Appendix 5-4-3

Characteristics of PSPP Potential Site

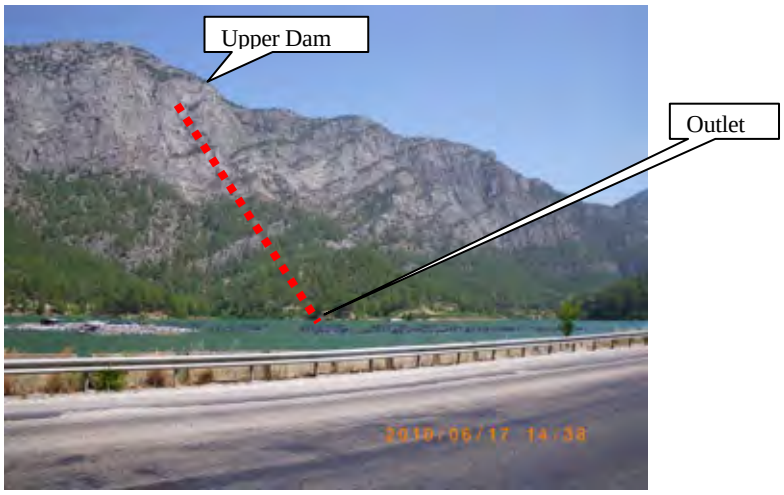
Site Name		**No.19**
Location (River name)		Upper Dam / Reservoir : Burdur Bucak Kocayer （Curukini River） Lower Dam / Reservoir : Burdur Bucak （Karacaoren II Lake）
Profile	Installed Capacity P (MW) Design Discharge Q (m^3/s) Effective Head H (m) Peak Duration Hour (hrs)	1,000 249 507 7
Geography / Geology	General Geology	- The regional geology belongs to the upper Miocene series. Only geology of right bank of Existing Karacaoren II lake is Cretaceous system, and they lay from the west to the east sequentially, Karpuzcay formation (Tmkp) of upper Burdigalian to Serravallian age, Aksu formation (Tma) of Tortonian to Serravallian age. - Karpuzcay formation (Tmkp) cousists of sandstone, claystone, siltstone, and conglomerate. Aksu formation (Tma) consists of conglomerate. - N50W/30NE strike and dip was measured at a conglomerate outcrop where southern part of Karacaoren II dam site which geology belongs to Karpuzcay formation. On the other hand, N15W/35NE strike and dip was measured at a calcilutite outcrop on the slope of northern national road, and a fossil of bivalve was found in the outcrop.
	Upper Dam / Reservoir	- Since the ridge of Right Bank the upper dam is relatively narrow, the dam axis was moved on the safe side about 200m upstream from the original one, where is the location of original intake site. - Though we tried to approach to the upper dam site from the northern side of the divide (EL.880) of the upper reservoir, but we could only get up to the EL. 800m point and could not find any water flow in the branch creek. - Conglomerate of Aksu formation cropped out widely not only in the reservoir area but also Mt. Karadağ and the height of its western slope is more than 400m. Layers of Aksu formation are folded as same as Karpuzcay formation which distributes at low order of Aksu formation. Their strike and dip of bedding plane change variously, such as N50W/20-30NE at the outlet and N15E/33SE at the upper reservoir. - Joints of N30E strike are developed with intervals of 30 to 50m in the conglomerate at the upper reservoir. It is necessary to examine the relationship between these developed joints and permeability of the surrounding rocks of the upper reservoir. - Concrete gravity dam or some concrete faced type dam is recommendable for the upper dam, by the view point of materials, because there fully exposes sound rocks surrounding the upper reservoir area. - Since hard and massive bedrock crops out around the dam site and there is little soil material around the upper reservoir, concrete gravity type or concrete faced fill type is suitable to be applied.
	Waterway / Underground Powerhouse	- The geology of waterway and UPH seems to belong to Karpuzcay formation. - The geology is suitable especially for construction of the UPH, because the weathering will not be deep.

