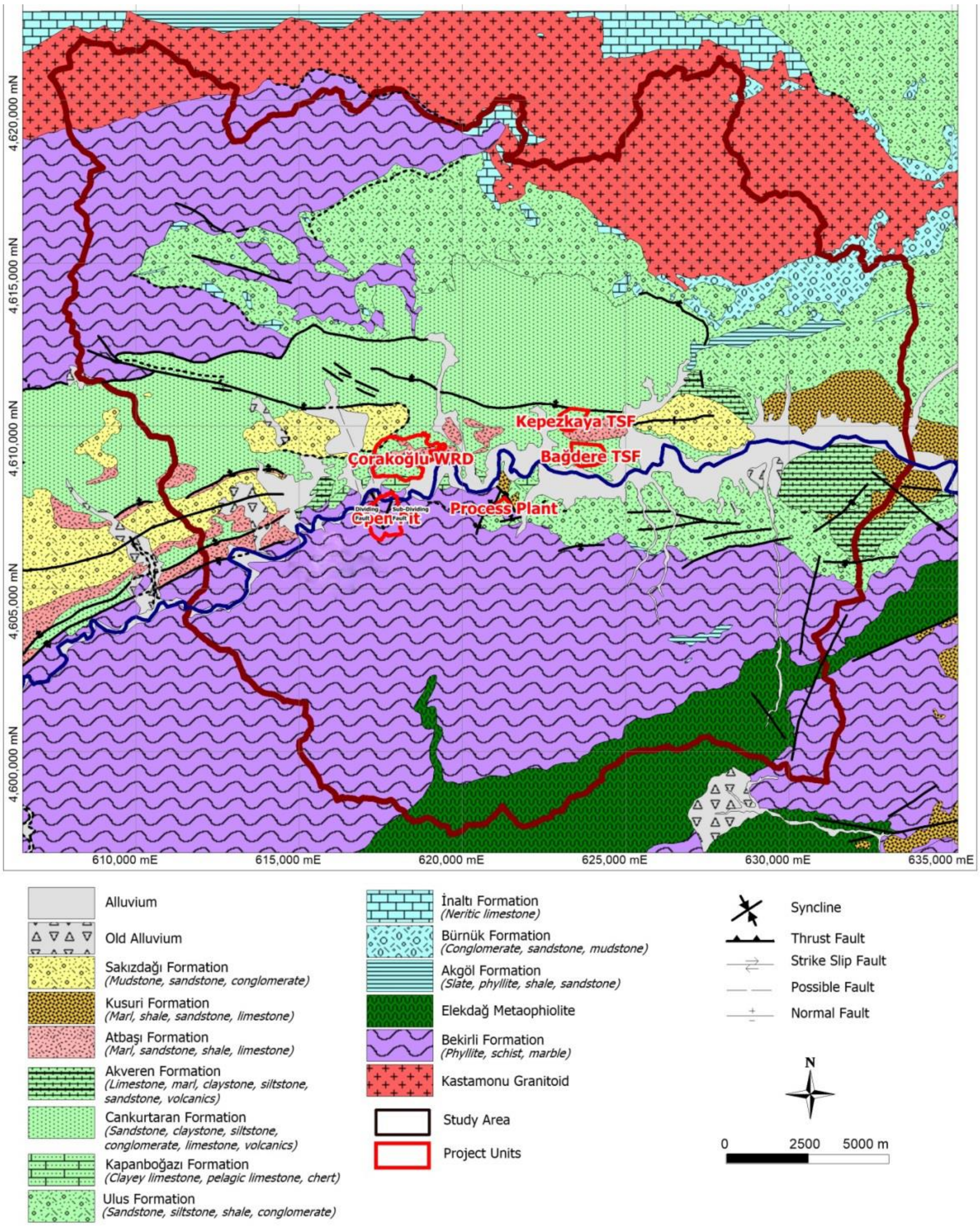


Figure 2-7 Geological Map of the Study Area (revised from MTA)

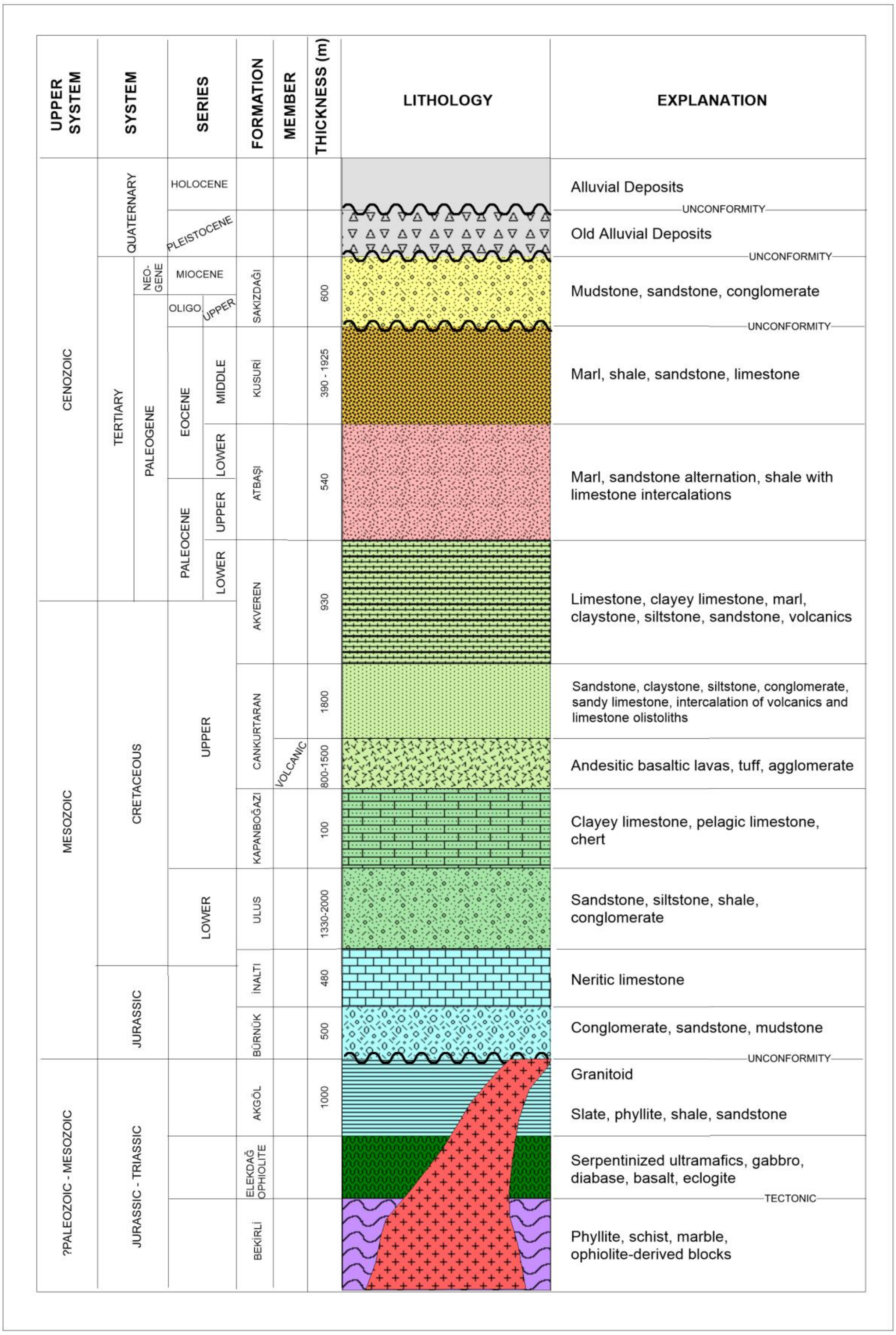


Figure 2-8 Generalized columnar section of the study area (modified from Uğuz and Sevin, 2007)

2.5.1.2 Regional Structural Features

According to Okay et al., (2006), the location of the license area is within the Çangaldağ-Complex. The intrusion by the Jurassic granites put a constraint to its age. Okay et al., (2006) describes the unit as a northward dipping tectonic slice with a true thickness of approximately 5 km. It is bounded to the south by a 50°–60° northward dipping shear zone (the Acısu Fault) as shown in Figure 2-9. The Acısu Fault is interpreted to be a normal fault which was reactivated during the Cretaceous Period as a thrust fault. North of the Gökırmak valley, the Çangaldağ-Complex is bordered by Maastrichtian to Eocene sediments which form the Gökırmak fold and thrust belt.

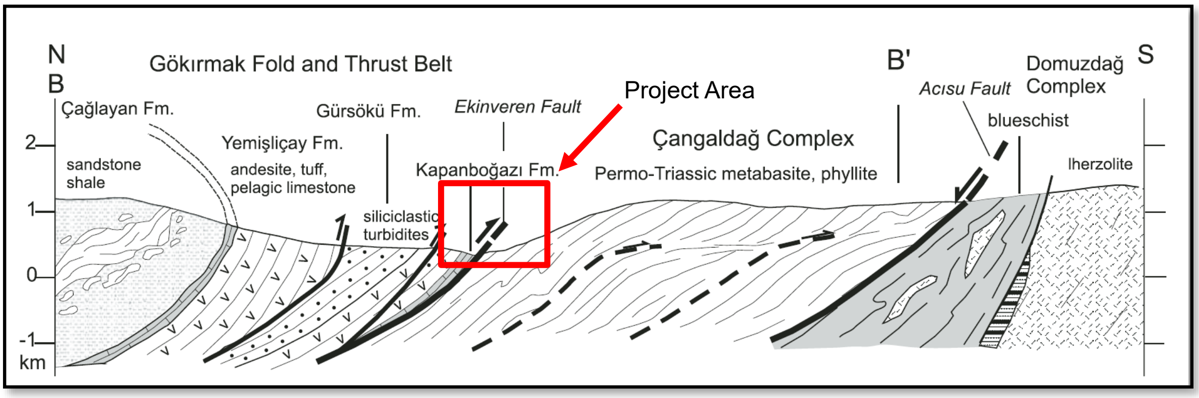


Figure 2-9 Cross-Section through the Gökirmak Fold and Thrust Belt (Okay et al., 2006)

The study area includes east-west trending structures owing to the north-south directed compressional regime. Syncline-anticline axes and bedding strikes are east-west directed. The Ekinveren Fault appears as the most prominent fault of the study area, bordering the northern boundary of the Kastamonu-Taşköprü-Boyabat basin. The Ekinveren Fault is known as a high-angle, normal or reverse fault. The formations outcropping beneath the project units are composed of Bekirli, Cankurtaran, Atbaşı, Sakızdağı and Kusuri formations and alluvium deposits.

Based on the previous studies carried out so far (RPS, 2015), bedrock in the open pit area is known to be heavily fractured and faulted. Core samples retrieved from the previous boreholes completed in the open pit indicates a major fault, known as the Dividing Fault. Investigations on the core samples show that the Dividing Fault has a north-south orientation that enhances the hydraulic conductivities along the fault plane. Details about the Dividing Fault are provided in the section given below.

2.5.2 Mine Site Geology

Open Pit

The open pit area is mainly composed of schists, phyllites and metavolcanic rocks that belong to Bekirli formation. Fracturing and faulting is observed throughout the bedrock in the open pit area. In the northern part of the open pit, alluvial deposits are observed along the Gökırmak riverbed.

Waste Rock Dump (WRD)

The Çorakoğlu WRD is underlain by Cankurtaran, Atbaşı and Sakızdağı formations. Cankurtaran formation is mainly composed of andesites, basalts, tuff as well as claystone, siltstone, sandstone alternation. Also, marl, shale and limestone alternation belonging to Atbaşı formation is observed at the small portion of Çorakoğlu WRD. The Sakızdağı formation, which is composed of alternation of mudstone, sandstone and conglomerate, is outcropped at the northwestern part.

Tailings Storage Facilities (TSFs)

The Kepezkaya TSF is composed of Cankurtaran and Atbaşı formations and alluvium deposits. The claystone, siltstone, sandstone alternation comprising Cankurtaran formation is mainly observed in the Kepezkaya TSF. In addition, marl, shale and limestone alternation of Atbaşı formation and alluvial deposits cropped out in the Kepazkaya TSF.

The Bağdere TSF, on the other hand, is composed of Cankurtaran formation. Andesites, basalts, tuff as well as claystone, siltstone, sandstone alternations are observed in the Bağdere TSF.

Process Plant

The marl, sandstone and limestone alternation of Kusuri formation and shale, siltstone, sandstone and conglomerate that belongs to Ulus formation are mainly observed in the process plant area.

2.6 Hydrology

2.6.1 Drainage Pattern

The Project Area is located in the Kızılırmak River catchment, which covers an area of approximately 82,000 km^2. The Gökırmak River, which is one of the biggest tributary of Kızılırmak River, flows between the project units. The Gökırmak

River - originates from northern flanks of Ilgaz Mountain (Kastamonu) - flows in the eastern direction in the Project Area. The Gökırmak River passes Taşköprü and Hanönü villages and reaches Kızılırmak near Boyabat village, approximately 20 km away from the southeastern part of the study area (Figure 2-10).

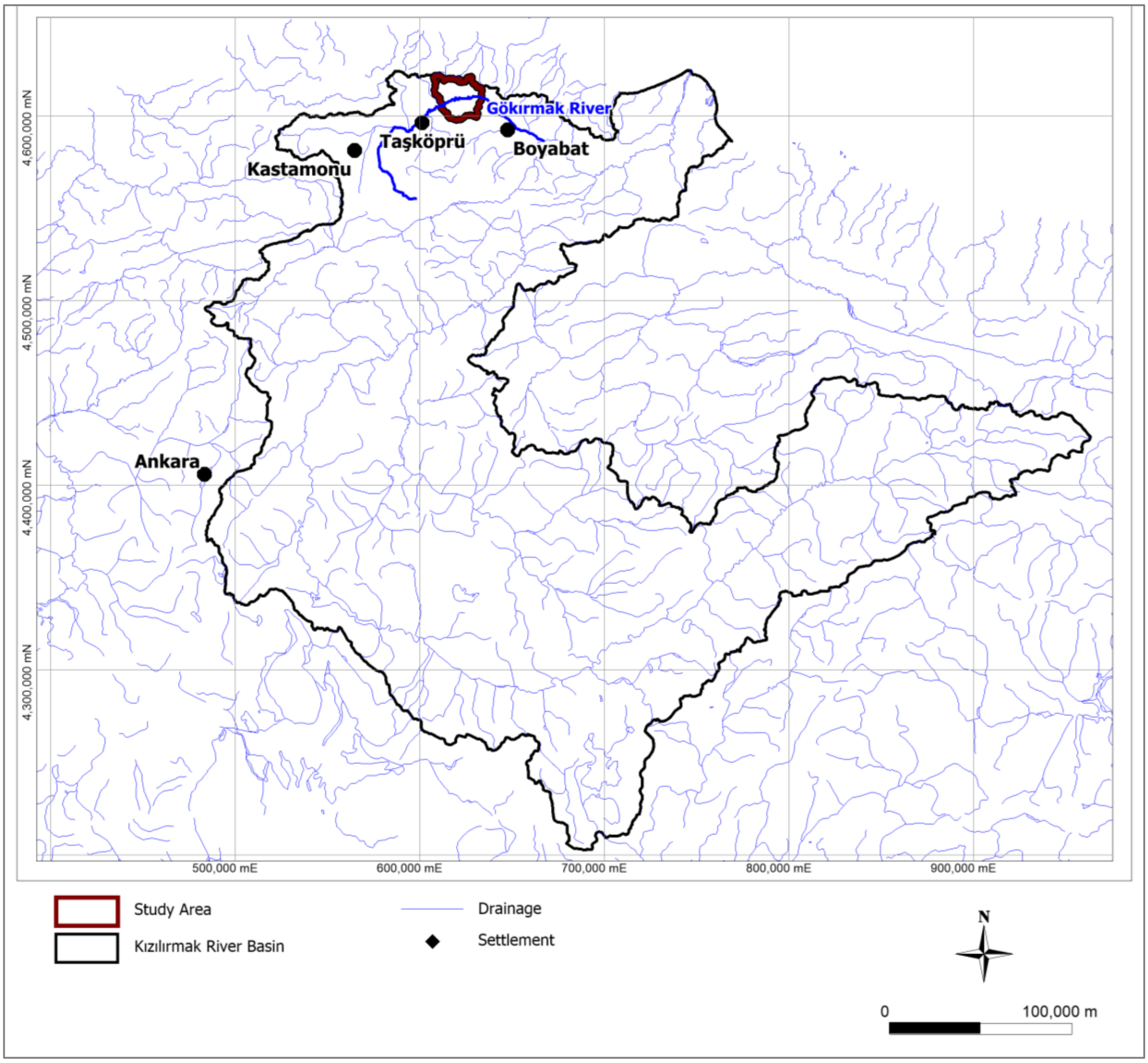


Figure 2-10 Drainage pattern of the Kızılırmak River

The drainage pattern at the Project Area and its immediate vicinity is presented in Figure 2-11. With the initiation of the Project, 11 flow monitoring points (SW-2, SW-4, SW-5, SW-7, SW-8, SW-9, SW-11, SW-12, SW-15, SW-17 and YS-2) were established on the ephemeral creeks draining the Project Area and its vicinity, and monthly flow rates have been monitored since May 2016.

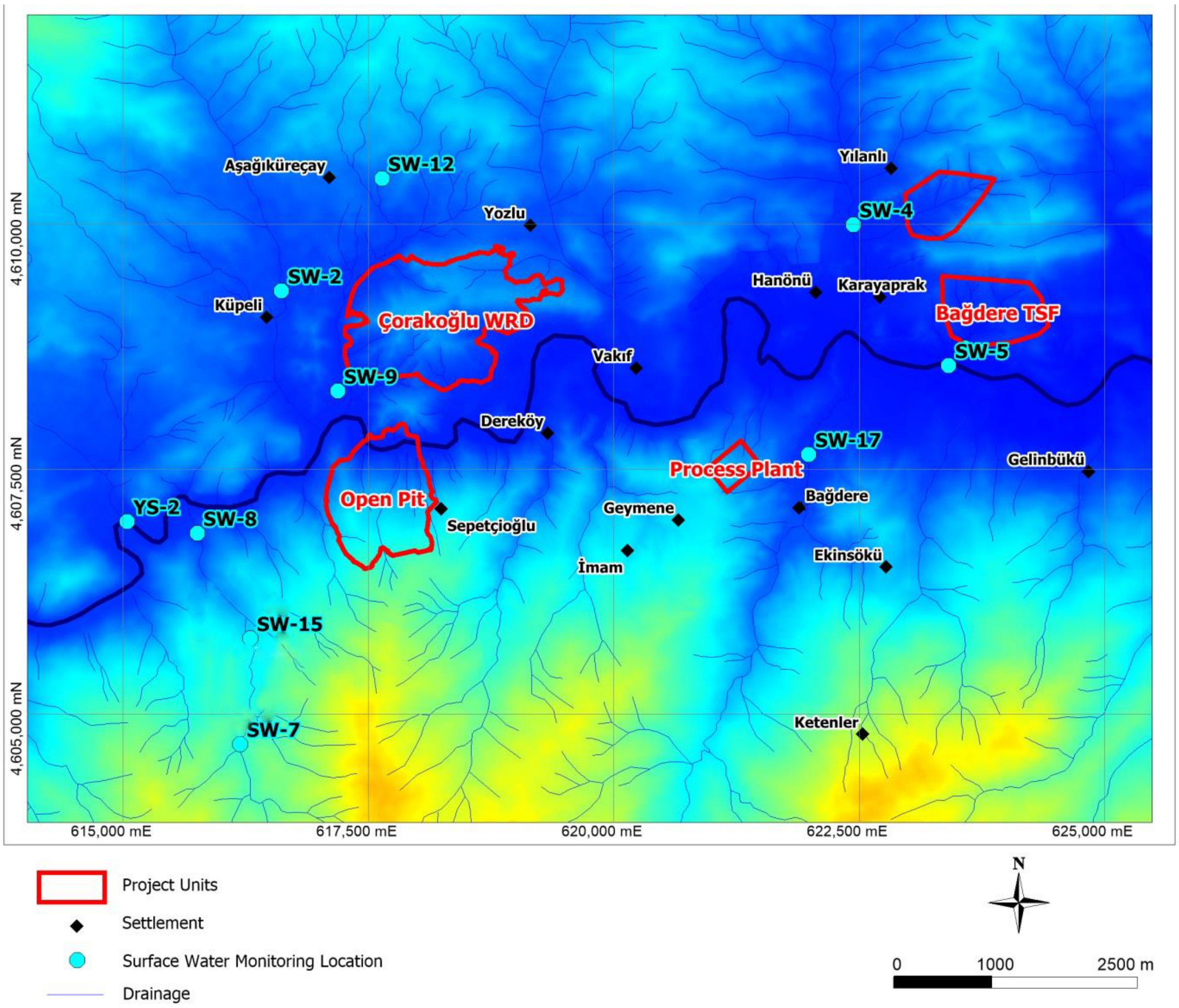


Figure 2-11 Location of surface water monitoring points

2.6.2 Gökirmak River Flow Rates

Several stream flow gauging stations were established along the Gökırmak River and its tributaries by DSI and Electrical Power Resources Survey and Development Administration (EIEI). The closest flow monitoring stations to the Project Area are Gökırmak – Kuyluş (E15A024) and Gökırmak –Purtulu (E15A045) stations (Hidro Dizayn, 2015). The locations of these stations are shown in Figure 2-12.