	Lower Dam / Reservoir	- Existing Karacaoren II reservoir is planned to use as the lower reservoir. - The original outlet site is located at a flat terrace used for farm which height is about 3 meter from the HWL of the reservoir and the slope is gentle with approximately 20 degrees. - The geology of the outlet site belongs to Karpuzcay formation. Alternation of siltstone (30cm) and thin (5cm) claystone crops out. The strike and dip of layer is N65W/20SW. They are from highly to completely weathered. - Judging from the above conditions, the location of outlet was moved at the other ridge around 300m upstream. The dip of layers of the area is steeper (about 45 degrees), and degree of weathering is weaker than that of the original outlet site.
Natural / Social Environment	Natural Park / Protected Area	- There is no designation of national parks, natural parks, or natural protection areas at the project site. And also, the project site is not located in any environmental protection areas.
	Prosperous fauna / flora	- The upper dam and reservoir site is located in mainly pine tree forest, which is relatively thin. - Wild goats live in the forest. Those can be hunted under license. - There is no information of rare and important species of fauna and flora so far.
	Resettlement / Compensatory assets	- There is a house and a floating restaurant at the outlet site, which will be directly affected by the construction of the outlet. - And also, fish cages for salmon breeding are located in front of the outlet site. Relocation of the cages or some compensation is required.
	Historical / Cultural Heritage	- There is no historical and cultural heritage to be affected. - However, the existing reservoir of Karacaoren II dam, which will be used as the lower reservoir for the project, is used not only for power generation but also for leisure site for swimming and fishing. Since water level will be fluctuated by HSPP operation, safety measures should be taken in to consideration.
	Others	- There is a development plan of water supply project for Antalya City. Karacaoren II dam is one of candidate water resources. Therefore, progress of the project should be monitored.
Others' Special Note		- It is possible to access to the UPH, switch yard, outlet from the existing Karacaoren II dam. - Although it is possible to access to the northern side of the divide of the upper reservoir, the access road is a punishing road and needs to be upgraded. And also, an access road from the northern side of the divide to the upper dam site is to be constructed newly. - Length of new power line is estimated about 30km from the nearest 400kV substation.

Lower bedrock of Cretaceous limestone and upper order of Karpuzcay formation (Tmkp)
Strike and dip of bedding plane of Karpuzcay formation (Tmkp) is N15W/35NE
Photo 1 Regional Geology

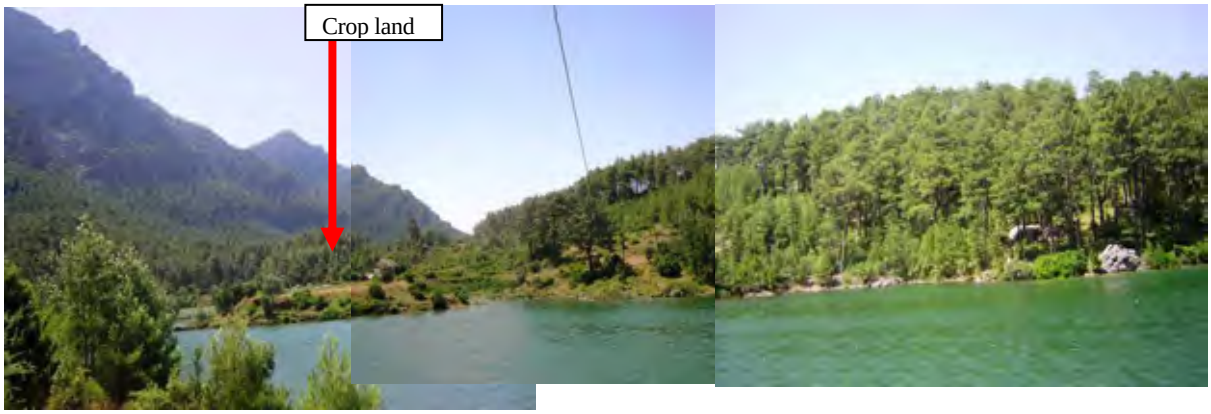
Photo 2 The upper dam site, viewing from the upstream

Photo 3 Joints of N30E strike at intervals of 30-50 meters developed in the Conglomerate
(Right bank of the upper reservoir)



The upper order of Aksu（Tma）and lower order of Karpuzcay formation (Tmkp)
Alternation of siltstone and claystone which lays under the Conglomerate of the upper order is weathered and eroded, and forms a gentle slope.