The Gökırmak-Kuyluş station was operated between the years 1954 – 1998. The Gökırmak-Purtulu station, which is in operation since 1999, replaced Kuyluş station. The long-term average monthly discharge rates measured at these stations are given in Figure 2-13.

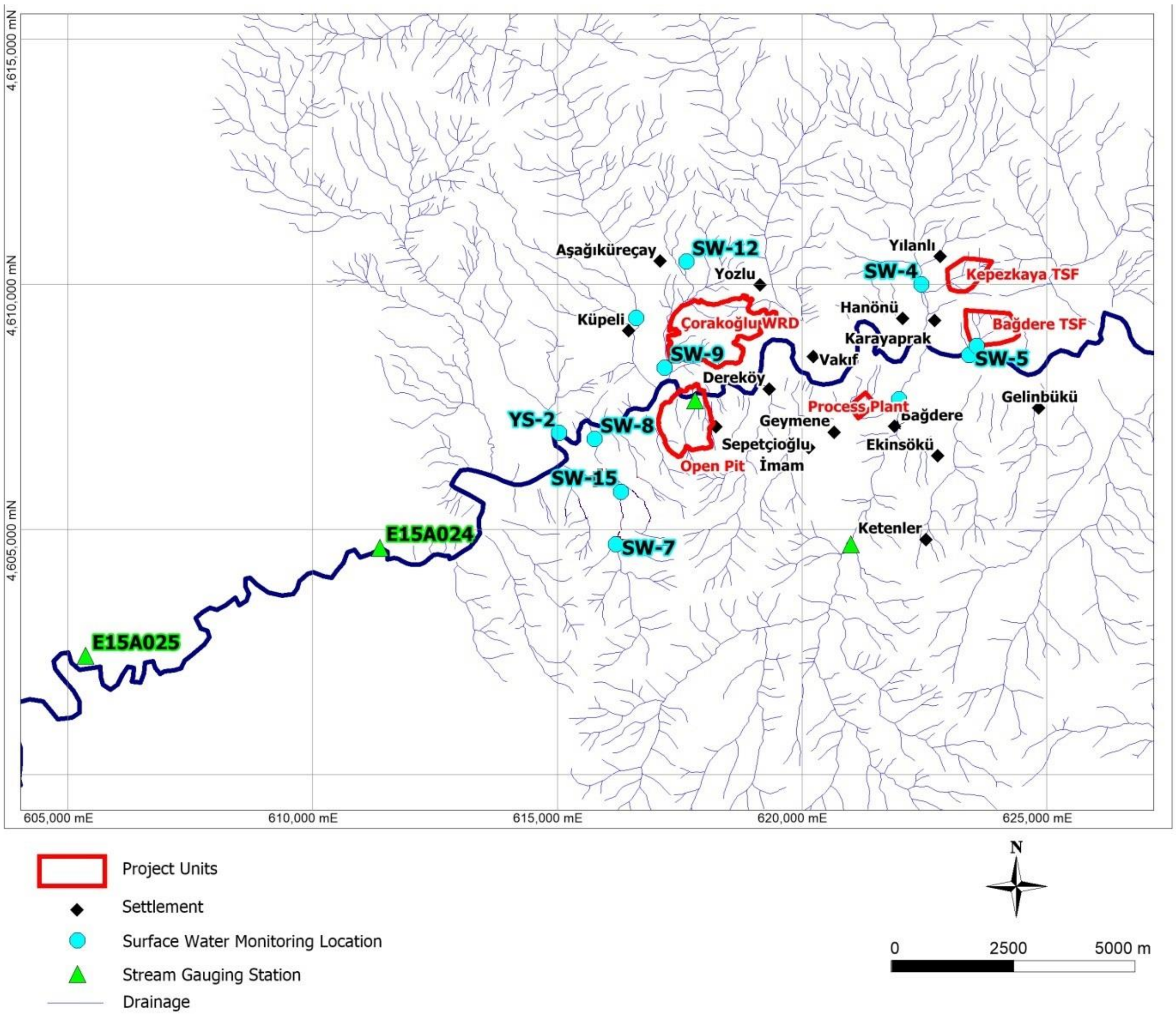
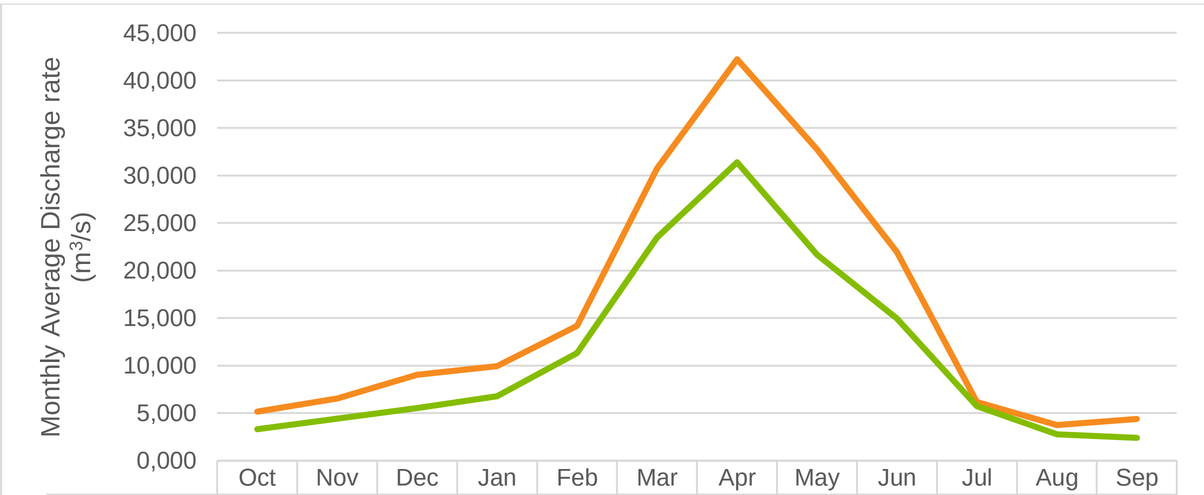


Figure 2-12 Location of stream flow monitoring stations



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
E15A024	5,162	6,561	9,040	9,954	14,175	30,751	42,239	32,733	21,975	6,192	3,764	4,396
E15A045	3,312	4,417	5,543	6,793	11,333	23,471	31,386	21,654	14,960	5,725	2,780	2,411

Figure 2-13 Long-term Average Monthly Discharge Rates Measured in Purtulu and Kuyluş Stations

2.6.3 Other Surface Water Resources and Structures

2.6.3.1 Lakes and Ponds

Several ponds are present within the Kastamonu Province. Table 2-2 shows notable ponds with their storage capacities, irrigation areas and their distances to Hanönü Town. The nearest ponds to the Project Area were identified as the Asar Pond, having a distance of 30 km, and Kabalar Pond, having a distance of 31.1 km to Hanönü. Both ponds are primarily used for irrigation purposes with storage volumes of 4.56 hm^3 and 0.56 hm^3, respectively. There is also a natural lake, known as the Dipsiz Lake, located in Tosya region of the Kastamonu Province, however, no study has so far been carried out regarding its use as a water resource.

Table 2-2 Notable Ponds in the Kastamonu Province

Pond Name	Nearest Settlement Area	Corresponding Stream	Completion of Construction	Storage Volume (hm3)	Irrigation Area (ha)	Distance to Project Area
Kösençayırı	Tosya	Kavuncu	1986	2.04	2000	72.5
Kabalar	Taşköprü	Değirmen	1975	0.56	53.4	31.1
Tasçılar	Daday	Iğdır	1983	1.02	126	90
Yumurtacılarf	Daday	Bakırca	1981	0.93	124	86.5
Çiğdem	Devrekani	Çatak Boğazı	1981	1.005	111	49.2
Tuzaklı	Araç	Gavur	2002	1.1	229	96
Asar	Taşköprü	Hasanlı	2008	4.56	1010	30
Bezirgan	Daday	Koldan	Under Construction	17.5	2505	91.5

2.6.3.2 Existing Surface Water Structures

Dams

Seven dams are currently being operated within the Kastamonu Province. The dams were identified to be used for different purposes such as drinking and industrial water supply, irrigation, and power production. The nearest dam was identified to be the Karadere Dam having a distance of 31.1 km to the Project Area. Table 2-3 provides general information on surface areas, volumes and their distances to the Project Area.

Table 2-3 Information on dams located within the Kastamonu Province

Name of Dam	Surface Area (ha)	Volume (hm3)	Distance (km)	Direction	Intended Purpose
Karaçomak	154	23	68	South-West	Drinking water+ Irrigation
Germeçtepe	54	7.3	72	South-West	Irrigation
Beyler	240	25	54.6	North-West	Irrigation
Karadere	101	26	31.3	South-West	Irrigation
Küre-Çatak	1	0.51	68	North-West	Industrial Water Supply
Kulaksızlar	200	18.72	43.5	West	Irrigation
Altınkaya	11800	5.763.00	58.3	South-East	Energy Supply

Demirci Regulator and Hydroelectric Power Plant

Privately-owned Demirci Regulator and Hydroelectric Power Plant (Demirci HEPP) is constructed on the Gökırmak River, next to the Dereköy Village in Hanönü. The facility consists of 18.500 m-long supply canal, forebay pool, 200 m-long penstock pipe, turbine and a power house. Thalweg and crest elevations of the Demirci HEPP are 420 m and 425m while maximum water elevation is 428 m, respectively. Installed capacity of the facility is 13.05 MW and it is planned to generate 59.1 GWh power per year. The nearest project units to the Demirci HEPP are the Open Pit and the Çorakoğlu WRD which are situated in 1 km (Open Pit) and 600 m (Çorakoğlu WRD) distances. Figure 2-14 shows the location of the Demirci HEPP within the Project Area.

2.6.3.3 Planned Surface Water Structures

Taşköprü Dam and Power Plant

Taşköprü Dam is planned to be constructed on the Gökırmak River with a thalweg elevation of 437 m. The dam embankment will be constructed approximately 1.5 km southwest of the upstream cofferdam of the Gökırmak River diversion. The dam is planned to provide water for both irrigation purposes and power generation. Following its construction, the Taşköprü Dam is expected to irrigate 6062 ha gross agricultural land area (5456 ha net area) with an annual energy production of 52.20 GWh. Dam site, reservoir and 1st unit of irrigation area (Hanönü Irrigation) are located within Kastamonu (Hanönü province) while the 2nd unit of Irrigation (Urluca Irrigation) site is located within Sinop, (Boyabat and Durağan provinces).

It should be noted that Taşköprü Dam Project has granted its EIA approval from the Ministry of Environment and Urbanization and is included in the "Planned Dam List" by the State Hydraulic Works.

Gökçeağaç Pond

Gökçeağaç Pond is planned to be constructed approximately 7.5 km from the Open Pit area, to supply drinking water. The nearest project units to the planned Gökçeağaç Pond are the Kepezkaya and Bağdere TSFs that are located within 2 km and 2.6 km distances. Figure 2-14 shows the location of the planned Gökçeağaç Pond with respect to Kepezkaya and Bağdere TSF areas.

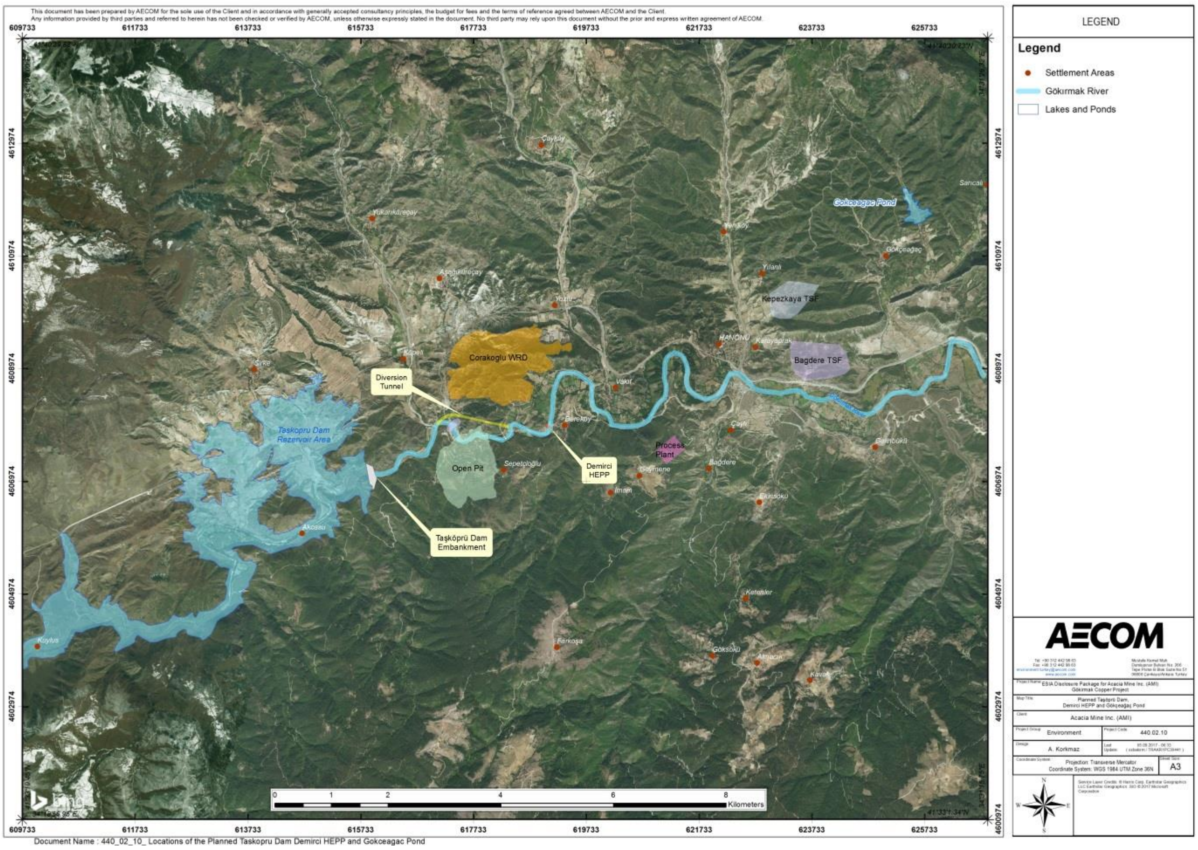


Figure 2-14 Locations of the planned Taşköprü Dam, Demirci HEPP and Gökçeağaç Pond

2.7 Hydrogeology

An extensive hydrogeological study has been carried out by AECOM to 1) to fulfill the gaps that were identified, 2) to improve the understanding on hydrogeological characteristics of the mining site through site investigations and aquifer tests and 3) to assess the potential impacts that may arise due to mining activities (AECOM, 2017). Interpretations of the results obtained from the site investigations, numerical modeling outputs and potential impacts of the mining activities are given in Hydrogeological Impact Assessment Report in Volume-III of the ESIA Disclosure Package while highlights on hydrogeology are provided below.

2.7.1 Water Bearing Units

Water bearing units in the Project Area can be classified into two main categories (1) highly permeable and (2) semipermeable to impermeable units.

Highly Permeable Units

Unconsolidated alluvial deposits associated with the Gökırmak River and its tributaries are classified as highly permeable units. These deposits can exhibit a significant primary permeability where clean sand, gravel or pebble units are present. In the vicinity of the pit, the width of the alluvium is generally up to 200 meters and thicknesses of up to 40m have been recorded. Furthermore, where the tributaries meet with the Gökırmak River, alluvium fans can be noted. The width of these fans can reach up to 500m meters and thicknesses of up to 60m.

These coarse grained alluvial deposits have the potential to act as significant aquifers for the Project. A key feature is the storage properties of these aquifers and the degree of hydraulic continuity/connectivity of the deposits. Furthermore a study completed by AECOM in September 2015, indicated that these alluvial units are being recharged by the surface water. Especially on the upstream sections of the tributaries of Gökırmak River, up to 50 l/s of surface water flow was noted where the river bed was formed by the outcropping bedrock units. On the other hand, as soon as the flow reaches to a location where this alluvium unit overlies the bedrock; the water flow on the surface was fading away and continued at the subsurface.

Various studies have been completed to estimate the aquifer parameters of the alluvial deposits by different parties (DSI 1994, 1996, Nbaproje 2013, 2014, RPS 2015, AECOM 2015 and AECOM 2017). Test results indicate that the alluvial deposits in the Project Area shows permeable features having hydraulic conductivities on the order of 10^{-3} and 10^{-6} m/s (majority of the test results are on the order of 10^{-3} m/s).

Semipermeable to Impermeable Units

The schists, phyllites, metabasic rocks as well as the sedimentary and volcanoclastic rocks are classified as semipermeable to impermeable units. These units cover almost all of the Project Area except for the areas that the alluvial units are present (underlies the alluvial deposits as well). The thickness of these units can reach more than 1000 meters.

Fresh and un-fractured sections of these units show almost impermeable behavior. On the other hand, the contact zones and significant fracturing and/or alteration zone of the rock mass shows a semipermeable behavior.

Third parties have completed a series of aquifer tests on these units. However the majority of the tests were not completed in accordance with the international standards. The results of the tests provided by the third parties are given here just to give a rough estimate about the permeability of these units. The tests completed on the un-fractured sections of these units indicate hydraulic conductivities on the order of 10^{-7} to 10^{-9} m/s. On the other hand, the tests that have been completed on the fractured sections indicate hydraulic conductivities reaching up to 10^{-5} m/s.

2.7.2 Estimation of Groundwater Recharge

Precipitation in an area is transformed into runoff, infiltration and/or evapotranspiration components. Water budget calculations estimate the ratio of these components to precipitation. During the estimation of the water budget for the study area, Thornthwaite method was used to calculate potential evapotranspiration while the estimated curve number was used for surface runoff determinations. The remaining portion of the precipitation was assumed to be equal to infiltration into groundwater (AECOM, 2017)

According to the water budget calculations, average annual groundwater recharge from direct precipitation in the near vicinity of the Project Area is calculated as 31.70 mm, which comprises 6 % of the annual precipitation. Since the study area is located in a steep and undulating topography, the distribution of groundwater recharge also varies within the catchment area. In this regard, the conceptual water budget calculations were also repeated for higher and lower elevations, which correspond to 75th and 25th percentile of the catchment area, respectively. According to the water budget calculations, average annual groundwater recharge from direct precipitation at the higher elevations was calculated as 50.39 mm, which comprises 9 % of the annual precipitation. On the other hand, at the lower elevations, average annual groundwater recharge from direct precipitation was determined as 14.03 mm, which comprises 3 % of the annual precipitation.

2.7.3 Hydrogeological Characteristics of the Project Units

Open Pit

Open Pit will be developed around Ibicik Tepe, next to the west of Sepetçioğlu Village, about 4.5 kilometers SW of Hanönü. The open pit will have a circular crest with about 1 kilometer in diameter and will have a maximum depth of 100 meters below ground level at Gökırmak's River stage. It will be developed within the low permeability schists showing an unconfined behavior within the pit area. Secondary porosity and permeability was developed in the schists due to fracturing and faulting zones. In addition to schists, a relatively thin (about 40 m) alluvium layer is present within the open pit boundaries. However, the alluvial material within the open pit boundaries has been hydraulically disconnected from the rest of the alluvial aquifer along the Gökırmak River with the slurry walls of the diversion dams.

One groundwater monitoring well (GK-12) was installed in the Open Pit area within the scope of this Project. However, several other monitoring and test wells were also drilled within the scope of previous studies. AECOM combined the data produced in the past and the data produced in GK-12 to characterize the hydrogeological properties of the Open Pit lithologies. Depth to groundwater levels measured in this area varies between 5 and 52 meter. Groundwater table generally follows the topography and the groundwater flow direction is from south to north. The groundwater levels change from 800 m at the southern part to 425-450 m near the Gökırmak River. The hydraulic gradient range within 0.25 and 0.4 in the open pit area (along the schist) and it decreases as the topography gets gentle to the north. The effect of two major faults, dividing and subdividing faults, can be clearly seen on the groundwater levels, indicating a relatively high conductivity zone in between the faults.

Hydraulic conductivity values vary between 1.75E-09 m/s (GK-12) and 1.54E-07m/s (BTBH) for the schist, 2.73E-06m/s (FOBH) and 6.56E-06m/s (SOBH) for the fractured / faulted sections of the schist. The difference between the conductivity values of the schist underlying the Gökırmak alluvium, and the schist that behaves as the host rock of the Open Pit is thought to be consequence of the weak fault zone that extends from the Open Pit through the spillway. On the other hand, hydraulic conductivity values for the alluvium were estimated as 1.27E-03m/s (AOBH) and 1.56E-06m/s (OW-4, partly in alluvium).

Surface water monitoring results show slightly alkaline properties with a mean pH value of 8.02 while EC values were observed to vary between 550-650 µS/cm. Surface waters located in the near vicinity of the Open pit reflect Ca-HCO_3 type of hydrochemical facies according to the analyses results. Groundwater pH was identified to range within 5.81-9.10 while EC values were observed between 282-2800 µS/cm with a mean of 927 µS/cm. Groundwater samples indicate a hydrogeochemical facies type of Ca-HCO_3 for the Open Pit groundwater.

Çorakoğlu WRD

Çorakoğlu WRD will be situated 1 km north of the Open Pit, across the northern bank of the Gökırmak River. The area will be located 4 km West of Hanönü. Waste rock in the Çorakoğlu WRD will be deposited on lithological units composed of schists, limestone, claystone and volcano-sedimentary units that show unconfined behavior. Secondary porosity is observed among these lithologies related to fracture zones, more particularly for schists.

A total of four groundwater monitoring wells were installed to identify the hydraulic characteristics of the lithologies situated in the Çorakoğlu WRD. Depth to groundwater levels were observed to vary between 19 and 36 meters. Groundwater table is forming an irregular mound around the Çorakoğlu Hill, in line with topography. The groundwater flow occurs radially from this zone of groundwater high. However, the predominant flow network from this mound is from center to the south east and again from center to west and then south. The average hydraulic gradient is about 0.4 in the Çorakoğlu WRD. Average hydraulic gradient were observed to be 0.1 towards the North, 0.3 towards the South, 0.2 and 0.1 throughout the East and West, respectively.

Based on the aquifer test analyses carried out among the monitoring wells in the Çorakoğlu WRD area, the limestones were observed to have hydraulic conductivity values on the order of 6.18E-06 m/s (GK-9) while the hydraulic conductivities for the sandstone-claystone and schist alternations were found to be on the order of 2.64E-08 m/s (GK-7). Pumping test results show that the alternation of schists and sedimentary units shows hydraulic conductivity value on the order of 4.42E-06 m/s (GK-6).

Çorakoğlu WRD surface waters show pH values between 7.62-8.64 while EC values were found to be between 348-1873 µS/cm with a mean of 966 µS/cm. Based on the analysis results Çorakoğlu WRD surface waters were identified to reflect two different hydrochemical facies types as Ca-HCO_3 and Na-SO_4. Groundwater monitoring results indicate a pH and EC range as 7.21 - 8.60 and 395-4076 µS/cm, respectively. Groundwater samples show a facies type of Na-SO_4 while drinking water depots show hydrogeochemical facies types of Ca-HCO_3 and Na-HCO_3.

Kepezkaya TSF

Kepezkaya TSF will be situated about 1.5 km NE of Hanönü, along the Kepezkaya Valley. The TSF will be constructed on low permeability units which are composed of turbidites and sandstone-claystone alternation.

Taking into the account of previously drilled monitoring wells in the Kepezkaya TSF, one monitoring well was installed in downstream section of the TSF to identify the hydraulic properties of the lithologies. Groundwater flow direction was identified as from NE to SW, following the topography, with hydraulic gradient varying between 0.05 and 0.2. Pumping tests performed indicate low hydraulic conductivities on the order of 2.00E-06 m/s for the Kepezkaya lithological units according to the previous studies.

Mean of pH value for surface waters for the Kepezkaya TSF area was observed to be 8.23 which indicates slightly alkaline conditions. EC mean was determined to be 373 µS/cm. Major ion distribution of the surface water samples reflects a hydrochemical facies type of Ca-HCO_3. Groundwater in this area on the other hand, shows a baseline pH mean of 7.82 with an EC mean of 2831 µS/cm within 489-6060 µS/cm range. Type of water was identified as Ca-HCO_3 from the examination of drinking water depots while groundwater samples generally show a facies type of Na-SO_4.

Bağdere TSF

Bağdere TSF will be constructed along the Valley on the Karayaprak Neighborhood about 1.5 km E of Hanönü. The TSF will be constructed on low permeability units which are composed of claystone-marl alternation with sandstone intercalations.

A total of five groundwater monitoring wells were installed in the Bağdere TSF to identify the hydraulic properties of the lithologies in this area. The groundwater flow generally follows the topography and its direction was determined as from North to South with an average hydraulic gradient of 0.1. Based on the aquifer tests performed in the 5 monitoring wells, hydraulic conductivity values for Bağdere TSF lithologies were found to have relatively low hydraulic conductivity values on the order of 3.00E-07 m/s except for GK-4 which probably lies in a zone of weakness (K=3.31E-05 m/s).

Baseline data for pH and EC parameters of surface water monitoring provided mean values of 8.39 and 512 µS/cm, respectively. Surface water analysis results show a hydrochemical facies type of Ca-HCO_3 for this project unit. Groundwater monitoring results show mean values for pH and EC to be 7.12 and 4204 µS/cm, respectively. Groundwater analysis results show that the hydrogeochemical facies type is Ca-HCO_3 for the Bağdere TSF area.

Process Plant

Process Plant will be constructed on Gücük Tepe about 2 km S of Hanönü. A total of two groundwater monitoring wells were installed in this area to identify the hydraulic characteristics of the Process Plant lithologies. Based on the aquifer tests performed among the 2 monitoring wells, hydraulic conductivity values for the process plant lithologies were found to be relatively low, on the order of 10^{-7} to 10^{-8} m/s.

Surface water monitoring for this unit revealed a pH mean of 8.76 and an EC mean of 300 µS/cm. Mg-HCO_3 type of facies was determined for the surface waters located in the near vicinity of the Process Plant area. Groundwater monitoring results show a baseline pH mean of 7.98 and an EC mean of 393 µS/cm. Hydrogeochemical facies type was identified to be Ca-HCO_3 for the drinking water samples collected within the near vicinity of the Process Plant.

2.7.4 Springs and Depots

Drinking water resources for the nearby settlement areas were identified by AECOM in September 2015 (AECOM, 2015). Findings of this study are summarized below:

- Sepetcioğlu Village: the closest village to the Open Pit area. Habitants of this village consume water directly from a nearby spring (K-1 in Figure 2-15). A depot does not exist in the village. K-1 coded water sample was collected and analyzed.

- Dereköy Village: located in the southern bank of the Gökırmak River. This village uses a nearby spring located in the upstream portion of Kızılince stream. The K-4 coded water sample was collected from this spring and D-4 coded sample was collected from the water depot of the Dereköy village.
- Vakıf Village: located at the northwest of the Process Plant near the Gökırmak River. Domestic water for this village is supplied from a well located in the village. Water is pumped to the depot of Vakıf village constructed in the northeast of the village and then distributed to the households.
- Küpeli Village: located in the west of the Çorakoğlu WRD. Domestic water need of this village is met from a well, constructed within the bank alluvium of the Gökırmak River. Water is pumped to the village water depot via a buried pipeline system.
- Hanönü Town: located in the west of the Kepezkaya and Bağdere TSFs. The spring used for drinking water supply is located north of the Yeniköy Village on the upstream of Yılanlı Stream. Hanönü has two water depots in the Karayaprak Village. The municipality of Hanonü utilizes a caisson well located at the intersection point of Gökırmak and Yılanlı streams to meet the additional water needs in the dry season.
- Yılanlı Village: located near the planned Kepezkaya TSF. This village uses the same water supply system which is utilized for the Hanönü Town.
- Imam Village: located toward the southwest of the planned Process Plant. The village has a relatively small water depot fed by a nearby spring located 50 m away from the depot.
- Geymene Village: located at the south of Hanönü between Bağdere and İmam villages. Domestic water source location is not exactly known. However, based on the information verbally obtained from the locals, the source is close to the Farkoşa Village in the south. Water is stored in the depot of the village itself.
- Yeniköy Village: located in the north of the Hanönü Town (upstream section of the Yılanlı Stream). Water is provided by the same source as the Hanönü Town.
- Bağdere Village: located in the south of Hanönü Town. A domestic water source is located in close proximity to a waterfall on the Sarıkaya stream. There are two water depots belonging to Bağdere in the South, one of them is known to be the old one while the other is the new. These depots belong to both Bağdere and Çaylı Villages.
- Çaylı Village: located between Bağdere and Hanönü. Tap water is transferred from the Bağdere Village water depot.

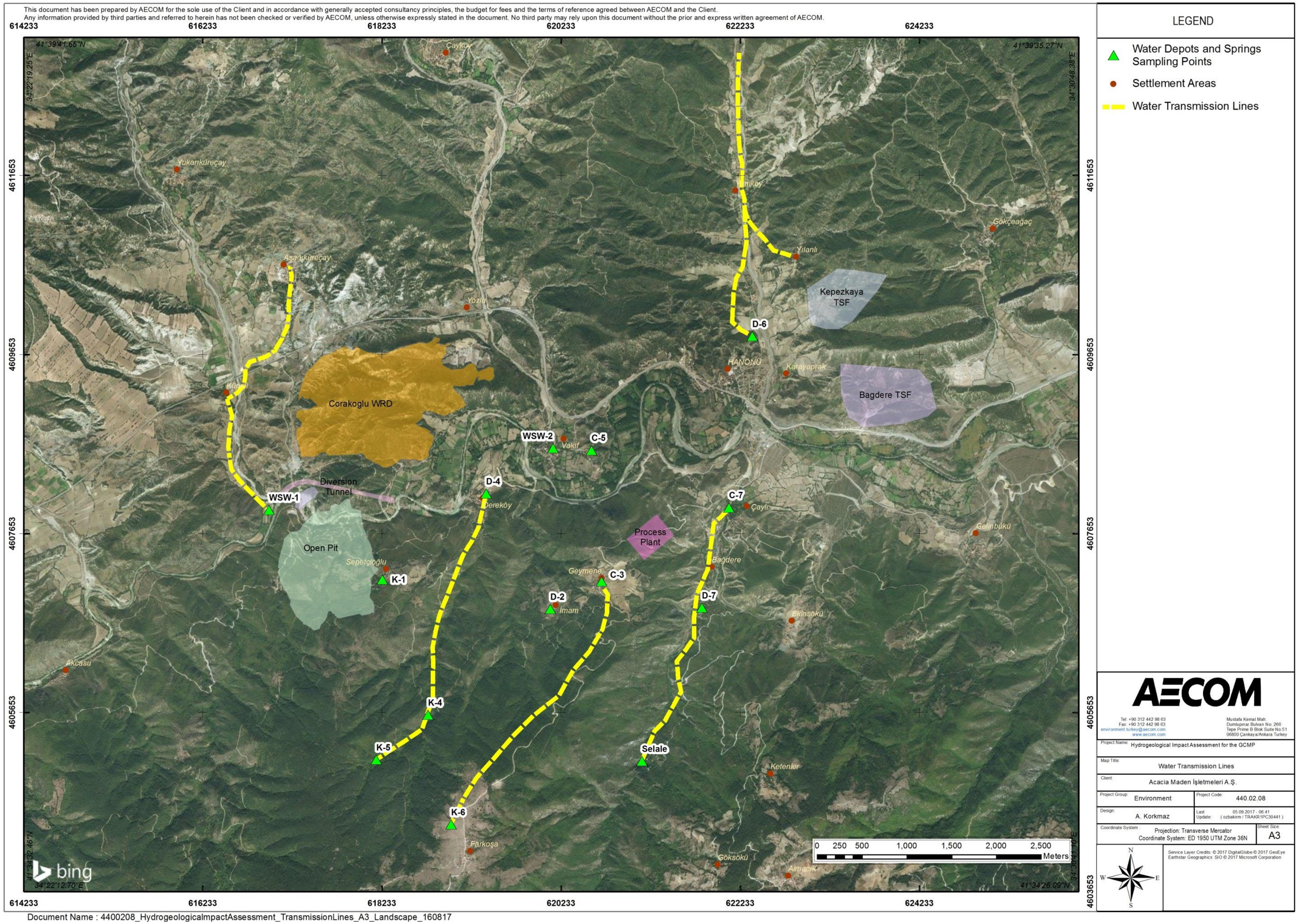


Figure 2-15 Drinking water locations and water transmission lines for the nearby settlement areas

2.8 Geochemistry and Acid Rock Drainage

A phased geochemical characterization program was implemented in accordance with the internationally accepted standards for Acid Rock Drainage and Metal Leaching (ARD-ML) assessments. Geochemical testing was carried out in two stages to identify any potential ARD-ML issues prior to mining operations. Representative drill core samples from the waste rock lithologies were collected to be analyzed with relevant analysis methods to enable initial characterization of the main rock types that will be deposited in the waste rock dump (WRD). Selected samples also include low grade copper ore samples to represent lithologies that are likely to remain on the exposed pit walls at the end of the operational phase.

Geochemical testing program was carried out in two stages. Stage 1 - Static Tests were performed for each selected sample to identify bulk geochemical properties and potential to mobilize constituents that may create a negative impact on the surrounding environment. Stage 2 – Kinetic Tests were performed to identify reaction rates and solute loads over long term, through a simulation of natural processes in laboratory environment.

A total of 255 samples were collected and together with the 17 older samples (excluding 2 composite samples), a total of 272 samples were analyzed within the scope of this study. 19 old rock (drill core) samples were collected in 2012 by Jeoband Danışmanlık AŞ (Jeoband) and submitted for static testing by the fully accredited AGAT laboratories, Burnaby, BC, Canada. These samples were also analyzed in the previous report prepared and submitted by Jeoband on November 25, 2013. In this report, the old samples except two composite samples were included in the data analysis studies.

139 rock (infill) samples, 11 sedimentary samples, 10 soil samples and 95 pulp and coarse reject samples were collected in 2015 by Geochemico Consulting Inc. (Geochemico) and submitted for static testing to Global ARD’s laboratory. Findings of the geochemical characterization studies by Geochemico are summarized in below sections.

2.8.1 Static Testing Analytical Results

274 samples (including 2 composite samples) of rocks, sediments and overburden from the GCP were submitted for geochemical characterization by static testing to Global ARD laboratories, an accredited laboratory located in Burnaby, BC, Canada. The testing requested included a four acid digestion followed by cation determination by ICP-MS to determine major and trace elements in particular as well as shake flask extraction (SFE) testing and ABA testing. Below are the key findings of the GCP static testing samples.

Greenschist rocks are generally not capable of generating ARD/ML and therefore do not require special treatment and may be used for general construction and foundations, except where visible sulphides are present (only found in one sample close to the ore);

- Metal leaching is very unlikely to be a problem with the greenschist facies rocks;
- Approximately thirty percent of mixed schist rocks were found to potentially be capable of generating ARD/ML. This lithology requires further testing using kinetic (humidity cell) testing;
- Metal leaching characteristics of the mixed schist require further study using kinetic testing techniques, although no PCOC were identified using either Turkish or Canadian regulatory standards at the median sample population concentrations of all elements;
- Overburden is very unlikely to generate acidity and may be stockpiled and used for remediation purposes;
- One sample of sandstone (intended for TSF impoundment construction) was found to be potentially capable of generating acidity, although the remainder of the samples is benign. Sandstone from the area of the PAF sample should not be used for construction;
- A number of PCOC were identified for all lithologies at the 95th percentile of sample population concentrations including Al, Cu, Fe, Mo, Zn, P, V, pH, Cd, Ni, V, Se, sulphate, Sb, Na, and Mn.

2.8.2 Kinetic Testing Analytical Results

Two rock types were found to require kinetic testing; tailings derived from copper ore and mixed schist. Results from two types of kinetic testing are described herein; sequential shake flask testing (or SSFE kinetic testing), and; humidity cell testing. Sequential shake flask testing is in use world-wide and allows rapid (although only approximate) prediction of the time of lag to the beginning of ARD as well as the likely extent of ARD generation. The advantage of the SSFE technique is that data are received within a month instead of the usual 6 to 8 months required for humidity cell testing and the testing is therefore much less expensive than humidity cell testing. It is important to note that kinetic testing is still required, but SSFE does provide a measure of confidence regarding ARD generation over the short term (two to five years) that allows some mine development and planning to occur while the humidity cell data is acquired.

Three of the six samples analyzed by SSFE proved to be capable of generating ARD (DG106-134-S, DG510-184-S and SS-ASYA; all are mixed schist samples). Two samples are deemed not capable of generating ARD according to static testing (DG506-130-M and DG102/70-160-S). The sixth sample, SC-ASYA, shows a balance of NP and APP over time, indicating a possibility for local ARD production depending on grain size, mineralogy etc.

The important aspect of the ARD characteristics of the samples is that the SSFE testing shows that for all samples the onset of ARD is between 190 and over 2000 years into the future. This prediction will hold provided that the pH of the leachate does not fall below 5.0. Below this pH a much more rapid reaction rate will apply and the samples may generate ARD much faster. This analysis will be further checked using humidity cell testing but the long lag time does mean that the mine should have adequate time to stockpile waste in the open without special precautions and also have adequate time to devise and verify appropriate mitigation strategies. It should be noted that SSFE predictions are based on a short period of testing and are therefore only applicable for the first two years of weathering/oxidation at the mine site.

- It is very unlikely, based on interpretation of both static and kinetic testing that metal leaching or acid rock drainage issues arising from waste rock storage will be encountered at the Gökırmak Copper Project;
- Kinetic testing shows that only the rougher and float tails at the Gökırmak Copper Project can be expected to generate ARD/ML;
- Metal leaching is unlikely to be a significant problem for the rougher tails; however, the float tails will very probably generate leachate exceeding most of both Turkish and Canadian water quality standards. Tails must be contained within a lined storage facility as dictated by Turkish environmental legislation;
- Kinetic testing of the representative sample of rougher tails showed that the lag time to ARD generation is about 24 years although the float tails are likely to generate ARD/ML within two years of deposition;
- All mixed schist (including calc-silicate schist and fault breccia) lithologies are unlikely to generate ARD/ML, despite the static testing data suggesting otherwise as the neutralization potential of the rocks is generally adequate to prevent the formation of acidic leachate from the oxidizing sulphides.

Details on geochemical characteristics of the mining lithologies are provided in Volume-III of the ESIA Disclosure Package.

2.9 Biodiversity

The assessment on Biodiversity considers the loss of habitat, degradation and fragmentation, invasive alien species, overexploitation, migratory corridors, hydrological changes, nutrient loading and pollution.

The field surveys for biodiversity and habitat related subjects conducted for the Project until the time that this ESIA has been published are given in Table 2-4.

Table 2-4 Field Surveys Conducted for Biodiversity

Timing	Subject of Survey	Scope of the Survey
May 2012	Terrestrial Flora and Fauna and Aquatic Biodiversity	ESIA Report by ENVY
August 2012	Terrestrial Flora and Fauna and Aquatic Biodiversity	ESIA Report by ENVY
28.10.2015	Flora	Flora and Habitat Assessment Report by AECOM
02.04.2016	Terrestrial Flora and Fauna and Aquatic Biodiversity	Biodiversity Management Plan by AECOM

The evaluation criteria of the biodiversity elements used in this report (ERL, CITES, BERN, EU Habitat and Bird Directives) are given in detail in ESIA Disclosure Package and Biodiversity Management Plan (AECOM, 2017).

3. Identification of Closure Obligations and Commitments

Land use in long term in Turkey is regulated by different laws and regulations. The land use rights of privately owned lands belong to owner. The rehabilitation plans for forest, pasture, and public properties should be submitted before starting to use the land for mining purposes. These lands cannot be rehabilitated for different purposes without relevant permits. Therefore, closure and rehabilitation of mines are regulated depending on the land use of the Project. As most of the Project Area is on the forestry land, a “Forestry Rehabilitation Report” has been prepared as requested by the Ministry of Forestry and Water Affairs (MFWA).

In accordance with the legislative requirements, all liabilities are effective until forest areas are returned to General Directorate of Forestry. Ensuring safe slope stability in long term and covering flat areas with top soil are legally required for successful mine closure. Closure of the open pit, waste rock dumps, process plant, and tailings storage facilities will be monitored and audited by a number of government agencies.

Most of the land belongs to the General Directorate of Forestry. After completion of the mining activities, these areas will be returned to the Regional Directorate of Forestry (RDF) providing that the rehabilitation has been conducted to the required standard. This standard requires areas to be levelled, to be free from any steep slopes and to have top soil in place. The RDF does not accept the land if it does not meet these requirements. A “Forestry Rehabilitation Report” has been prepared as requested by the MFWA.

A mining license has been granted by the General Directorate of Mining Affairs (MİGEM). The MİGEM requires the RDF to sign-off rehabilitation works before it assumes liability for the land, particularly with regard to long-term slope stability and top-soil placement.