Photo 4　Regional Geology



The original outlet site is located at a flat terrace used for farm which height is about 3 meter from the HWL of the reservoir and the slope is gentle with approximately 20 degrees.

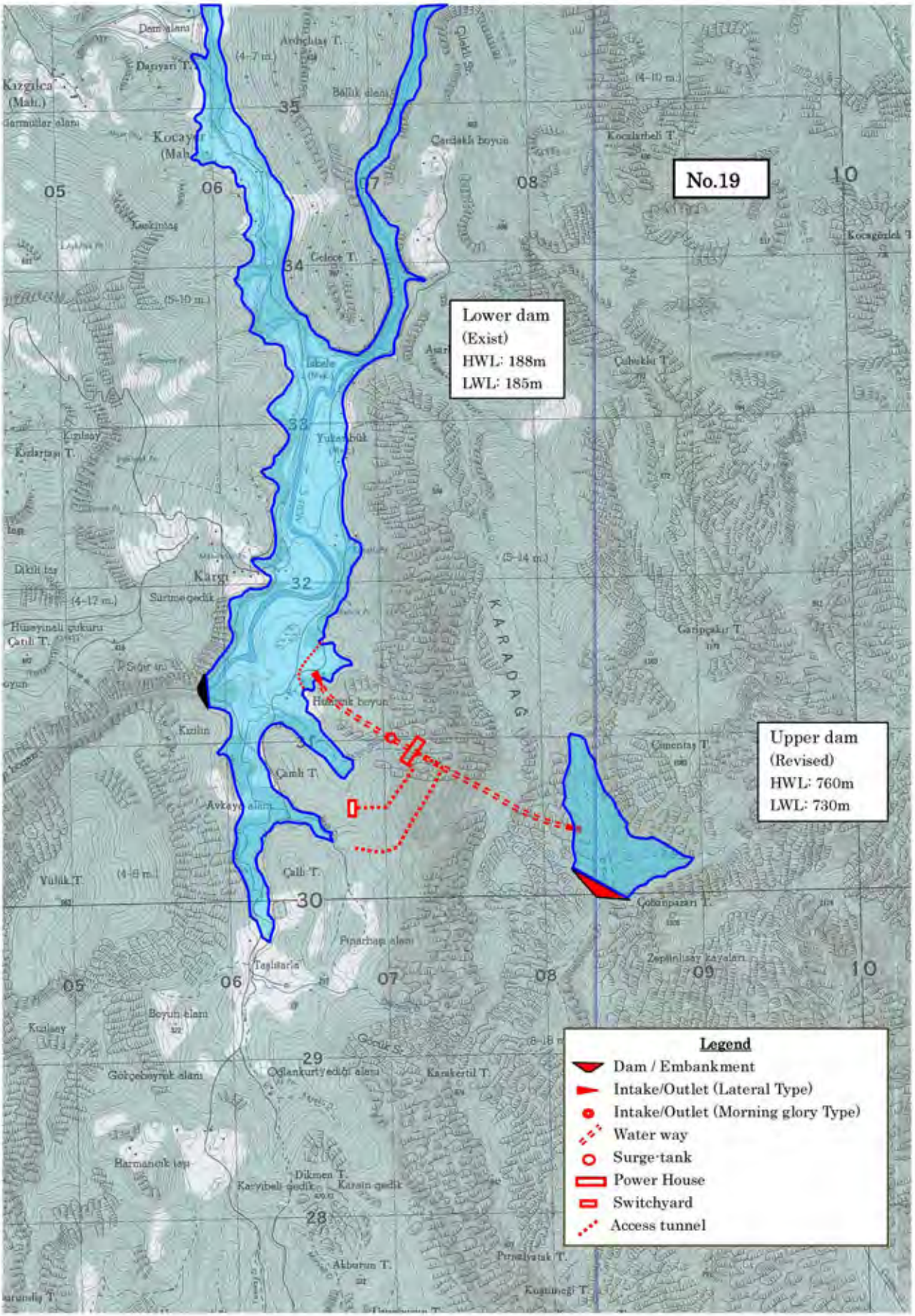
Photo 5　Original outlet site viewing from the upstream

Photo 6 Outlet site (There are a house and fish cages.)