Water quality management and monitoring will be audited by the Ministry of Environment and Urbanization, and State Hydraulic Works (DSİ). These agencies will monitor the quality of the rehabilitation by taking samples from the open-pit lake and groundwater monitoring wells located around the open pit, waste rock storage area and tailings storage facilities. These agencies may request additional measures according to the results of the monitoring program. Expansion of the monitoring period or construction of a treatment plant may be requested from either of these agencies.

The legal basis of the mining activities is a mining license which is issued by General Directorate of Mining Affairs (MİGEM). After completion of mining activities, mining license will be relinquished. MİGEM ensures all required rehabilitation work has been completed before relinquishment. MİGEM will consider the rehabilitation as completed when MİGEM has received the letter from Regional Directorate of Forestry stating that the Regional Directorate of Forestry took over the land.

4. Social Impact Assessment and Stakeholder Engagement

A social impact assessment has been carried out by SRM Consulting to identifies the types of social impacts, devices and mitigation mechanisms in order to avoid/minimize/reduce any potential adverse impacts. SIA’s scope includes;

- Determining the area of influence
- Establishing the socio-economic baseline
- Assessment of socioeconomic impacts of the project according to category and type of impact, duration, probability of occurrence and significance level.
- Defining mitigation measures for each impact.
- Developing a monitoring program throughout the project implementation period.

Details on Social Impact Assessment study is provided in Volume-II of the ESIA Disclosure Package (AECOM, 2017).

5. Closure Objectives and Post-Mining Land Use

This section explains post-mining land use of the mine units and mine closure implementation for the Gökırmak Copper Project.

There are different options for mine closure and rehabilitation plan for the GCP. Closure and rehabilitation alternatives depend on the long term physical and chemical stability, requirements set by the regulations, land use, visual impact assessment, and human health concerns.

Rehabilitation and closure plan should meet the minimum requirements that are summarized below:

Physical Stability: After the mine closure, open pit walls and waste rock dump slopes should be physically stable in long term. During the operational phase, short term slope stability optimization takes place but optimal slope angles in short term are not always be the same as long term stability conditions. Therefore, slope angles should be rearranged for long term stability conditions with additional excavation or blasting.

Chemical Stability: Throughout the mine closure period, project units such as waste rock dump area, open pit, and tailings storage facility has to be chemically stable. Additional mitigation measures should be developed if the project units do not meet the chemical stability requirements.

Regulatory Compliance: There are strict rules which regulate land use in long term. The land use rights of privately owned lands belong to owner under laws and regulations. The rehabilitation plans for forest, pasture, and public properties should be submitted before starting to use the land for mining purposes. These lands cannot be rehabilitated for different purposes without permission.

Land Use and Visual Amenity: Even though there is no regulatory requirement, visual amenity of rehabilitated mine sites can be subjected to use for tourism purposes. Rehabilitated mine sites can be used especially by the local community. Visual amenity for the rehabilitated areas also brings in an extra reputation for the company.

Human Health and Safety: The main purpose of the rehabilitation is the long term protection of local community's health and safety in consideration of the above mentioned principals.

Since the rehabilitation works may have different components for different areas, they will be discussed separately for each project facility.

This section provides an overview of rehabilitation plans for the open pit, the waste rock dump, the processing plant, the tailings dam, and other related facilities. Mine closure needs to be progressively updated over the course of mining operations as more site- specific information is acquired. It is also proposed that progressive remediation will be implemented throughout the mine life, including the re-grading, cover placement, and re- vegetation of exposed final surfaces at the open pit and the waste rock storage area.

As part of the application for forestry permits, the RDF requires a rehabilitation plan which includes conceptual details for mine closure.

Forestry law clearly describes the principal decrees that are to be complied in using forest areas. According to the forestry law, forest areas are unsalable and not able to be indefinitely transferred. Forest areas will temporarily be leased by AMI to carry out mining activities and will be delivered back to the Regional Directorate of Forestry after all rehabilitation work is completed.

5.1 Open Pit

Following items have to be applied during the closure of the open pit.

1. **Rehabilitation Stages and Duration:** The duration of the operational phase might vary depending either on the anticipated motives or unforeseen reasons which may result in rescheduling of the rehabilitation works.

Rehabilitation stages will be based upon the selected closure alternative. Duration of the open pit rehabilitation is expected to be 2 - 3 years.

2. **Applicable Land Use Objectives:** Land use objectives of the open pit should be finalized in accordance with the stakeholders' demands and viable plans. The open pit can be rehabilitated into a proper landscape that has a suitable visual appearance.
3. **Monitoring and Sampling:** Monitoring and sampling management is of primary importance to make a successful progress on rehabilitation. A monitoring plan should be developed both for the operational and closure phases to detect any potential impacts that might be generated from mining activities.
4. **Material selection for Closure:** Gravel, clay, top soil, and waste material will be used during closure and rehabilitation stages. Resources for those materials will be specified during the operational phase to be included in final closure plan.
5. **Remediation of the contaminated sites:** Minor contaminations may occur during the rehabilitation stage of the open pit. Contaminated areas and pollutants will be remediated, if any. A remediation management plan should be prepared for this purpose.
6. **Revegetation:** A specialist will be in charge of plant selection and revegetation applications. Research, investigation and trials will be conducted during mining operations to have best revegetation result after mine closure.
7. **Approval of Closure:** Closure and rehabilitation has to be approved by relevant governmental agencies. Therefore, necessary applications will be submitted to the agencies for a final approval of the mine closure.

For rehabilitation of the open pit areas left exposed after the pit void has been filled, two options can be considered:

- On-going rehabilitation during the life-of-mine
- Rehabilitation commences after mining has ceased. There are three options to consider for the void of the open pit:

There are three options to consider for the closure of the open pit:

- Allow the open pit to be flooded by the Gökırmak River,
- Leave the open pit as it is with the diversion tunnels in place and allow it to fill with water naturally;
- Backfill the open pit with waste material.

5.1.1 Physical Stability

Rehabilitation for the open pit is planned to start once the ore extraction is completely over. Open pit area is subjected to Forestry Law and belongs to General Directorate of Forestry. Therefore, prior to the mining activities, all required permits must be obtained from the General Directorate of Forestry. During the application process for forest use permits, Regional Directorate of Forestry requests a rehabilitation plan which includes conceptual details for the mine closure.

All liabilities terminates once the rehabilitated forest areas are taken over by the General Directorate of Forestry. At this stage, long term slope stability and the top soil cover conditions should be satisfactory to meet the legal requirements. Acid rock drainage and metal leaching (ARD/ML) potential of the mining lithologies should be monitored during the operation phase to improve the understanding on long-term geochemical behavior during the closure phase.

As mentioned earlier, open pit rehabilitation can either be started during the operational phase simultaneous to the ongoing mining activities or immediately after the mining operations.

A. Simultaneous Rehabilitation during the Operation Phase

Rehabilitation activities can commence after each bench has been mined to the final pit profile. Mining on the final wall will occur from the top of the pit and progress down. Rehabilitation works can therefore commence after the mining equipment has vacated the bench. Appropriate hazard management techniques will be required to avoid material falling on the active mining areas below.

As illustrated in Figure 5-1, rehabilitation can commence on the slopes of the upper levels once mining is complete. The success of rehabilitation on slopes depends on effective water management. The water-channels on the upper benches divert surface run-off to the outside of the open pit area. Building appropriate-sized channels is important, as is use of long lasting materials (e.g. concrete). These channels should be designed to handle the expected flow rate.

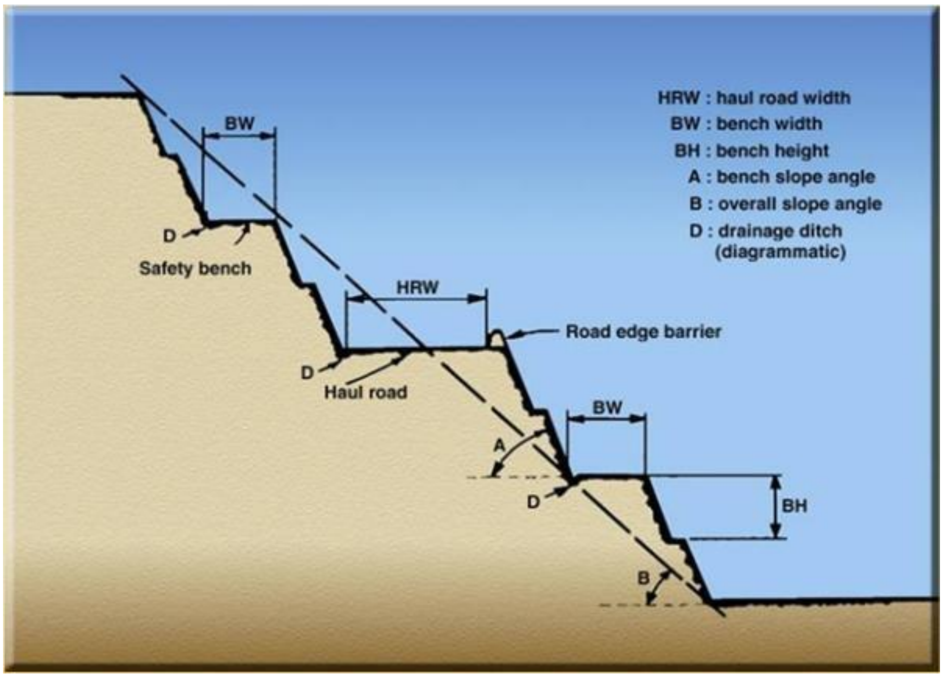


Figure 5-1 Conceptual Cross-Section of an Open Pit Ready for Rehabilitation (www.infomine.com)

Top soil laid out on the surface of the slopes is quite sensitive to water erosion in early periods. Therefore, rain water should be diverted via trenches leading to ponds where eroded soil can be collected and reused. The locations of the trenches are represented in Figure 5-1. The trenches should be filled with gravel in order to minimize the risk of erosion during later years. The gravel fill will allow water to flow through but at reduced velocity thus preventing scouring.

Slight weathering is expected to occur on the open pit benches due to exposure. Debris falling from the upper portion of the slope will accumulate at the bottom of the slope. Benches will become smoother and more suitable for rehabilitation. Figure 5-2 represents the gradual change of the landform over time.

The advantage of simultaneous rehabilitation is the ability to use equipment and personnel on site for the mining process. This reduces the time taken for closure activities after the end of mining. This strategy also allows the opportunity to test different scenarios during mining which guides an optimum solution.

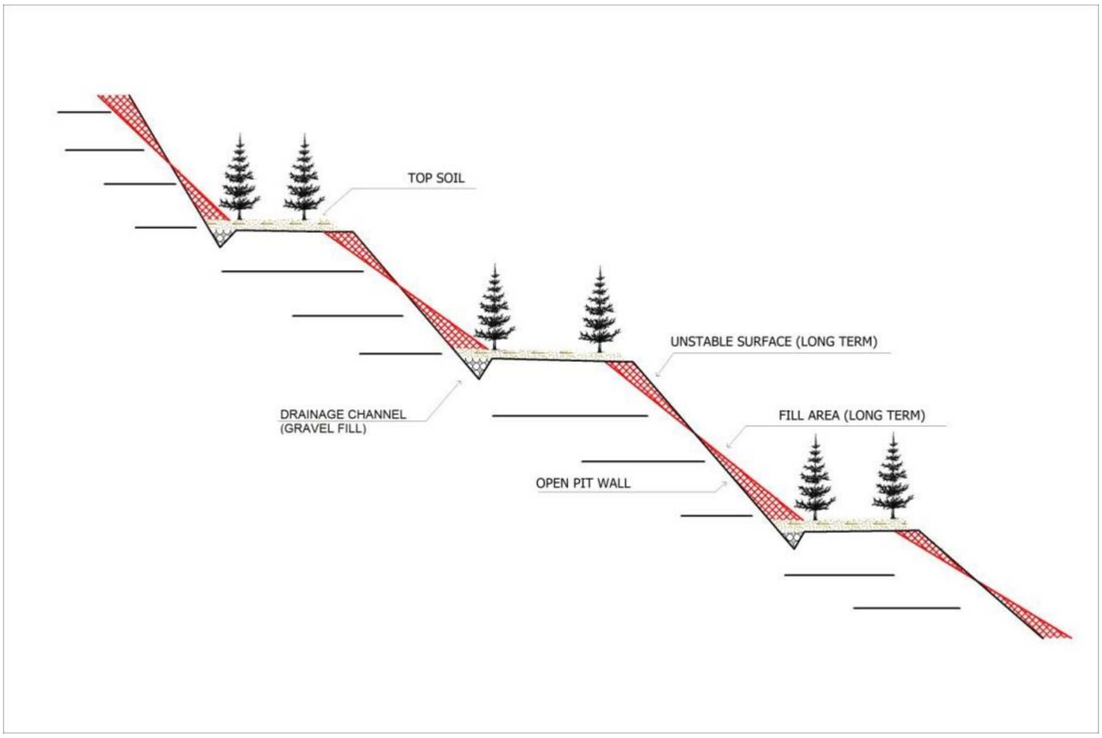


Figure 5-2 Pit Wall Slopes after Closure

B. Starting the Rehabilitation after Mining Activities

This scenario envisages rehabilitation starting after mining ceases. This method is not recommended due to damage that may occur to the benches due to water erosion before rehabilitation commences. This may prevent the establishment of an optimal solution. Given that slope angles need to be achieved to ensure physical stability conditions for the long term, preventing damage to the benches due to water erosion is a high priority. The rehabilitation is recommended to be carried out as in Figure 5-2.

5.1.1.1 Managing the Open Pit

When the mining activities are over, the bottom elevation of the open pit will be 270 meters and the top elevation of the open pit will be around 700 meters. There are three different rehabilitation options currently identified for the open pit void. While detailed assessment on pit lake formation scenarios are given in Hydrogeological Impact Assessment Report in Volume-III of the ESIA Disclosure Package, highlights of open pit closure are provided below.

Allowing the Open Pit to Fill Naturally

The first option is leaving the open pit as it is with the diversion tunnels in place and allowing formation of a pit lake. This process will eventually create a hydraulic gradient towards the open pit to form a pit lake over a period of time as a result of a combination of groundwater inflow to the pit, direct precipitation and pit wall runoff. In this case, the Gökırmak River will be kept diverted out of the pit preventing the river flowing into the open pit. Conceptual closure conditions for Scenario 1 are illustrated in Figure 5-3.

According to this scenario two different options should be evaluated during the operation phase;

- The open pit area will be bounded by the upstream and downstream cofferdams, in the west and in the east. Assuming that the cofferdams will act as barriers and given that the crest elevation of the downstream cofferdam is 431 m, the pit lake has the potential to overflow the downstream cofferdam into the Gökırmak River. Results achieved from the numerical groundwater flow model indicate that the pit lake will reach to 431 masl within 42 and 57 years depending on different climatic conditions.

- The river will still be diverted out of the pit via the diversion tunnel but the cofferdams will be removed as the mine closure starts. Pit wall runoff will be diverted out of the pit to Gökırmak River downstream by in-pit interception channels. Hence, pit wall runoff is eliminated in this scenario which reduces the amount of water input to the pit lake, resulting in longer period for the pit lake to form. The final post-closure pit water elevation is estimated to be approximately 426 masl which corresponds to the Gökırmak River stage. The resulting lake reservoir will cover an area of 378,268 m^2 with a maximum depth of 156 m. Results achieved from the numerical groundwater flow model indicate that the pit lake will reach to 426 masl within 87 and 140 years depending on different climatic conditions.

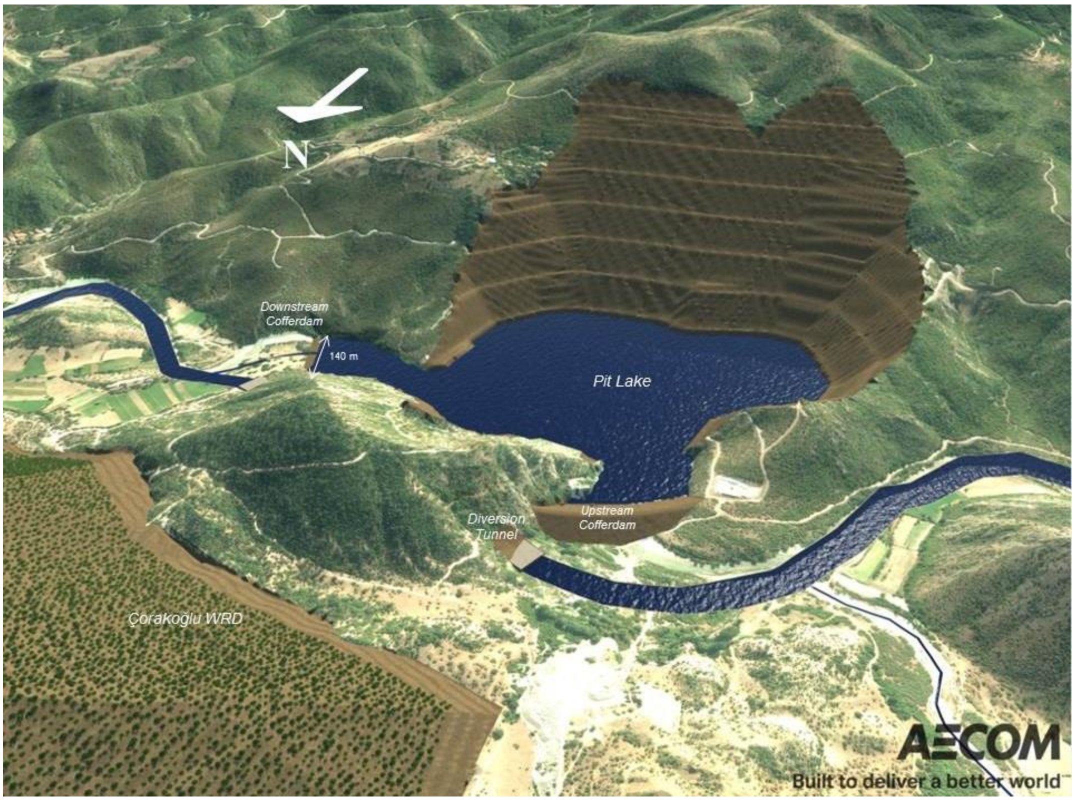


Figure 5-3 Conceptual closure for the open pit to fill naturally

Flooding by the Gökırmak River to Create a Pit Lake

Based on this scenario, the open pit is allowed to be flooded by the Gökırmak River within a relatively short period of time compared to filling the open pit naturally. This scenario involves the removal of the cofferdams and considers the Gökırmak River being reset to its original course during the closure and allowing the river to flow directly into the open pit. According to three runs and assuming different amounts of water need at the downstream, the pit lake level will stabilize ~4 months (Demirci HEPP water use = 10 m^3/s), ~4 months (Demirci HEPP water use = 15 m^3/s) and ~2.5 years (Demirci HEPP water use = 20 m^3/s), respectively, after the closure of mine. Baseflow at the Gökırmak River is also assumed to be persistent throughout the closure phase of the Project. Conceptual closure conditions for this scenario are illustrated in Figure 5-4.

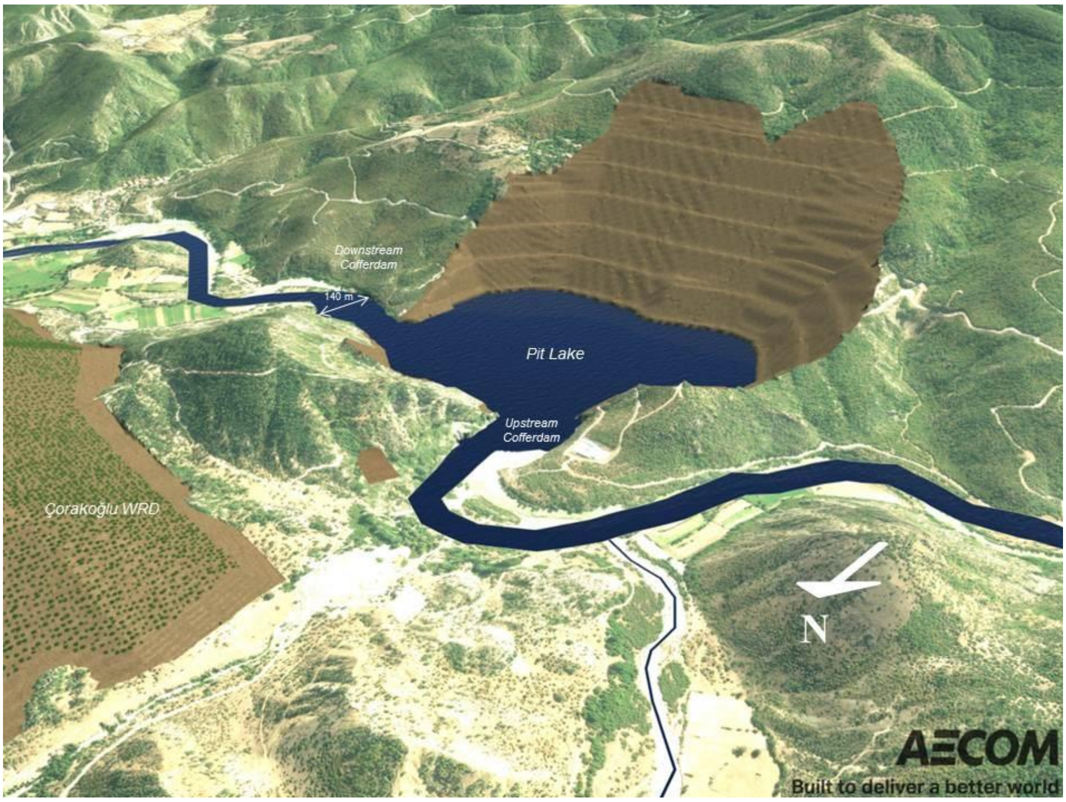


Figure 5-4 Conceptual closure scenario for the open pit to be flooded by the Gökırmak River

Backfilling the Open Pit with Waste Rock Material

Although this scenario can also be considered as another closure option, backfilling the open pit is relatively an expensive alternative compared to the above-mentioned closure options. According to this alternative, at least 30-40 million m^3 of waste rock material would be required to fill the open pit up to the original groundwater level. The required material could be supplied from the waste rock storage area located 1 km north of the open pit. In order to simulate the backfilling option, a water quality modeling study is recommended by AECOM to simulate the rock-water interaction after backfilling.

5.1.2 Chemical Stability

Early avoidance of Acid Rock Drainage and Metal Leaching (ARD-ML) problems is a best practice technique that may be achieved through integrating the results of characterization and prediction in mine planning design and waste management strategies (INAP, 2012) Potential geochemical impacts that may be generated due to mining activities have been studied by extensive geochemical characterization and modeling study by Geochemico Consulting Inc. Detailed report on geochemical characterization and modeling study is presented in Volume-III of the ESIA Disclosure Package while the highlights of the study is provided in Section 7.1 of this report.

5.1.3 Legal Compliance

Closure of the open pit, waste rock dumps, process plant, and tailings storage facilities will be monitored and audited by a number of government agencies. Major portion of the land belongs to the General Directorate of Forestry. After completion of the mining activities, these areas will be returned to the Regional Directorate of Forestry (RDF) provided that rehabilitation has been conducted to the required standard. This standard requires areas to be levelled, to be free from any steep slopes and to have top soil in place. The RDF will not accept the land if it does not meet these requirements. A “Forestry Rehabilitation Report” has been prepared as requested by Ministry of Forestry and Water Affairs (MFWA).

Open pit water quality management and monitoring will be audited by the Ministry of Environment and Urbanization and State Hydraulic Works. These agencies monitor quality of the rehabilitation by taking samples from the open pit lake and groundwater monitoring wells located around the open pit. The agencies may request additional measurements according to the results of the monitoring program. Expansion of the monitoring period or construction of a treatment plant can also be requested from the related agencies.

The legal basis of the mining activities is a mining license which is issued by General Directorate of Mining Affairs (MİGEM). Once the mining activities are over, license will be relinquished. MİGEM will ensure if all required rehabilitation work is achieved before relinquishment. MİGEM will consider the rehabilitation as completed when MİGEM has received the letter from Regional Directorate of Forestry stating that the Forest Department took over the land.

5.1.4 Land Use and Visual Amenity

As the mining operations cease, the un-rehabilitated land form will be unsuitable for human activities. This area should be rehabilitated within acceptable cost limits. Assuming additional studios are supportive, it is likely the preferred closure method will involve filling the pit void with water from the Gökırmak River (Figure 5-5). Combined with rehabilitation of the open pit trenches, the area will likely achieve acceptable visual amenity limits.

The open pit lake could be used for different purposes such as fisheries, pools for fire extinguishing etc. Hanönü province will gain a valuable area with the addition of landscaping works by related agencies.

5.1.5 Human Health and Safety

The risk to public health and safety will depend upon the preferred closure method. For example, filling the open pit with the water of the Gökırmak River may create a drowning risk, which would not be completely eliminated by the erection of a perimeter fence and warning signs. The most appropriate way to prevent this situation is that the related agencies turn the area around the open pit lake into a recreational area and keep the area under control.

Backfilling the pit void with mine waste rock would involve the least risk to public safety, but is the most expensive option, and would deprive the local community with a recreation area.

The option of creating an open pit lake with rainfall and incoming groundwater will take a significant period and will pose a fall risk to the public during its implementation. Results achieved from the numerical groundwater flow model indicates that the time period for the pit lake to reach steady state conditions takes a minimum of 40 years based on natural pit lake formation scenario. In the case of rapid fill scenario with the Gökırmak River to be reset to its original course, then the pit lake is estimated to fill within a time period from a few months to few years depending on the amount of water that the downstream receptors would demand.

5.2 Waste Rock Dump (WRD)

Waste rock excavated during the operation phase will be stored in Çorakoğlu WRD. The WRD is located approximately 1.5 km north of the open pit.Rehabilitation for the waste rock dump area can either be carried out after the operation phase or it can be started and resumed synchronously with the open pit operations, which is the preferred choice of option. This preliminary report provides the details for rehabilitation synchronous to the mining operations.

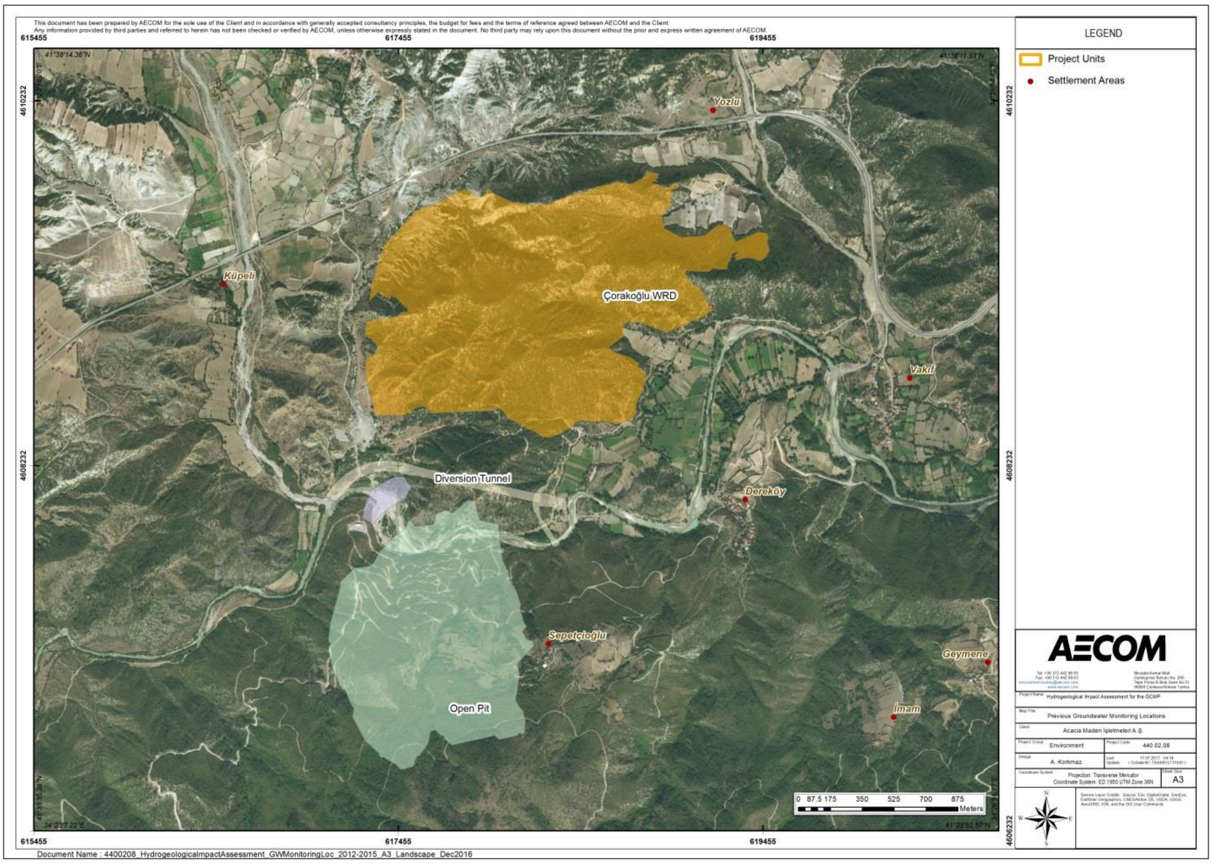


Figure 5-5 Location of the Open Pit, Çorakoğlu WRD

5.2.1 Physical Stability

The 122.5 million LCM waste rock (with the swell factor in consideration) generated during the lifetime of the Project as a result of stripping operations is planned to be stored at the Çorakoğlu WRD. The WRD is planned towards north of the pit, in close proximity since the main criteria for site selection of the waste rock dump areas is minimization of impacts caused by haulage distance such as extent of topography alteration and air emissions, as well as economic factors associated with fuel consumption and time. Çorakoğlu WRD will cover approximately 119.59 ha area.

For waste dump design, the Turkish mining regulations require that the final waste dump landform be stable in long term. Final design criteria for the Çorakoğlu WRD are shown in Table 5-1.

Table 5-1 Waste Dump Designs Criteria

Item	Unit	Value
Bench face angle (BFA)	Degrees	37
Bench Height	m	10
Catch Bench Width	m	6
Overall slope angle (OSA)	Degrees	28
Haul Ramp Width	m	18
Maximum Height	m	240

Source: Updated Feasibility Study (July, 2017)

5.2.2 Chemical Stability

Geochemical behavior of the waste rock lithologies and cover options for WRD areas are studied in detail by Geochemico Consulting Inc. in Volume-III of the ESIA Disclosure Package while highlights of geochemical characterization and modeling studies are provided in Section 7.1 of this report.

5.2.3 Legal Compatibility

Rehabilitation study of site will be inspected by three different governmental institutions. Project site will be handed over to the Regional Directorate of Forestry (RDF) after all mining activities and rehabilitation study is completed. Regional Directorate of Forestry will not issue the rehabilitation before the waste rock slopes are properly rehabilitated. Rehabilitation should include proper grading of the waste rock material, ensuring that there is no crack or gap within the waste rock dump areas and waste rock is covered with top soil.

Ministry of Environment and Urban Planning is responsible for management and monitoring operations of the waste rock dump areas. Rehabilitation impacts will be evaluated by carrying out monitoring studies in groundwater wells that will be drilled at representative locations around the waste rock dump areas. Depending on the results, Ministry of Environment and Urban Planning may require additional precautions. In addition, extension of monitoring period or setting up treatment facilities might also be required by other responsible institutes.

Main legal base of mining activities in the field is the license taken from General Directorate of Mining Affairs (MIGEM). Decisions of General Directorate of Forestry and Ministry of Environment and Urban Planning will also be adequate for MIGEM.

5.2.4 Land Use and Visual Amenity

After completion of mining activities, waste storage areas will relatively look like a pyramid. Stabilization period of the areas are currently unknown. Therefore construction of structures on the WRD surface for human activity is not recommended. Most accurate solution for the site is to afforestation and/or vegetation of the WRD areas which will also make the field esthetically valuable.

5.2.5 Human Health and Safety

Heavy construction equipment will actively take place in rehabilitation of the WRD areas during the beginning period of the closure. Accident risk must be exterminated by precautions. Relatively steep topography of the final WRD geometry poses significant risks human activity on the WRD surface in long term which should be avoided during the closure phase.

One of the other significant risks to human health is the potential degradation of water receptors due to potential seepages from WRD. Although the geochemical studies indicate relatively low ARD-ML potential for the waste rock material (See Volume-III of the ESIA Disclosure Package), periodical monitoring of water quality is strongly recommended during the operation and closure phases of the Project to improve the understanding on geochemical behavior of WRD in long term.

5.3 Tailings Storage Facilities

Information provided in this section is compiled from the Feasibility Report of the Project, the TSFs Siting Study prepared by Hidromark and the TSF Design Study prepared by Hidrodizayn.

A siting study was completed in 2013 by Hidromark in order to determine and select the best location for the tailing storage facility (TSF) required for storing tailings generated from the tailing thickening circuit. The outputs led to the conclusion that the Kepezkaya and Bağdere TSF sites, which are located at the north-east of the mine and process plant areas, adjacent to the town of Hanönü, were the best alternatives.

The sites of the proposed TSFs are located in valleys to the east of the Hanönü District. Preliminary assessments indicate that these two locations have sufficient capacity to store over 13 million m^3 of tailings. Detailed studies were completed for the Kepezkaya site, which has a 5.15 million m^3 reservoir capacity. This requires that the construction of the Bağdere TSF commences approximately in Q3 of year 3 of production. The preliminary studies showed that the Bağdere TSF reservoir capacity will be slightly above 8 million m^3. In total, the tailings storage requirements of the GCP are met.

The TSF design concept consists of a main dam and closing dyke embankments in order to provide valley containment of tailings. The reservoir surfaces and the upstream face of the TSF dam and closing dyke embankments will be lined with HDPE membrane and geosynthetic clay liner (GCL) to ensure impermeability.

The geosynthetic linings were selected as follows, listed from top to bottom:

- Drainage Geocomposite: for the upper drainage system, consisting of a geonet core and a protective geotextile on the tailings side, which resists clogging of the geonet by soil particles. This material also protects the adjacent geomembrane from being damaged.
- Geomembrane: A 2 mm thick geomembrane for impermeability is selected.
- GCL: Consisting of a layer of sodium bentonite between a woven and a non-woven geotextile, which is needle-punched together.
- Drainage Geocomposite: The lower drainage system will utilize the same drainage geocomposite as the upper drainage system, but with the protective geotextile on the soil side.

The linings listed above will be laid over a minimum thickness of 0.5 m support layer wherever possible, being the reservoir basin and slopes with steepness less than 3H/1V.

Drainage systems planned for Kepezkaya TSF include the following:

- A total of six intermittent stream collection structures and diversion channels around the reservoir are planned to divert the rainfall runoff within the valley catchment. The diversion channels will discharge the flows to the downstream side of the TSF with the aid of chute channels and energy dissipaters.
- The upper drainage system was designed to collect the contact waters leaching from the waste. All applied impermeable layers and dam embankment upstream face will be layered with a drainage geocomposite with the above mentioned specifications, as well as an additional mesh type drainage system. In addition, at least a 3° inclination will be ensured from the upstream side to the downstream side and also from left and right banks to the center. The collected water will be diverted by the drainage geocomposite and drainage system to the high strength HDPE perforated pipes installed at the bottom, below respective filters. These pipes will transfer the water to the upper drainage collection pit.
- The lower drainage system will collect and divert groundwater flow, especially increasing seasonally by melting of snow and/or heavy rain events, from below the impermeable layers to prevent any such flow's damage to the dam and installed impermeability structures. The system will consist of drainage trenches, which will also serve the purpose of anchorage for fixing the geosynthetics.

All materials for the impervious linings and drainage systems were selected by considering the chemical contents of the tailings and underground waters, which includes 100% polypropylene and HDPE geosynthetics and pipes.

It should be noted that, although definitive design and parameters are subject to change, Bağdere TSF will also utilize similar impermeability and drainage measures.

Tailings will be transferred to TSFs via open-ended discharge points, spigots connected to a 3.8 km slurry pipeline that will be constructed routed across the main embankment and around the west side of the TMF, together with its own maintenance roads.

Below steps can be practicable for rehabilitation of the tailings storage facilities;

- Prior to closure, free water recommended to be drained out completely and to be evaporated at least 1 year.
- After ensuring that the tailings material is dry, an initial layer is recommended to be formed with waste rock backfilling above the tailings. A 0.5% surface slope angle would help the rain waters to be drained out of the surface.

- As the second layer, a 30 cm thick clay material is recommended to be laid above the waste rock to create an impermeable layer.
- For the drainage of water on the surface, 10 cm thick gravel package will be laid and at least 20 cm of soil will be overlaid.
- All rainfall will be drained to downstream through zoning channels.
- Surface will be vegetated with grass.
- Tailings storage facilities will finally be banned for construction and kept as vegetated areas.

Initiation of the rehabilitation will finally be approved by the Ministry of Environment and Urban Planning. All rehabilitation works will finally be terminated with an approval from both the Ministry of Environment and Urban Planning and General Directorate of the Forestry. Monitoring wells will be drilled upstream and downstream site of tailings storage area. Samples will be collected and analyzed periodically from these monitoring wells.

5.4 Process Plant

Rehabilitation will commence after production is completed. Salvage and scrapping of plant and structures will be undertaken and will provide cash flow during the mine closure period. Suggested rehabilitation steps for the processing plant are described below:

- All material which has been in contact with oil or chemicals will be washed. Waste water will be pumped into tailings storage areas with existing lines.
- Ore stockpile area will be scratched and moved to waste rock dump areas.
- All economically valuable equipment will be separated and sold (Tank, engine pump etc.).
- Pipes carrying waste will be removed.
- All areas that are contaminated with waste oil during the removal operation will be disposed and sent to a licensed waste disposal facility.
- Economically valuable steel constructions and other metals will be recycled.
- Remaining parts will be removed to be sent to solid waste disposal facilities.
- All concrete structures and foundations will be removed and the area will be rehabilitated.

Most of the processing plant area is forestry land. After the completion of the necessary requirements the site will be returned to the appropriate government authority.

5.5 Roads

Permanent roads constructed during planned mining and processing operations will not be removed during rehabilitation as they will be useful for further usage. Ore transportation road between the open pit and facility will be used by both Acacia and local people.

5.6 Diversion Tunnels

The first activity prior to mining commencing is the construction of the diversion tunnels and the upstream and downstream cofferdams to divert the Gökırmak River from the open pit area and return it to its natural course downstream of the project area. The final closure option for the diversion tunnels will be discussed and determined in consultation with the State Hydraulic Works, the Forestry Department and local state institutions.

Partial distraction of upstream and downstream cofferdams provides old channel flow to stream water. Remaining body parts of cofferdams may be kept as its own place or removed to open pit or waste storage area.

Derivation tunnels may rehabilitate in a different way. Partially, entrance and exit of the tunnels might be closed. Moreover, these tunnels can be further used for farming and/or for storage area for different kind of agricultural products.

Negotiation among general directorate of State Hydraulic Works, Forest Management and local management will be leading mutual decisions. This closure plan assumes the diversion tunnels will be rehabilitated in accordance with this final decision and no extra cost will be associated with closure of these tunnels.

6. Development of Completion Criteria

Mine closure and completion criteria for AMI to eliminate and/or reduce the impacts of mining and mineral processing and to reach a long-term stability of the mine units after mine closure and reclamation. AMI's ultimate objective is to leave the Gökırmak Copper mine area in a condition that meets regulatory requirements and satisfies other stakeholder expectations.

The completion criteria outlining the closure objectives are summarized below:

- Compliance with regulatory requirements,
- Compatibility with agreed post-mining land use,
- Physical safety,
- Physical and chemical stability,
- Revegetated or otherwise improved,
- Satisfactory visual amenity.

Compliance will be achieved on specified criteria above, by the methods provided in Table 6-1.

Table 6-1 Gökırmak Copper Mine Compliance Criteria

Criterion	Criterion Objective	Mine Unit	Criterion Standard or Milestone	Verification Procedure
Final Land Use	Agreed final land use will be applied.	All	End land use for the open pit area will be partially an open pit lake and partially forestry land. The final land use of waste rock dump areas, Kepezkaya Processing Plant, and tailings storage areas will be forestry land. However, there would be a continuous consultation work with relevant stakeholders, and administering authority during the life of the mine for final land use of Project units.	Land use and objectives are documented in the Mine Closure Plan and will be verified by a mine closure audit during final cessation of mine operations.
Safety	The site is safe for use by humans and wildlife under the agreed final land use.	All	All hazards that could endanger the safety of any person or animal will be identified and eliminated where possible, or will be controlled through appropriate active control measures (e.g. fences, warning signs, etc.).	All relevant Turkish safety regulations will be applied. Safety of all mine unit sites will be controlled by related regulatory body via an audit for safety of human use.
Mine Unit Stability	Reclaimed mine units are physically and chemically stable.	All	Mine units will be rehabilitated as described in criterion "Final Land Use". Their structural stability will be checked and no significant or failure of constructed slopes or berms will be allowed. The physical and chemical stability of mine units will be controlled especially for erosion, water leakage, ARD occurrence. Inspections of the rehabilitated mine units will be conducted to monitor their physical and chemical stability over time.	Reports on mine unit rehabilitation and required maintenance will be prepared. These proposals will be controlled via rehabilitation inspections.
Visual Amenity	Visual amenity of rehabilitated mine units will be harmonious with that of regional landforms.	All except Open Pit Lake	All mining units will be rehabilitated in a manner that they are blending into the surrounding landscape and are similar to the existing local landforms.	Report on rehabilitation works and rehabilitation inspections will be validated the final visual amenity.