Photo 7 Leisure facility (restaurant) on the existing reservoir at the outlet site

Photo 8 Existing Karacaoren II dam as the lower reservoir

Photo 9 Karacaoren II HEPP



No.19 Layout of Main Facilities

Characteristics of PSPP Potential Site

Site Name		**No.21-1**
Location (River name)		Upper Dam / Reservoir : Isparta Sutculer Yildiz Lower Dam / Reservoir : Isparta Sutculer （Karacaoren I Lake）
Profile	Installed Capacity P (MW) Design Discharge Q (m^3/s) Effective Head H (m) Peak Duration Hour (hrs)	1,000 222 568 7
Geography / Geology	General Geology	- Geological structure of this area is complex, but in general, strike of strata is NNW-SSE. There are a lot of minor faults of parallel strike with strata and N-S strike in the strata. - Neritic limestone of Tekedağı formation (JKt) in Rhaetian to Cenomanian age of Jurassic to Cretaceous period distributes in the eastern part of the project site. Alakırçay formation(Tra) in Ladinian to Norian age of middle to upper Triassic period takes part in it. Alakırçay Group is dominant in the western part, and it is overlain by some younger formation. - Alakırçay Group consists of sandstone with plant fragments, shale, radiolarian chart, spilite, basalt, and limestone with fossil of bivalve of *Halobia*, etc. they are divided into following each formation from the lower order - Candir(TRac), Karadere(TRak), Gokdere(TRag), and Tesbihli(TRat) with conformity.
	Upper Dam / Reservoir	- Neritic limestone of Tekedağı formation overlays ophiolitic mélange of Kırkdirek formation (KKm) at the upper reservoir area. Since the latter layer is soft and easy to be eroded, the boundary is topographical transition line. The boundary is uneven and is cut by faults here and there. - The topography of the upper reservoir basin is flat and the ground surface is covered by gravelly soil. The material seemed to be transferred from upper reach by mudflow and consists of silty sand. And the mudflow might push the original river flow channel to the left bank side in the past. - Ophiolitic mélange of Kırkdirek formation distributes widely on the surface of the right bank terrace and the river bed, and is weathered from moderately to highly. The rock is easily crushable by hammer, but it is estimated the rock has enough bearing capacity for the foundation of artificial pond full facing type dam. - According to the villagers' information, chromium mining had been operated until 1960's. - Limestone distributes at the both abutment of the original dam site and so there is possibility of leakage from the dam and upper reservoir area is widely flat. Judging from the above conditions, artificial pond full facing type dam is suitable to be applied. - Water flow was observed in the river.