Criterion	Criterion Objective	Mine Unit	Criterion Standard or Milestone	Verification Procedure
Sustainability	Rehabilitation is sustainable and the land capability for the agreed end land use. Surface and groundwater quality will be similar to pre- mining conditions or better.	All where relevant mine units.	Monitoring, research data and site inspections will indicate that the rehabilitation will be sustainable and will continue to fulfil rehabilitation objectives relating to the agreed final land use in terms of flora, vegetation, and fauna. Additionally, surface water and groundwater quality is similar to pre-mining conditions or better.	This data will be documented in relevant monitoring and research reports; and verified by site inspections.
Vegetation Development	Vegetation is suited to the agreed final land use.	All with revegetation	Established vegetative cover should be self-sustaining and similar to the surrounding undisturbed vegetation. Monitoring of rehabilitated areas will be undertaken until it can be demonstrated that the landscape and vegetation is progressing towards a self-sustaining state. A target for revegetation cover will be developed.	Monitoring of rehabilitation development vegetation. Monitoring results will be reported in site inspections and rehabilitation monitoring sites to assess whether criteria have been met.
Surface Hydrology	Rehabilitation drainage patterns have been established and impacts on natural surface water flows minimized.	All where relevant	The quality and quantity of water returned to local and regional surface water resources will be in similar prior to mining. Surface water quality should fall within same Turkish Water Quality standards similar to conditions prior to mining. Water quality monitoring of surface water will be undertaken after significant rainfall events, and monitoring results will be reported. There are no significant, physical off-site impacts. A drainage management plan will be prepared, showing the inputs, outputs and control structures needed for surface water flow.	Monitoring results will be reported. Site inspection to verify no unplanned impacts on surrounding natural drainage patterns.

Criterion	Criterion Objective	Mine Unit	Criterion Standard or Milestone	Verification Procedure
Groundwater Hydrogeology	Mining-related impacts on groundwater will be minimized.	All where relevant	In the event that monitoring identifies a contamination of groundwater resources in the open pit, waste rock dump areas, processing plant, and tailing storage facilities, an investigation will be conducted to determine whether the contamination is the result of mining related activities; and where this is the case, management measures will be implemented to decontaminate the affected area.	Review compliance of operations with the relevant water extraction license(s) issued by DSI. Review of water monitoring reports to ensure there are no unplanned impacts to receptors.
Infrastructure	Infrastructure will be decommissioned and removed (as not otherwise agreed by the stakeholder consultations)	All infrastructure exists	Final usage of some infrastructures (make-up water pipeline, haulage roads, etc.) will be decided by stakeholder consultations. Afterwards required arrangements will be signed with the related governing bodies. Infrastructure not required will be removed (recycled/reused where possible) and the site will be rehabilitated to the approved post-mining land use.	Site inspection and documentation of infrastructure removal and related rehabilitation operations.
Contaminated Sites with hydrocarbons	Sites with hydrocarbons contamination will be documented and rehabilitated according to the Turkish regulations	All where relevant	All commitments relating to the identification and management of contaminated sites, as per Regulation on Soil Pollution Control and Point Source Contaminated Sites 2010 will be fulfilled.	Report documenting compliance with specific requirements.

7. Identification and Management of Closure Issues

The overall objective of sustainable closure and rehabilitation of the GCP will be achieved with operational level management that will ensure a cohesive, integrated outcome. Therefore an adaptive management approach will be utilized, which will include a risk assessment procedure to identify the issues that will be important at mine closure.

Modelling and assessment tools will guide the application of management approaches to address closure issues. Monitoring programs during construction and operation period will provide data and information to support the progressive development of the mine closure strategy. Rehabilitation trials and research studies will be utilized to inform closure and rehabilitation planning.

Outcomes of the studies and investigations subsequently will provide increased knowledge to specific closure strategies and design features for the mine units. Additionally the involvement of stakeholders and specialists will be important to decide the final mine closure scenarios.

A Closure Planning Risk Assessment was undertaken for the Hanönü Copper Mine with consideration given to the issues summarized in Table 7-1.

Table 7-1 GCP Closure Issues Summary

ARD Potential	Surface Waters	Groundwater	Final Landform	Rehabilitation
• Waste Rock Storage Areas • In pit walls. • Tailings storage facilities	• Flow and quality • Design and maintenance of management structures	• Flow and quality • Pit lake formation • Groundwater quality	• Stability of mine voids and waste rock storage area • Closure of the mine void (backfill or pit lake) • Closure of the tailing storage facilities • Visual amenity	• Growth media • Soil management • Revegetation • Fauna habitat

Management of these identified issues is briefly discussed in the following sections.

7.1 ARD-ML Potential

7.1.1 Çorakoğlu WRD

The proposed waste rock dump will incorporate greenschist and mixed schist together with small proportions of mineralized vein waste and alluvium. Waste rock loading rates were calculated from static and kinetic testing of waste rock samples and two sets of loading rates; the base case (median loading rates), and the worst case (95th percentile loading rates) were modelled for the proposed Çorakoğlu waste rock dump.

Mass balance/PHREEQC modelling of the Çorakoğlu waste rock dump without a constructed cover showed that principal contaminants of concern (PcoC) are: As, B, Na, Ni, Se, Sb, V, and Zn, and occasionally, acidity. An engineered cover consisting of locally available clay, gravel and overburden is described and tested from a hydrogeological perspective. The waste rock dump was re-modelled utilizing the engineered cover and very significant reductions in leachate concentrations at the toe of the dump are achievable using the engineered cover.

The probable environmental impact of the waste rock dump leachate on the Gökırmak River for both the base and worst case, with the engineered cover installed, was calculated using mass balance/PHREEQC modelling. The river water is naturally exceedant in sulphate. No other exceedances were found to be caused by the discharge of mine leachate, in fact the sulphate concentration of the river water is slightly diluted by the toe of dump leachate, after settling.

The overburden beneath the Çorakoğlu waste rock dump is generally relatively impermeable. Modelling of infiltration rates of the waste rock dump pore water into the underlying overburden by combining the Aecom (2017) hydrogeological model with the mass balance/PHREEQC modelling reported herein showed that only very small quantities of pore water reach the

Gokirmak River receptor 79 years after WRD construction. No elements will exceed EU regulatory guidelines, except for sulphate, which is naturally exceedant in the river.

7.1.1.1 WRD Cover Design Objectives

The purposes of an adequate WRD cover design for the GCP are listed below:

- To allow re-vegetation of the WRD during the mine closure.
- To minimize the influx of precipitation into the WRD, therefore minimizing the flow of leachate at the toe of the dump and maximizing dilution by run-off.
- To prevent erosion.
- To prevent pore water present in the WRD from rising upwards, thereby forming a vadose zone in the upper zone of the WRD and potentially killing vegetation as well as mobilizing secondary alteration minerals.

There are three material types at the GCP that may be utilized for a cover design, overburden/soil (Shown by static testing not to be potentially ARD generating (Geochemico, 2016a), clay and locally available gravel (Geochemico, 2017).

7.1.1.2 WRD Cover Design

The proponent initially suggested a cover of gravel, overlain by overburden to allow re-vegetation. The local gravel possesses a sufficiently high saturated hydraulic conductivity, however, that such a cover would allow all the incident rainfall to pass into the WRD, although slightly delaying the influx of precipitation. Such a design would not allow the attainment of cover criteria (2) although all other cover criteria would be met. Consequently, a more appropriate cover design was sought, using locally derived materials, especially in view of the potential of the WRD to generate metal leaching.

The proposed cover design for the Çorakoğlu WRD is shown in Figure 7-1. This cover design, allowing the attainment of all criteria is formed of a ‘sandwich’ of a lower layer of gravel (nominal thickness 15 cm), itself covered by a layer of clay (nominal thickness 0.5 m) with an additional upper layer of gravel (nominal thickness 10 cm), which is itself covered by soil/overburden to facilitate re-vegetation (Figure 6-4). Rainfall on the WRD will pass through the upper vegetated soil layer, some of it evaporating and a portion of the rainfall will be transpired into the atmosphere. Evaporation was modelled but not transpiration as this factor depends greatly on the type of vegetation, biomass, leaf area etc., which at this point are unknown. Choosing not to model the transpiration also renders the cover model more conservative. The upper layer of gravel will transport rain water through it to the layer of clay, while also protecting the clay layer from erosion and from desiccating. Most of the rain water passing into the upper gravel layer will move horizontally and report to the seepage collection pond via the seepage collection ditches surrounding the WRD, where it will dilute any leachate from the WRD. The clay layer, remaining saturated, will allow throughput of a very small amount of rainwater into the lower gravel layer. The lower gravel layer receives a small increment of water each quarter from rainfall and a small increment from WRD pore water moving vertically by capillary action up into the gravel. Modelling of the capillary movement of water upwards through the lower gravel layer indicates the pore water will not reach the lower gravel/clay interface. Effectively, no rain water will be able to percolate through the three cover layers. Modelling of the engineered cover indicates that the design is very resilient to any changes to climate patterns that may be caused in the future by climate change (Geochemico, 2017).

Details of the mass balance – PHREEQC modeling study to characterize the Çorakoğlu WRD is provided in Volume-III of the ESIA Disclosure Package (Results of Mass Balance / PHREEQC Modeling of the WRD at the Gökırmak Copper Project, Kastamonu, Turkey).

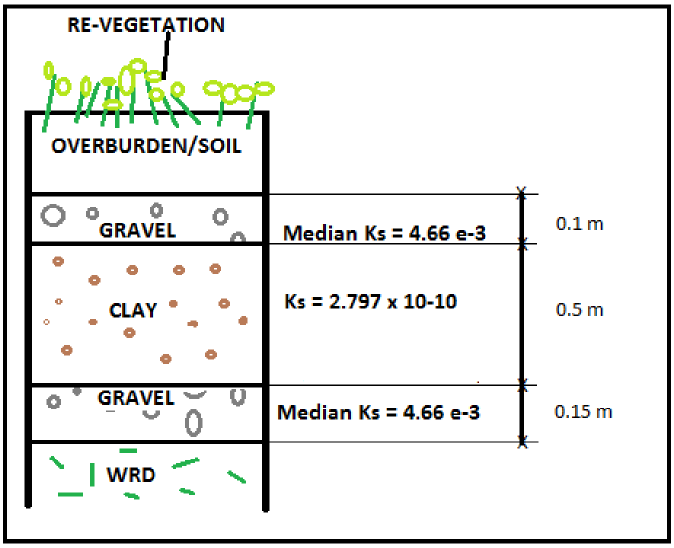


Figure 7-1 Proposed WRD Cover Design for the GCP (Geochemico, 2017)

7.1.2 Open Pit Lake

With reference to the mass balance/PHREEQC modeling studies to geochemically characterize the pit sump (Geochemico, 2017), the proposed open pit will incorporate greenschist and mixed schist together with small proportions of mineralized vein waste or ore in the pit walls, floor and constructed benches. Waste rock loading rates were calculated from static and kinetic testing of waste rock samples and two sets of loading rates; the base case (median loading rates), and the worst case (95th percentile loading rates) were modelled for the proposed open pit.

Three scenarios were modelled; the first two involve flooding of the pit after the cessation of mining activities and allowing the pit lake to overflow into the Gokirmak River. The third scenario involves removing all coffer dams and allowing the Gokirmak River to flow into the open pit after pit closure. Mass balance/PHREEQC modeling showed that all scenarios are associated with parameter exceedances compared to Turkish and EU drinking water standards in the early phase of mining. Scenarios one and two were also associated with parameter exceedances during the pit flooding phase.

Study of the environmental impact of the three scenarios on the Gokirmak River showed that scenarios one and two are associated with Na exceedance in the river, although they also dilute the naturally present sulfate exceedance in the river. Scenario 3 only very slightly dilutes the natural sulfate in the river and shows a very small exceedance in pH for maximum pH values. Scenario three appears to represent the optimal option for pit flooding, although it is likely to be associated with sedimentation issues that require further evaluation.

Following conclusions are drawn based on the geochemical modeling study conducted by Geochemico Consulting Inc.

- Three pit flooding scenarios are examined from an environmental impact perspective using mass balance/PHREEQC water quality modeling. On balance, scenario 3 (allowing the Gokirmak river to flow through the open pit after closure, appears to be the optimal scenario, however, it is associated with sedimentation issues, the evaluation of which are outside of the scope of this report;
- Scenario 1 resulted in pit sump/pit lake exceedances for pH, sulfate, F, Mn, Al, As, B, Fe, Pb, Na, Ni,Se, Sb, Cr, and Cd during both the opening years of mining and during pit lake flooding. The exceeding Al, As and Mn were persistent through much of the life of the pit sump/pit lake;
- Scenario 2 resulted in pit sump/pit lake exceedances for pH, sulfate, F, Al, As, B, Cr, Fe, Hg, Na, Ni, Pb, and Se during both the opening years of mining and during pit lake flooding. Al, As and Fe exceedances were somewhat persistent through the life of the pit sump/pit lake;
- Scenario 3 resulted in fewer parameter exceedances in the pit sump compared to the other scenarios (pH, sulfate, F, Al, As, Na, Ni, Se and Sb) and these only occurred during the initial few years of mining;

- Modeling of the environmental impact of the three scenarios on the Gokirmak River showed that scenarios one and two reduced the sulfate content of the river, but developed Na exceedance. Maximum pH values in the river, from scenario three, slightly exceeded the EU guidelines and the natural sulfate exceedance in the river was reduced very slightly;
- The pit lake is extremely unlikely to contaminate the groundwater present in pore spaces of the host lithologies due to the upwelling of groundwater into the pit lake.

Scenario 3 appears to be the optimum methodology for open pit flooding; however, it is associated with sedimentation issues. The maintenance, safety and engineering aspects of the sedimentation should be investigated before selecting this option.

7.1.3 Tailings Storage Facilities

With reference to the mass balance/PHREEQC modeling studies to geochemically characterize the changes in chemistry and mineralogy that occur as leachate from the proposed Kepezkaya TSF (Geochemico, 2017), The Kepezkaya tailings leachate is the product of acid rock drainage, and is not only extremely acidic but also contains high concentrations of sulfate, Al, As, Cd, Cr, Cu, Fe, Pb, Mn, Zn and Ni. The bedrock pore water mixes with is slightly alkaline and contains elevated sulfate concentrations.

Based on the geochemical modeling results, the tailings seepage was found to rapidly increase in pH following reaction with carbonate minerals in the bedrock and mixing with bedrock pore water. The increasing pH causes precipitation of a series of mineral phases into the bedrock pore spaces, effectively sealing the bedrock and preventing further migration of the tailings seepage.

The complete reduction of porosity in the bedrock pore spaces beneath the perforation in the geosynthetic liner prevents further migration of the tailings seepage; effectively preventing the tailings seepage from ever reaching any environmental receptors.

Following conclusions are drawn based on the geochemical modeling study conducted by Geochemico Consulting Inc. (Geochemico, 2017).

- Estimation of the Kepezkaya tailings storage facility pore water using ninety-fifth percentile concentrations for the last five weeks of humidity cell testing data indicate that it is likely to be highly acidic (pH 2.7) and will probably be exceedant, with respect to Turkish and EU drinking water regulatory standards, with regard to: pH, sulfate, Al, As, Cd, Cr, Cu, Fe, Pb, Mn, and Ni concentrations. Zn concentrations are also expected to be elevated;
- Estimation of the pore water chemistry in the bedrock underlying the Kepezkaya tailings storage facility, using shake flask testing data, indicates it will be slightly alkaline and only the sulfate concentration will exceed Turkish and EU drinking water regulatory standards;
- PHREEQC modeling of the interaction between the tailings and bedrock pore water and the bedrock mineralogy indicate that there will be an initial rise in solution pH as carbonate minerals in the bedrock lithologies are dissolved, followed by precipitation of numerous mineral phases within the bedrock pore spaces;
- Calculation of the rate of rapid dissolution of calcite as the tailings pore water meets bedrock and bedrock pore water, as well as the mass of rapidly precipitating mineral phases caused by the subsequent rise in pH of the groundwater, indicates that the bedrock pore spaces beneath a perforation in the geosynthetic liner will become clogged very rapidly, thus preventing further migration of the tiny contaminant plume;
- Based on the PHREEQC modeling described above, it is extremely unlikely that any tailings seepage will migrate more than a very small distance from a geosynthetic liner perforation and therefore will be unable to cause any environmental impact regarding nearby environmental receptors.

7.2 Groundwater

Should pits be left as open voids after the completion of mining, pit lakes will develop that reach equilibrium on a balance of pit inflows and evaporation. Potential hydrogeological impacts that may generate due to pit lake formation were assessed within the scope of the Hydrogeological Impact Assessment given in Volume-III of the ESIA Disclosure Package and summarized in Section 5.1 of this report.

Although different pit lake formation scenarios were evaluated within the scope of the study, AECOM recommends the optimal closure of the pit will be decided during the operational phase as the long term data from pit dewatering and on-site meteorological station is collected.

Taking the account that the information on pit lake water quality is currently limited, three scenarios have to be reevaluated again during the operation phase of the Project. Ongoing monitoring on pit lake water level, groundwater levels in monitoring wells, and water quality will be performed during the closure. Monitoring on upstream and downstream Gökırmak River will be carried out to improve the long term understanding on flow rates and water quality during the closure phase of the Project.

7.3 Surface Water

The surface water system at closure will be designed to meet the closure principle of no significant impact on baseline surface water quality and flow regimes in nearby rivers. Key considerations will include an assessment of the likelihood of the mine voids that will 'capture' creek lines, or that the risk that major weather events will result in damage to surface water controls that may in turn have long term consequences. The design of surface water management works to meet operational needs will include consideration of closure requirements.

The surface water management post closure will focus on ensuring the long term stability of the WRD as well as the Gökırmak River. The closure design will consider:

- Surface water runoff from the WRD,
- The Gökırmak River section adjacent to the open pit,
- The diversion/realignment of the Gökırmak River.

The drainage from the WRD and any upstream catchments will be managed to ensure landforms are stable in the long term. The natural river next to the pit will include flood protection bunds for protection during operation. The flood protection works required for closure will need to be stable. In the river section which will be diverted for mining operations, the initial diversion design will consider closure requirements. The systems will be designed to achieve comparable hydraulic and geomorphological characteristics to the original river system. Seepage from the river base and interaction with groundwater should be studied and measures implemented to reduce seepage where appropriate.

Based on the current state of knowledge surface water closure issues will be addressed by:

- Data collection to improve understanding of the river hydrology,
- Investigation of the suitability of operational surface water controls and the required modifications to meet closure requirements.

7.4 Final Landforms

The post mining landform design needs to be progressively developed and updated, taking the account of all closure domains. Critical to the transfer of the operational domains, to a successful and sustainable landform design is a fundamental understanding of the chemical and physical properties of the soil and/or waste material used to construct the final landform. In particular, the surface materials must be appropriate to withstand erosive forces and sustain vegetation growth in the long term. Inherent in this consideration is the water and nutrient holding capability of the growing media. Similarly, its chemical properties must have low ARD risk.

Based on the current state of knowledge the final landform for the project's closure and rehabilitation will be developed iteratively throughout the life of the mine to integrate the suite of mine closure domains and be guided by further studies including ARD.

7.5 Rehabilitation

The revegetation program will be designed to establish native vegetation that blends with the surrounding areas and provides habitat and foraging areas for native fauna. The establishment of a robust soil profile is critical for the successful establishment of vegetation. Prior to use in rehabilitation, topsoil is stripped and stored (if required) in accordance with the procedures provided in ESIA Disclosure Package. The study will establish the quantity of current stockpiled material in addition to identifying alternative growth media materials within waste stockpiles that can be utilized for rehabilitation activities. The rehabilitation standard requires that revegetation be conducted so as to establish plant species that will support the approved post-mining land use. The selection of plant species used is to be selected from the revegetation species lists generated for each site as part of planning works, and must include a range typically suited to the post-mined landform. The diversity of vegetation types used in rehabilitation must be maximized in order to improve the habitat.

8. Closure Implementation

This preliminary plan will be revised every three years and will be finalized at least two years prior to the planned end of Gökırmak Copper Project, a revised Mine Closure Plan to contain more specific detail on the planning and implementation of the decommissioning phase. Any issues and programs regarding mine closure should be reviewed and updated regularly to implement any change that might occur during the operation phase of the Project.

In addition to the topics provided in previous sections, information obtained from operational activities and ongoing environmental monitoring (mine water quality and quantity, onsite meteorological data, air quality, soil quality and etc.) will help to improve strategies on rehabilitation. A progressive rehabilitation needs to be implemented by taking the account of;

- Updated design of final landforms,
- Design of drainage structures for successful management of mine waters,
- Revision on source and amount for different type of earthwork materials to be used during rehabilitation,
- Effective re-vegetation of the disturbed mining units,
- Ongoing monitoring on rehabilitation.