	Waterway / Underground Powerhouse	- Tekedağı formation which expose in the surface, Kırkdirek formation is underlain and Alakırçay formation which is the lowest order is predicted to distrubute around the waterway and UPH. - The UPH is located under a gentle hill and outcrops are rarely observed. Furthermore, the rock cropped out was mudstone weathered highly. Meanwhile, bedrock of the outlet also is highly weathered and altered. Judging from that, it is estimated that the rock around UPH will be weathered and altered deeply. - It is necessary to investigate carefully deterioration degree around UPH due to weathering, alteration, and faults. - Since the tailrace is planned to go through under the relatively large-scale valley, it is necessary to investigate with or without of week zone along the waterway.
	Lower Dam / Reservoir	- The lower reservoir is planned to use the existing Karacaoren I reservoir. Sandstone, shale, and radiolarian chart outcrops were observed. Those outcrops are deteriorated due to weathering and/or alteration, cohesive soil washed out from clay stone by wave was observed in the lakeshore. - Since the geology around the outlet site is fragile, the construction cost of tailrace and outlet will increase a lot. - Active water depth of Karacaoren I reservoir is as deep as 30m, therefore, morning glory type is suitable to apply for the outlet, and the tailrace has to extend up to the off shore.
Natural / Social Environment	Natural Park / Protected Area	- There is no designation of national parks, natural parks, or natural protection areas at the project site. And also, the project site is not located in any environmental protection areas.
	Prosperous fauna / flora	- The upper reservoir site is used for agriculture land (wheat and other vegetables) and meadows. Recently, the local residents started cherry production under the assistance from regional office of agriculture. - There is no information of rare and important species of fauna and flora so far.
	Resettlement / Compensatory assets	- No involuntary resettlement is anticipated. - However, there is possibility that the villagers (25-30 houses) might be resettled because most of the agriculture field, which are main income source of the residents, may be submerged in the upper reservoir. - And also, fish cages for salmon breeding are located in front of the outlet site. Relocation of the cages or some compensation is required.
	Historical / Cultural Heritage	- There is a historical church in the village, but there is no historical and cultural asset to be directly affected.
	Others	- According to interviews with some local people, most of the villagers love the village, and it seems that they will oppose a dam construction in the village.
Others' Special Note		- Although it is possible to access to the upper dam, UPH, outlet from the existing Karacaoren I reservoir, the access road is a punishing road and needs to be upgraded. - Length of new power line is estimated about 40km from the nearest 400kV substation.

Photo 1　Original upper dam site viewing from the upstream

Ophiolitic mélange of Kırkdirek formation (KKm) distributes at the right bank of the river, and is weathered from moderately to highly.　The rock is easily crushable by hammer.

Photo 2　River bed in the upper reservoir

Rocks are weathered and forms even topography.

Photo 3　Kırkdirek formation (KKm) in the upper reservoir (right bank)

Gravelly soil distributes on the uneven ground surface. The material seemed to be transferred from upper reach by mudflow and consists of silty sand.

Photo 4 In the upper reservoir

Older ophiolite of Kırkdirek formation(right) and younger limestone of Tekedağı formation(left) risen by thrust

Photo 5 In the upper reservoir (right bank)