Taking into account that GCP is currently in construction phase, existing level of detail on strategy and activities on decommissioning phase of the Project is limited. Therefore, several other issues should be further refined for the decommissioning phase of the Project. Some of these include but are not limited to:

- Demolition decommissioning of mining facilities and infrastructure,
- Review of monitoring plan for finalizing the post closure monitoring and maintenance program,
- Completion of rehabilitation,
- Ongoing consultation with stakeholders.

9. Closure Monitoring and Maintenance

The mine closure monitoring plan is of primary importance in sustaining an agreed post-mining land use and to track the progress of rehabilitation. The monitoring plan will ensure the rehabilitation plan meets the legislative requirements as well as preventing/minimizing long and short term environmental impacts.

The monitoring program has been developed considering all significant structures and their potential impacts. The monitoring plan is based upon the monitoring program developed within the scope of the Environmental and Social Impact Assessment (ESIA) studies. Considering the location of the project infrastructure and the environmental factors specific for the prospect site, an updated closure monitoring program has been developed by AECOM. This section provides on overview of that program.

The mine closure monitoring program will address the following issues:

- Surface water and groundwater monitoring,
- ARD-ML and water quality monitoring,
- Soil quality monitoring.

The closure monitoring plan will comprise field sampling studies and in-situ field parameter measurements at selected monitoring locations. Analysis results will be archived and shared with ministry officials as required.

It is recommended that the closure monitoring program should be progressively evaluated throughout the course of the construction and operation phases of the project to better identify the final closure strategy for the GCP.

9.1 Mine Water Monitoring Plan

AA monitoring program was developed for water resources in order to prevent/minimize potential risks that might arise during the construction, operation and closure phases of the Project. The monitoring plan will comprise both in situ measurements and field samplings that aim to monitor the quantity and quality of the surface waters and groundwater over the project phases. Water monitoring plan will be implemented in compliance with the relevant regulatory criteria for surface waters and groundwater. Monitoring will be continued 10 years after the closure phase starts unless any significant change in water quality during the closure is observed. Monitoring plan and monitoring frequencies are provided in Table 9-1 and Table 9-2 while the details are presented below. Locations for the monitoring locations are shown through Figure 9-1 and Figure 9-3.

9.1.1 Surface Waters

Gökırmak River and its sidelong branches

Surface water locations along the Gökırmak River and its sidelong branches will be monitored to ensure there is no adverse impact which might originate from the mining activities. Field parameters / flow rate measurements and water quality sampling will be carried out. Analysis results and field measurements will be compared with relevant EU criteria and the quality criteria specified in Annex 5 – Table 5 of the Turkish Surface Water Quality Regulation.

Open pit lake

In order to evaluate groundwater inflow to the open pit during the operational phase, flow rate measurements and field parameters will be carried out monthly. Pit lake water quality will be monitored by collecting samples from the pit lake quarterly in a year.

As the mining activities are terminated and the groundwater level starts to rebound back to its original position, monthly measurements of flow rate, pit lake water level and field parameters will be carried out. Samples from the open pit lake will be collected quarterly in the first two years of the post-closure phase, semi-annually between 2nd and 4th years of the post-closure and annually for the latter periods of the post-closure phase. Analysis results will be compared with relevant EU criteria and Inland Water Quality Criteria specified in Table 1 of the Turkish Water Pollution and Control Regulation.

Diversion tunnel outlet flow rates

Flow rate and field parameters will be measured at the outlet of the diversion tunnel to monitor the amount of water that will be diverted. This will further provide a long term dataset for the Gökırmak River within the Project Area.

Sedimentation ponds

In reference to Mine Water Management Report prepared by RPS Aquaterra (RPS, 2015 – See Volume-III of the ESIA Disclosure Package), pit dewatering / pit wall runoff waters and WRD seepage waters will be captured in downstream sedimentation ponds. As for the selection of sedimentation ponds that will be used for monitoring purposes, locations and IDs specified in RPS Aquaterra's Mine Water Management Report was used. In order to determine the quantity and quality of seepage waters, collected water volumes will be measured monthly along with field parameters. Sampling surveys will be carried out quarterly.

Analysis results will be compared with relevant EU criteria and Inland Water Quality Criteria and Effluent Discharge Criteria for Mining Industry Wastewaters (prior to discharge, if any) specified in Turkish Water Pollution and Control Regulation.

9.1.2 Groundwater

Open Pit Monitoring Wells

Groundwater wells located in the upstream and downstream locations of the open pit will be monitored for field parameters and groundwater levels. Water quality sampling surveys will be carried out in the monitoring wells. A total of 11 new monitoring wells will be installed in the pit area to monitor groundwater quantity and quality while one well, already drilled within the schists, will also be used for monitoring purposes. Three wells will be installed on the western, eastern and southern boundaries of the pit while seven wells will be installed in the areas where the cofferdams are located. These wells will be completed prior to commence production. Monitoring purpose for the open pit wells are provided below:

Three monitoring wells (GK-15, GK-16, GK-17) to monitor water levels and water quality. Dewatering impacts will also be monitored from these wells during the operational phase. The wells are recommended to be completed with a casing and screen diameter of 175 mm. The well depths should extend 20 m lower than the ultimate pit bottom at each well location.

Three monitoring wells next to upstream cofferdam to monitor water levels and water quality within the alluvium (GK-22 and GK-23) and schist (BOBH). Alluvium wells are recommended to be constructed with large diameter (Ø >= 280 mm) for an additional purpose of emergency pumping, if needed. Monitoring wells within the schist are recommended to be completed with a casing and screen diameter of 175 mm.

5 monitoring wells next to downstream cofferdam to monitor water levels and water quality within the alluvium (GK-18, GK-19, GK-20 and GK-30) and schists (GK-21). Alluvium wells are recommended to be constructed with larger diameter (Ø >= 280 mm) for an additional purpose of emergency pumping, if needed. Monitoring wells within the schist are recommended to be completed with a casing and screen diameter of 175 mm.

In addition to the above-mentioned 11 monitoring wells, one pumping well (WSW-1), currently being used for water supply purposes for the Küpeli and Aşağıküreçay villages, and one monitoring well in the west of the open pit (GK-27) will also be monitored in terms of water levels and water quality.

Waste Rock Dumps Monitoring Wells

Groundwater monitoring in the Çorakoğlu WRD will be carried out in 5 monitoring wells to detect any potential seepage in downstream. Since the groundwater table forms an irregular mound in the Çorakoğlu Hill and groundwater flow occurs radially from the zone of groundwater high, potential flow paths will be monitored in the wells. In addition to the previously-drilled GK-6 and GK-7 wells, three more wells will be drilled for monitoring purposes. Field parameters and water levels will be monitored and water quality samplings will be performed in the monitoring wells.

Tailings Storage Facilities Monitoring Wells

Groundwater monitoring in the Kepezkaya TSF will be carried out in 4 monitoring wells to detect any potential seepage in downstream. In addition to the previously-drilled GK-13 and IK-3 wells, one monitoring well will also be drilled in downstream to monitor southwest end of the TSF. One monitoring well (GK-14) will be installed in the upstream of the Kepezkaya TSF in order to collect data from un-impacted zone. Field parameters and water levels will be monitored and water quality samplings will be performed in the monitoring wells. As for the Bağdere TSF, in addition to previously-drilled wells, one monitoring well in the un impacted upstream zone (GK-31) will be installed. Furthermore, one more downstream monitoring well on critical flow path (GK-25) will be needed. Therefore monitoring in Bağdere TSF will be conducted in four monitoring wells. Analysis results will be compared with relevant EU criteria and Inland Water Quality Criteria specified in Table 1 of the Water Pollution and Control Regulation.

A total of 28 monitoring wells (8 existing wells, 20 additional wells) will be installed in the Project Area to monitor groundwater levels and groundwater quality representative for each project unit. AECOM recommends real time monitoring (groundwater levels, pH and EC) in the TSF monitoring wells in order for Acacia to detect any potential impact early enough to take action.

Springs, Fountains and Village Water Depots

In order to monitor any potential impact of the mining activities on drinking water, springs, fountains and village water depots located in the downstream of the project units will also be monitored. These locations will be monitored for field parameters and flow rate measurements. Water quality sampling surveys will also be carried out in accordance with the intervals specified in Table 9-1.

9.1.3 Process Waters and Operational Structures

Tailings samples will be collected and analyzed in accordance with relevant regulatory criteria. In order to monitor site water balance, daily flow rates of the process tailings that is to be transmitted to TSFs will be measured. Stability and durability of the operational structures such as TSF embankments, diversion channels, sedimentation ponds and culvert structures will be inspected regularly to ensure if they function properly throughout the project lifetime. This will ensure that the stability of the structures is maintained over long term.

Document Name : 4400208_HydrogeologicalImpactAssessment_MonitoringPlan_GW_130917

Figure 9-1 Groundwater (Monitoring Wells, Sprigs and Water Depots) Monitoring Locations for the Project Area

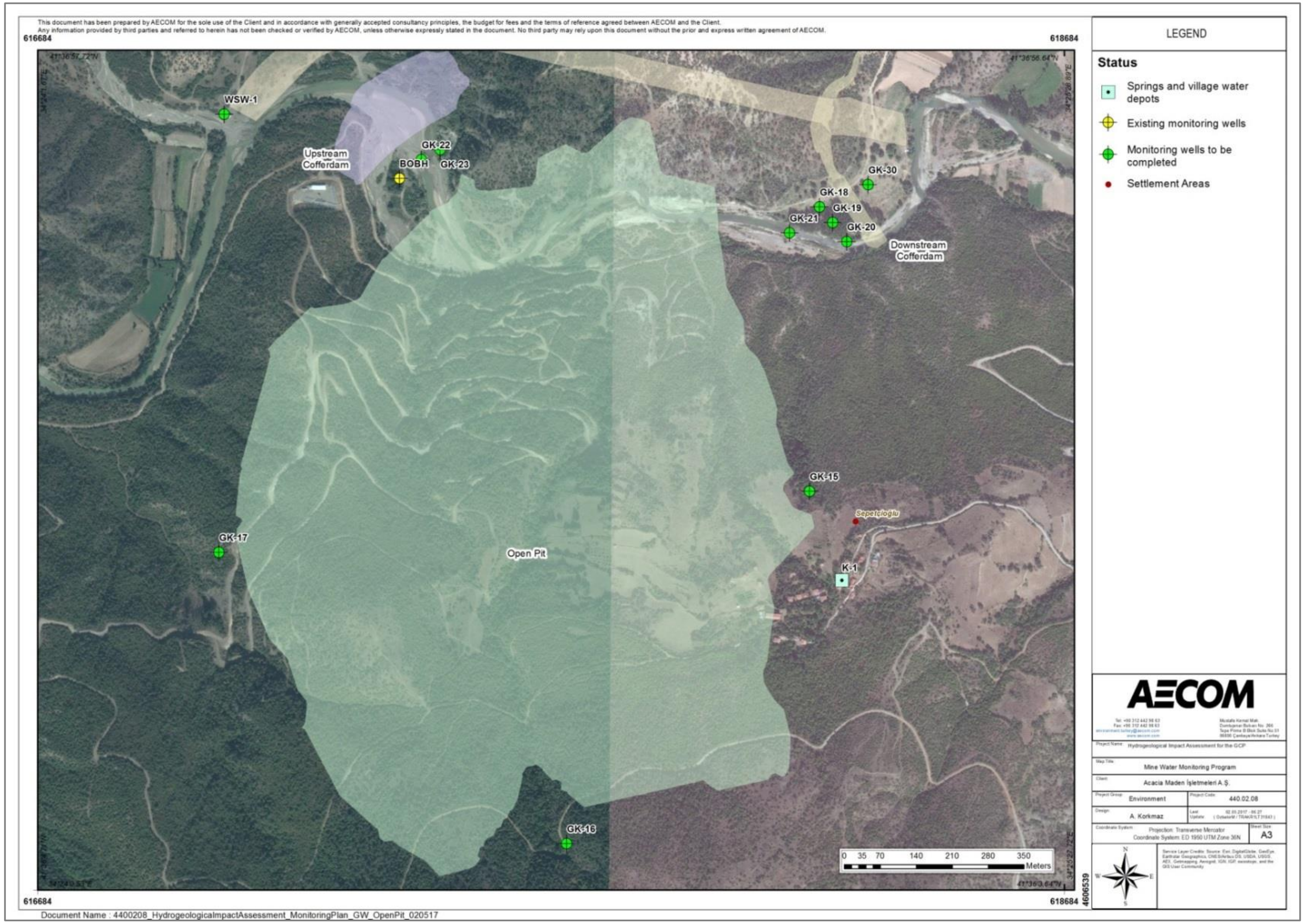


Figure 9-2 Groundwater (Monitoring Wells, Sprigs and Water Depots) Monitoring Locations for the Open Pit

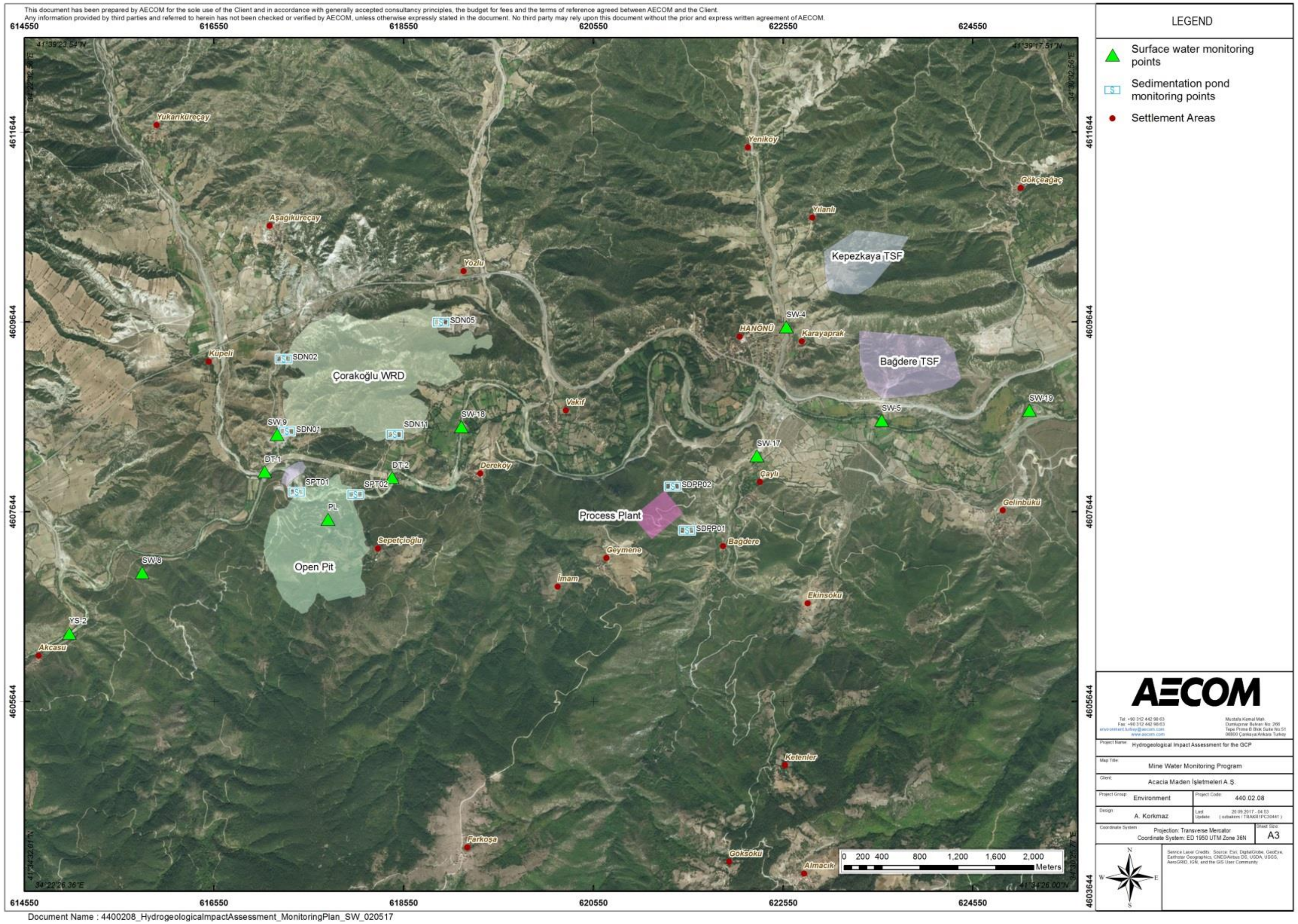


Figure 9-3 Surface Water Monitoring (Pit Lake, Streams and Sedimentation Ponds) Locations for the Project Area

Table 9-1 Water Monitoring Plan for the GCP

	Monitoring Location	Objective of Monitoring	Monitoring Frequency	Monitoring Parameters	Project Phase
Surface Waters	**Gökırmak River** (YS-2, SW-5, SW-18, SW-19, DT-1)	Gökırmak River flow rate and water quality monitoring (downstream sections of WRD, TSF and the Open Pit)	**Construction and Operational Phases:** Field parameter and flow measurements: Monthly Field sampling: Quarterly **Post-closure Phase:** Field parameters, flow measurements and field sampling: Quarterly (first two years of closure), semi-annually (2 to 4 years of closure), and annually (4 years after closure).	• Turkish Surface Water Quality Regulation, Annex 5 - Table 5: Quality Criteria for the Inland Surface Water Resources	Construction, Operational and Post-Closure Phases
	Gökırmak River sidelong branches (SW-4, SW-8, SW-9, SW-17)	Gökırmak River sidelong branches flow rate and water quality monitoring (downstream sections of WRD, TSF and the Open Pit)	**Construction and Operational Phases:** Field parameter and flow measurements: Monthly Field sampling: Quarterly **Post-closure Phase:** Field parameters, flow measurements and field sampling: Quarterly (first two years of closure), semi-annually (2 to 4 years of closure), and annually (4 years after closure).	• Turkish Surface Water Quality Regulation, Annex 5 - Table 5: Quality Criteria for the Inland Surface Water Resources	Construction, Operational and Post-Closure Phases
	Open pit lake (PL)	Pit lake water level and water quality monitoring	**Operational Phase:** Field parameter and pit inflow measurements: Monthly Field sampling: Quarterly **Post-closure Phase:** Field parameter and pit inflow measurements: Monthly Field sampling: Quarterly (first two years of closure), semi-annually (2 to 4 years of closure), and annually (4 years after closure).	• Turkish Water Pollution and Control Regulation, Table 1: Quality Criteria for the Inland Water Resources	Operational and Post-Closure Phases
	Sedimentation Ponds (SPT01, SPT02, SDN01, SDN02, SDN05, SDN11)	Water quantity and quality monitoring for waters that are captured in sedimentation ponds	**Construction and Operational Phases:** Field parameter and flow measurements: Monthly Field sampling: Quarterly	• Turkish Water Pollution and Control Regulation, Table 1: Quality Criteria for the Inland Water Resources	Operational and Post-Closure Phases
Groundwater	**Monitoring Wells**				
	Open pit (WSW-1, GK-15, GK-16, GK-17, GK-18, GK-19, GK-20, GK-21, GK-22, GK-23, GK-27, GK-30, BOBH) Çorakoğlu WRD (GK-6, GK-7, GK-24, GK-28, GK-29, Kepezkaya TSF (GK-13, GK-14, IK-3, GK-26) Bağdere TSF (GK-2, GK-4, GK-25,GK-31)	Groundwater level and quality monitoring in existing and planned monitoring wells.	**Construction and Operational Phases:** Field parameter and static water level measurements: Monthly Field sampling: Quarterly **Post-closure Phase:** Field parameters, static water level, flow measurements and field sampling: Quarterly (first two years of closure), semi-annually (2 to 4 years of closure), and annually (4 years after closure).	• Turkish Water Pollution and Control Regulation, Table 1: Quality Criteria for the Inland Water Resources • EU Groundwater Directive 2006/118/EC (includes min parameter list, provides limits for nitrates and pesticides)	Construction, Operational and Post-Closure Phases
Drinking Waters	**Springs, fountains and village water depots** (K-1, K-4, C-5, C-7, D-4, D-6, D-9, D-10)	Groundwater flow rate and quality monitoring (springs located in the downstream of WRD, TSFs and the open pit, if any). Drinking water quantity and quality monitoring (fountains and village water depots located within the Project Area)	**Construction and Operational Phases:** Field parameter and flow measurements: Monthly Field sampling: Quarterly **Post-closure Phase:** Field parameters, flow measurements and field sampling: Quarterly (first two years of closure), semi-annually (2 to 4 years of closure), and annually (4 years after closure).	• Regulation on Waters Intended for Human Consumption (RWIHC), Chemical Parameters and Indicator Parameters – Turkish Ministry of Health, 2005 • EU Quality Criteria for Waters Intended for Human Consumption – Council Directive 98/83/EC of 3 November 1998 • WHO Drinking Water Guidelines, 2011	Construction, Operational and Post-Closure Phases
Discharge Waters	Discharge Waters	Discharge water quality monitoring, if any.	Prior to discharge, if any.	• Turkish Water Pollution and Control Regulation, Table 7.1: Effluent Discharge Criteria for Mining Industry Wastewaters • IFC Effluent Discharge Criteria for mine waters • EU Urban Wastewater Treatment Directive	Operational Phase

Table 9-2 Monitoring Plan for the Operational Water Structures

Monitoring Location	Objective	Monitoring Frequency	Monitoring Parameters	Project Phase
Process tailings discharge	Monitoring of site water balance	Daily measurements	Tailings discharge rate	Operation
Process tailings	Monitoring chemical composition of the tailings material	Annual analysis	Physical parameters and metals	Operation
TSF embankment	Monitoring physical stability of the TSF	Daily observations, monthly measurements	Consolidation and stress	Operation and Post-Closure
Diversion channels and Sedimentation ponds	Monitoring sustainability of the diversion channels	Weekly observations	Water level and stability	Operation and Post-Closure
Culvert structures and waterways	Monitoring sustainability of the culvert structures waterways	Weekly observations	River flow rate and culvert stability	Operation and Post-Closure

9.2 Soil and Sediment Quality

Monitoring of soil and sediment quality is recommended to ensure that the project satisfies rehabilitation objectives. Within the scope of the environmental baseline studies, a total of 14 soil samples were analyzed to determine the background quality of the soil. For mine closure, an initial soil sampling prior to rehabilitation is recommended to determine if there is any evidence of contamination in soils as a result of operations. The analysis of soil samples will be conducted in accordance with the generic limit values specified in the Turkish Regulation on Soil Pollution Control and Point Source Contaminated Areas.

10. Financial Provision for Closure

Financial cost estimation has been prepared for the closure and rehabilitation of the GCP. Number of assumptions has been used in estimation of the closure costs. These assumptions and resulting costs are presented below:

- The rehabilitation assumptions are based on the reports "Bakır Madeni Açık Ocak İşletmeciliği Kapasite Artışı Nihai ÇED Raporu" and "Bakır Ocağı Kapasite Artışı, Zenginleştirme Tesisi, Atık Depolama Tesisi ve Beton Santrali Projesi Nihai ÇED Raporu", which were prepared by ENVY and final technical design report provided by AMI;
- The 2015 price lists extracted from the Ministry of Forestry and Water Affairs and General Directorate of State Hydraulic Works (DSİ) were used to calculate certain cost items (http://dsi.gov.tr/docs/birim-fiyatlar/proje_2015dsibf_sonraki.pdf?sfvrsn=2);
- The 2015 price list extracted from the Ministry of Environment and Urbanization and General Directorate of İLBANK (http://www.ilbank.gov.tr/index.php?Sayfa=htmlsayfa&hid=2522) was used where cost items were not present in the DSİ price list;
- Gravel that will be used in the closure and rehabilitation stage will be supplied from a nearby quarry and raw materials will be crushed in the crushing plant.
- It is assumed that a clay source is present within a 20 km radius from the project site;
- The average exchange rate of Central Bank of the Republic of Turkey is used;
- It is assumed that there will be 15 tons of hazardous waste produced upon closure of the mine; and
- It is assumed that the scrap cost of the plants and machinery will be 15% of the initial investment cost. AMI will acquire monetary value through the selling of scrap.
- It is known that DSİ and İLBANK costs are the final costs for construction firms and 30 % profit is already added to those. Because of that 30 % discount has been applied to final costs.

The calculated cost is subject to change should the assumptions or scope of work change.

10.1 Cost Estimation

10.1.1 Tailings Storage Facilities

Two TSFs will be constructed within the Project Area. Total volume of the TSFs is 16 million m^3 with a total surface area of 102.85 hectares. An engineered sotre- release cover will be designed and laid top of the TSFs. This cover will include 30 cm of clay, 10 cm of gravel, and 20 cm of topsoil above the overburden material.

Rock-fill material will be supplied from the overburden (without any ARD potential) disposal area and clay material will be supplied within a 20 km radius of the project site. Gravel will be used from a nearby quarry and raw materials will be crushed in a crushing plant within the site. Topsoil will be provided from the topsoil storage area. Appropriate flora will be planted after the topsoil has been laid out.

10.1.2 Open Pit

As the operation of the open pit ceases and the dewatering pumps are shut down, groundwater levels will start to rise back to static water level.

Different pit lake formation scenarios have been assessed by AECOM (See Section 5.1) based on the numerical groundwater flow model which was provided in Hydrogeological Impact Assessment Report (AECOM, 2017). Although different pit lake formation scenarios were evaluated within the scope of this study, AECOM recommends the optimal closure of the pit will be decided during the operational phase as the long term data from pit dewatering and on-site meteorological station is collected.

Based on the findings established from the hydrogeological studies an approximate area of 45.31 hectares of the open pit will be submerged under water and the remaining 67.97 hectares will subject to rehabilitation. To minimize any ARD-ML potential on pit walls, a closure cover of 20 cm of clay, 10 cm of gravel, and 20 cm of topsoil is recommended along with viable flora to be developed. Gravel will be used to drain rain induced surface water. The clay will act as a low permeability layer.

Rock-fill material will be supplied from inert overburden while clay material will be supplied within a 20 km radius of the Project Area. Raw materials will be crushed in a crushing plant within the mine. Topsoil will be provided from the topsoil storage.

10.1.3 Waste Rock Dumps

Waste material will be stored in a 199 ha waste rock dump. In order to minimize any ARD related potential contamination, a closure capping of 20 cm of clay, 10 cm of gravel and 20 cm of topsoil will be laid out and tree plantation will be undertaken. Gravel is used to drain surface water from rains and clay will be impermeable layer.

Clay material will be supplied within a 20 km radius of project site. Gravel will be used from a nearby quarry and raw materials will be crushed in a crushing plant within the mine. Topsoil will be provided from the topsoil storage area. Trees will be planted after the topsoil has been laid out.

10.1.4 Process Plant

A total area of 13.66 hectares is required by the Process Plant and its associated infrastructure. This area consists of steel tools, machinery, pumps, valve mill, etc. It is assumed that the scrap cost of the plants and machinery will be 15% of the initial investment cost. AMI will receive cash flow through the selling of scrap.

Structures such as rooves, wooden windows, etc. will be disassembled by local construction firms and the remaining material will be dumped at the closest municipal landfill.

It is assumed that there will be 15 tons of hazardous waste present upon closure of the mine.

In accordance with the above circumstances and assumptions, estimated total closure and rehabilitation cost is 17,000,000.00 USD. The itemized cost breakdown is presented in Table 10-1 and with more details in Appendix B.

Table 10-1 Cost Estimation for the GCP Mine Closure and Rehabilitation

	Estimated Cost, USD	**Discounted Cost, USD**
Bağdere TSF Rehabilitation	9,050,000.00	6,350,000.00
Kepezkaya TSF Rehabilitation	6,950,000.00	4,900,000.00
Open Pit Rehabilitation	2,300,000.00	1,600,000.00
Çorakoğlu Waste Rock Dump Rehabilitation	6,750,000.00	4,700,000.00
Process Plant Rehabilitation	250,000.00	200,000.00
Auxiliary Facilities Rehabilitation	45,000.00	30,000.00
Hazardous Material Disposal	8,000.00	5,500.00
Sub-Total:	25,353,000.00	17,785,500.00
Contingency and Engineering Cost	2,535,300.00	1,778,550.00
Sub Total Rehabilitation Cost	27,888,300.00	19,564,050.00
Monetary Value from Scraps and Used Equipment	2,500,000.00	2,500,000.00
Total Rehabilitation Cost:	**25,388,300.00**	**17,064,050.00**

Appendices

Appendix A Glossary of Definitions

Abandoned mine site	Non-operational mines where mining tenure no longer exists and the responsibility for rehabilitation cannot be allocated to any individual, company or organization responsible for the mining activities. Such sites are also
Boundary of a landform	The edge of a landform is taken as being the base of the slope. This maybe the battered footprint or the non-battered footprint. The footprint must not exceed the area specified in approval documentation.
Care and maintenance	Phase following temporary cessation of mining operations where infrastructure remains intact and the site continues to be managed. All mining operations suspended, site being maintained and monitored.
Closure	A whole-of-mine-life process, which typically culminates in tenement relinquishment. It includes decommissioning and rehabilitation.
Completion	The goal of mine closure. A completed mine has reached a state where mining lease ownership can be relinquished and responsibility accepted by the next land user.
Consultation	A process that permits and promotes the two-way flow of ideas and information. Effective consultation is based on principles of openness, transparency, integrity and mutual respect.
Contaminated	Contaminated, in relation to land, water or a site, means having a substance present in or on that land, water or site at above background concentrations that presents, or has the potential to present, a risk of harm to human health, the environment or any environmental value. This definition may apply to the artificial concentration (localized accumulation) of natural substances or minerals which have the potential to present a risk of harm to human health, the environment or any environmental value through this accumulation, such as mineral processing sites or
ÇŞB	Ministry of Environment and Urbanization.
Decommissioning	A process that begins near, or at, the cessation of mineral production and ends with removal of all unwanted infrastructure
DSİ	General Directorate of State Hydraulic Works.
Disturbance type	A feature created during mining or exploration activity e.g. waste dumps, transport or service infrastructure corridor (haul roads, access roads), ROM pad, plant site, tailings storage facility, borrow pits, land (other than land under rehabilitation or rehabilitated land) that has been disturbed by exploration operations (e.g. drill pads), waste dump or overburden stockpiles, Building (other than workshop) or camp site, etc.
Disturbed	Area where vegetation has been cleared and/or topsoil (surface cover) removed.
Orman ve Su İşleri Bakanlığı	Ministry of Forestry and Water Affairs.
Orman Genel Müdürlüğü	General Directorate of Forestry
Orman Bölge Müdürülüğü	Regional Directorate of Forestry
Domain	A group of landform(s) or infrastructure that has similar rehabilitation and closure requirements and objectives.
Doğa Koruma ve Milli Parklar Genel Müdürlüğü	General Directorate of Nature Conservation and National Parks.
Earthworks	Reshaping, capping, water/wind erosion control, rock armoring.
Ecologically Sustainable	Development improves the total quality of life, both now and in the future, in a way that maintains the ecological processes on which life depends.

Environment	Living things, their physical, biological and social surroundings and interactions between all of these.
Environmental value	A beneficial use and/or an ecosystem health condition.
Key stakeholders	The term “key stakeholders” refers to post-mining land owners/managers and relevant regulators.
Kinetic testing	Procedure used to measure the magnitude and/or effects of dynamic processes, including reaction rates (such as sulphide oxidation and acid generation), material alteration and drainage chemistry and loadings that result from weathering. Unlike static tests, kinetic tests measure the behavior of a sample over time.
Legal Obligations Register	A register of legally binding conditions and commitments relevant to rehabilitation and closure at a given mine site.
Life of mine	Expected duration of mining and processing operations.
Mineral processing facilities	Includes all processing facilities for ore treatment including crushing plants, grinding, vat leach, heap leach, dump leach and tailings disposal facilities.
MİGEM	General Directorate of Mining Affairs.
Pits	All open excavations including active mineral rock, gravel, sand, clay, bauxite, and salt-pan extraction areas.
Post-mining land use	Term used to describe a land use that occurs after the cessation of mining operations.
Preliminary earthworks	Reshaping, capping, water/wind erosion control, rock armoring.
Project	The total integrated mining operations in which a number of sites contribute to the overall operation to supply ore, processing facilities and disposal of waste products.
Problematic materials	Materials that have the potential to detrimentally impact on humans and the environment and require careful and appropriate management (e.g. Potential Acid Forming (PAF) materials, radioactive materials, asbestiform materials, dispersive materials, arsenic etc.).
Rehabilitation	The return of disturbed land to a safe, stable, non-polluting/ non- contaminating landform in an ecologically sustainable manner that is productive and/or self- sustaining consistent with the agreed post-mining land use.
Relinquishment	A state when agreed completion criteria have been met, government “sign- off” achieved, all obligations under the Turkish Mining Law and Governing Regulations removed, and the proponent has been released from all forms of security, and responsibility has been accepted by the next land user or
Revegetation	Establishment of self-sustaining vegetation cover after earthworks have been completed, consistent with the post-
Safe	A condition where the risk of adverse effects to people, livestock, other fauna and the environment in general has been reduced to a level acceptable to all stakeholders.
Stable	A condition where the rates of change of specified parameters meet agreed criteria.
Stakeholder	A person, group or organization with an interest in a particular decision, either as individuals or representing a group, with the potential to influence or be affected by the process of, or outcome of, mine closure.
Static testing	Procedure for characterizing the physical or chemical status of a geological sample at one point in time. Static tests include measurements of chemical and mineral composition and the analyses required for Acid Base Accounts.
Tailings storage facility	An area used to store and consolidate tailings, and may include one or more tailings storage features.

Tenement	Land tenure granted under the Turkish Mining Law and Governing Regulations e.g. Production License, Exploration License, etc.
Unacceptable liability	Closure should not lead to regulators, or the community, or landowners or land managers having to take on responsibility for ongoing management, maintenance or monitoring above that which applied before mining, or that which applied to managing land uses comparable to the agreed land uses.
Waste landforms (or dumps)	Includes all mullock and waste rock disposal areas (also called Overburden Storage Area, Waste Rock Landform, or Waste Rock Storage/or Area), low grade stockpiles and mineralized waste stockpiles.

Appendix B Mine Closure and Rehabilitation Cost Estimation Breakdown

Project Unit	Area (m²)						Unit Price (TL)	Amount	Price (TL)	Price (USD)	Discounted Price (USD)
Bağdere TSF	**620.393**										
		First Embankment	DSİ 2017	B-15.306	Extracting or storing rock or soft ground for dams.	m3	7.80	248157.30	1935626.94	555416.63	388791.64
			DSİ 2017	07.006/28	Transportation (20 km)	ton	8.86	446683.10	3957612.27	1135613.28	794929.29
			DSİ 2017	B-15.311	Placement of rock material to the dam embankment.	m3	2.11	496314.50	1047223.60	300494.58	210346.20
			DSİ 2017	07.006/28	Transportation (20 km)	ton	8.86	893366.10	7915223.65	2271226.30	1589858.41
		25 cm (clay pack)			Clay	m3	5.00	155098.30	775491.50	222522.67	155765.87
			DSİ 2017	07.006/15	Transportation (20 km)	ton	8.86	279176.90	2473507.33	709758.20	496830.74
			İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	4666.00	407388.46	116897.69	81828.39
		10 cm (gravel pack)			Gravel	ton	9.00	111670.80	1005037.20	288389.44	201872.61
			DSİ 2017	07.006/28	Transportation (20 km)	ton	8.86	111670.80	989403.29	283903.38	198732.37
			İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	2800.00	244468.00	70148.64	49104.05
		20 cm (topsoil)	DSİ 2017	07.006/28	Transportation (20 km)	ton	8.86	1116708.00	9894032.88	2839033.82	1987323.68
			İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	950.00	82944.50	23800.43	16660.30
		Plantation	İLBANK 2017	37.035/İB	Plantation	1000 units	4807.25	155.00	745123.75	213808.82	149666.18
		Pipeline dismantling	İLBANK 2017	18,225,515	Pipeline dismantling (500 mm)	m	14.16	3500.00	49560.00	14220.95	9954.66
					Sub Total				**31522643.36**	9045234.82	6331664.38

Project Unit	Area (m²)						Unit Price (TL)	Amount	Price (TL)	Price (USD)	Discounted Price (USD)
Kepezkaya TSF	408.114										
		First Embankment	DSİ 2017	B-15.306	Extracting or storing rock or soft ground for dams.	m3	7.8	163245.80	1273317.24	365370.80	255759.56
			DSİ 2017	B-07.D/3	Transportation (20 km)	ton	8.86	352610.80	3124131.69	896450.99	627515.69
			DSİ 2017	B-15.311	Placement of rock material to the dam embankment.	m3	2.11	326491.50	688897.07	197674.91	138372.44
			DSİ 2017	B-07.D/3	Transportation (20 km)	ton	8.86	705221.60	6248263.38	1792901.97	1255031.38
		25 cm (clay pack)			Clay	m3	5	102028.60	510143.00	146382.50	102467.75
			DSİ 2017	B-07.D/3	Transportation (20 km)	ton	8.86	220381.80	1952582.75	560281.99	392197.40
			İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	4666.00	407388.46	116897.69	81828.39
		10 cm (gravel pack)			Gravel	ton	9	73460.59	661145.31	189711.71	132798.20
			DSİ 2017	B-07.D/3	Transportation (20 km)	ton	8.86	88152.71	781033.01	224112.77	156878.94
			İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	2800.00	244468.00	70148.64	49104.05
		30 cm (topsoil)	DSİ 2017	B-07.D/3	Transportation (20 km)	ton	8.86	866834.90	7680157.21	2203775.38	1542642.77
			İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	950.00	82944.50	23800.43	16660.30
		Plantation	İLBANK 2017	37.035/İB	Plantation	1000 units	4807.25	102.00	490339.50	140700.00	98490.00
		Pipeline dismantling	İLBANK 2017	18,225,515	Pipeline dismantling (500 mm)	m	14.16	2500.00	35400.00	10157.82	7110.47
					Sub Total				**24180211.11**	**6938367.61**	**4856857.33**

Project Unit	Area (m²)						Unit Price (TL)	Amount	Price (TL)	Price (USD)	Discounted Price (USD)
Open Pit	**1.132.854**	25 cm (topsoil)	DSİ 2017	B-07.D/3	Transportation (40 km)	ton	12.47	509784.30	6357010.22	1824106.23	1276874.36
			İLBANK 2015	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	2825.00	246650.75	70774.96	49542.47
		Plantation	İLBANK 2017	37.035/İB	Plantation	1000 units	4807.25	283.00	1360451.75	390373.53	273261.47
					Sub Total				**7964112.72**	**2285254.73**	**1599678.31**

Project Unit	Area (m²)						Unit Price (TL)	Amount	Price (TL)	Price (USD)	Discounted Price (USD)
Çorakoğlu WRD	**1.888.599**										
		20 cm (clay pack)			Clay	m3	5.00	377719.90	1888599.50	541922.38	379345.67
			DSİ 2017	07.006/28	Transportation (20 km)	ton	8.86	679895.80	6023876.79	1728515.58	1209960.90
			İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	9000.00	785790.00	225477.76	157834.43
		10 cm (gravel pack)			Gravel	ton	9.00	339947.90	3059531.10	877914.23	614539.96
			DSİ 2017	07.006/28	Transportation (20 km)	ton	8.86	339947.90	3011938.39	864257.79	604980.45
			İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	2200.00	192082.00	55116.79	38581.75
		20 cm (topsoil)	DSİ 2017	07.006/28	Transportation (20 km)	ton	8.86	679895.80	6023876.79	1728515.58	1209960.90
			İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	2155.00	188153.05	53989.40	37792.58
		Plantation	İLBANK 2017	37.035/İB	Plantation	1000	4807.25	472.00	2269022.00	651082.35	455757.65
					Sub Total				23442869.62	6726791.86	4708754.30

Project Unit	Area (m²)						Unit Price (TL)	Amount	Price (TL)	Price (USD)	Discounted Price (USD)
Process Plant	**136.651**						TL				
		20 cm (topsoil)	DSİ 2017	07.006/32	Transportation (40 km)	ton	12.47	49194.30	613452.92	176026.66	123218.66
		Plantation	İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	87.31	620.00	54132.20	15532.91	10873.04
			İLBANK 2017	37.035/İB	Plantation	1000 units	4807.25	34.00	163446.50	46900.00	32830.00
					Sub Total				**831031.62**	**238459.58**	**166921.70**

Project Unit	Area (m^2)						Unit Price (TL)	Amount	Price (TL)	Price (USD)	Discounted Price (USD)
		20 cm (topsoil)	İLBANK 2017	20	Transportation (20 km)	ton	7.88	13320.00	104961.60	30118.11	21082.67
Auxiliary	**37.000**	Plantation	İLBANK 2017	03.510/1	Bulldozer (laying soil and/or gravel)	hour	70.60	67.00	4730.20	1357.30	950.11
			İLBANK 2017	37.035/İB	Plantation	1000 units	4807.25	9.25	44467.06	12759.56	8931.69
					Sub-Total				**154158.86**	**44234.97**	**30964.48**

Project Unit	Area (m^2)						Unit Price (TL)	Amount	Price (TL)	Price (USD)	Discounted Price (USD)
Hazardous Waste					**Hazardous Waste Remediation**						
			İzaydaş		Hazardous Waste Remediation (incineration)	ton	1025.00	24.00	24600.00	7058.82	4941.18
			İzaydaş		Hazardous Waste Transportation	15 ton/km	2.50	1200.00	3000.00	860.83	602.58
					Sub Total				**27600.00**	**7919.66**	**5543.76**