Photo 6 Highly weathered pelite cropped out on the UPH

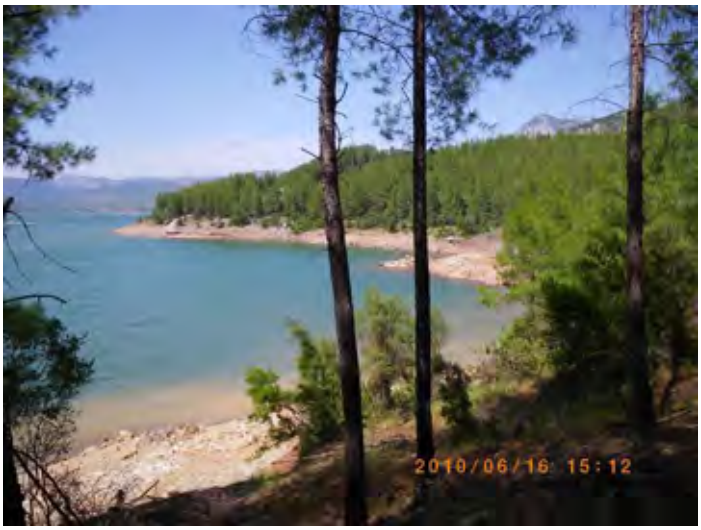


Photo 7　Intake Site

Cohesive soil washed out from clay stone by wave along the lakeside

Photo 8　Tailrace and Outlet site

Outcrops of chart eroded by wave

Photo 9　Tailrace and Outlet site

Photo 10　Cherry plantation and wheat field in the upper reservoir

Photo 11　Houses near by the upper reservoir site

Photo 12　Watering place in the upper reservoir

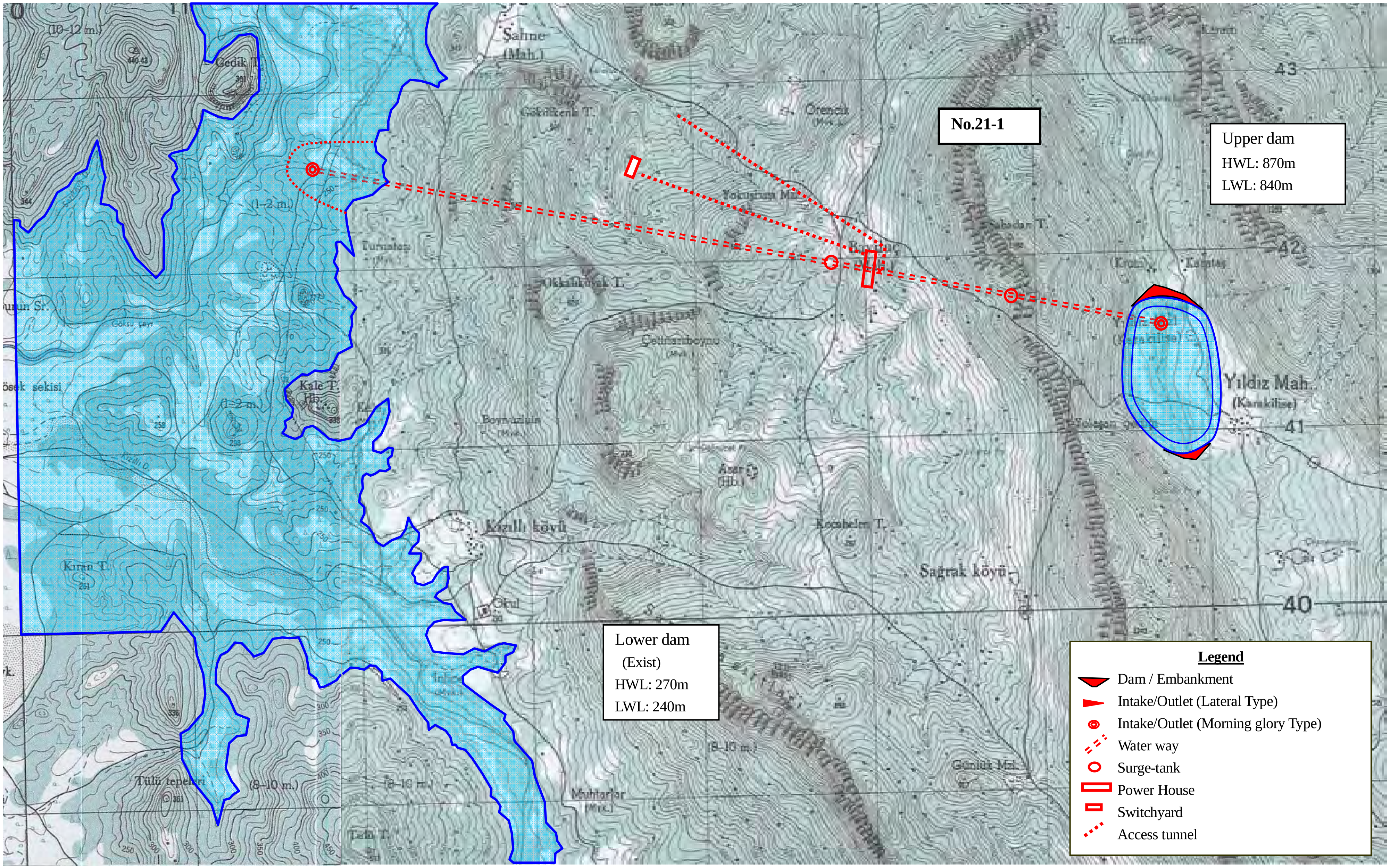
Photo 13　Quarry of marble on the right bank of the upper reservoir

Photo 14　Waterway route

Photo 15　Tombs on the waterway route


Photo 16 Fish cages for salmon bred in the existing reservoir (The right photo was taken in front of the outlet.)


Photo 17 Karacaoren I dam and its HEPP


No.21-1
Upper dam
HWL: 870m
LWL: 840m
Lower dam
(Exist)
HWL: 270m
LWL: 240m
Legend
Dam / Embankment
Intake/Outlet (Lateral Type)
Intake/Outlet (Morning glory Type)
Water way
Surge-tank
Power House
Switchyard
Access tunnel
Yıldız Mah.
Kızıllı köyü
Sağrak köyü

Appendix 5-4-5

Characteristics of PSPP Potential Site

Site Name		**No.24**
Location (River name)		上部ダム/調整池：Ankara Alpu Karacaoren 下部ダム/調整池：Ankara (Sakarya River, Gökçekaya Lake)
Profile	Installed Capacity P (MW) Design Discharge Q (m^3/s) Effective Head H (m) Peak Duration Hour (hrs)	1,000 191 661 7
Geography / Geology	General Geology	- Project site is located at the eastern of No.31 site, and geology is the similar. - In order from South to North, Göktepe metamorphics(PEg) of Pre-Cambrian age, Kayapınar marble (Pk) in Permian period, Otluk metamorphics (Eo) of the lower Triassic period, Mıhlıkaya formation (TRKm) between middle Triassic and lower Cretaceous period are distributed. Furthermore, they are overlain in unconformity by Girdapdere meta-olistostrome (Kg) of Torid-Anatorid zone, and Dağküplü mélange (Kd) of Izmir-Ankara zone in the upper Cretaceous period overlay at upmost. - Göktepe metamorphics (PEg) consists of schist, meta-granite, meta-rhyolite, and metabazite. Otluk metamorphics (Eo) consists of meta-sedimentary rocks such as meta-conglomerate, meta-sandstone, and meta-siltstone. Mıhlıkaya formation (TRKm) consists of recrystallized limestone to cherty limestone, and meta-clastite. Girdapdere meta-olistostrome (Kg) consists of metacalciturbidite, metagreywacke, meta-siltstone, and blocks of meta-volcanic. Dağküplü mélange (Kd) includes undifferentiated Ophiolite mélange and olistostrome. It is divided into (mk), (of), and (vs). (quoted from 1:100,000geologic map of Eskisehir -I26 quadrangle)
	Upper Dam / Reservoir	- Since the original upper dam site is located in the limestone area, the upper dam site was moved to the upstream of about 1.5km. - The alternative dam and reservoir are located in the geology of Precambrian Göktepe metamorphics (PEg). - Only outcrops of schist were observed along the logging road in the reservoir area. - They are hard and massive, but schistosities and joints are developed in the rock. Strike and dip of the schistosity plane and joint plane are N80E/70NW and N15-20W/80W-80E, respectively. Joint interval is from 0.5m to 2.0m. - In the wide flat plain at approximately EL.1250m on the right bank of the upper reservoir, plenty of core stones originated from calcic-schist are distributed in reddish brown colored soil. The thickness of them is less than 1.0m. - Some sub-rounded gravels are distributed in the part of the flat plain. These gravels are deemed to be sediments originated from the terrace deposits of the past. - Water flow was observed in the riverbed of the upper dam site.
	Waterway / Underground Powerhouse	- Following geology layers are distributed from the intake to the outlet along the water way - Göktepe metamorphics (PEg), Kayapınar marble (Pk), Otluk metamorphics (Eo), Mıhlıkaya formation (TRKm), Girdapdere metaolistostrome (Kg), and Dağküplü mélange (Kd) -. Most of them are schist having schistosity. - Schist rock crops out along a logging road of mountain on the left bank of Gökçekaya reservoir, and are exfoliated in placibis due to schistosity. Many landslides are observed on the left bank of the reservoir. - Although cracks in the deep underground where UPH is located will be contact, key blocks will be formed by schistosities and joints. Therefore, it is necessary to investigate in detail distribution of discontinuities to prevent surrounding rocks of UPH from abruption and collapse. The cost of support system for excavation of UPH cavern will increase.

	Lower Dam / Reservoir	- Gökçekaya reservoir is used for the lower reservoir. The outlet was moved about 5 km upstream (to the east) in line with the movement of the upper dam site. - The geology of the lower reservoir is the olistostrome composed of spilite, sandstone, and limestone of Dağküplü mélange (Kd). - Since many landslides were observed around the alternative outlet site, it is necessary to investigate topography and geology in detail to decide the location. - In the geology of the left bank of the reservoir, the inclination of its schistosity plane is parallel to the slope of mountain, therefore, joints are easy to be developed and landslides are easy to take place. Hence, in any case, construction cost of the outlet will increase a lot for the countermeasure of stability of the slope.
Natural / Social Environment	Natural Park / Protected Area	- There is no designation of national parks, natural parks, or natural protection areas at the project site. However, the project site is located in Eskisehir Catacik Wildlife Projection Site, and Sundiken Daglari Key Biodiversity Area (KBA No. ORT001).
	Prosperous fauna / flora	- The upper dam and reservoir site is located mainly in a forest, and the site is partially used as meadows. The vegetation of the upper reservoir and the waterway site is mixed forest of pine trees and oak trees (*Quercus petraea*), and is relatively well grown and dense. - Though there is no information of rare and important species of fauna and flora so far, the project site is located in the wildlife protection site and the KBA as mentioned above. Therefore, detailed environmental survey and impact assessment on wildlife is required.
	Resettlement / Compensatory assets	- No involuntary resettlement is anticipated. - Fish cages for salmon breeding are located in front of the outlet site. Relocation of the cages or some compensation is required.
	Historical / Cultural Heritage	- There is no historical and cultural heritage to be affected. And there is no important tourism resource to be affected.
	Others	- The existing Gökçekaya reservoir, which will be used as the lower reservoir, shows eutrophic phenomenon. Since the project might affect water quality of the upper reservoir, impact assessment should be done carefully.
Others' Special Note		- Although, it is possible to access from the Gökçekaya dam to the upper reservoir, the access road is a punishing road and needs to be upgraded. - It is necessary to upgrade the existing road from the upper reservoir to Actim Village, near the headrace surge tank, and to construct new road of around 10 km from the Village to the UPH and the outlet. - Length of new power line is estimated about 10km from the nearest 400kV substation.

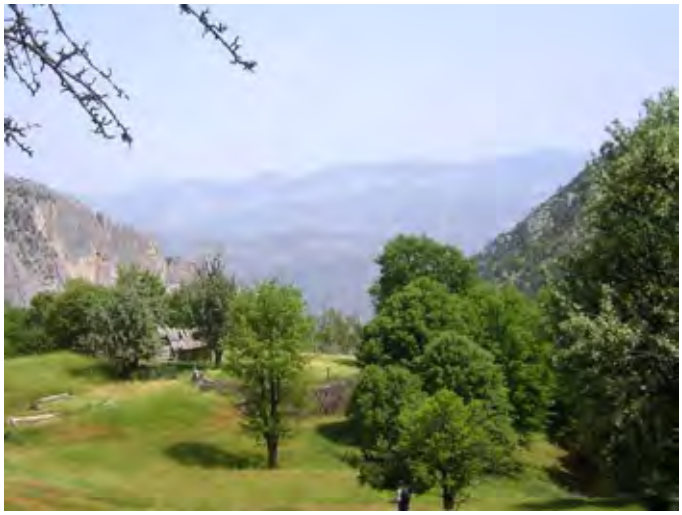


Photo 1　Original upper dam site, viewing from the upstream

Photo 2　Alternative upper dam site, viewing from the left bank

Schist cropped out in the reservoir（joints are developed）

Photo 3　Alternative upper dam site

Photo 4　Upper reservoir, viewing from the upstream

Photo 5　Waterway route

Photo 6　Existing Gökçekaya Dam (Lower reservoir)

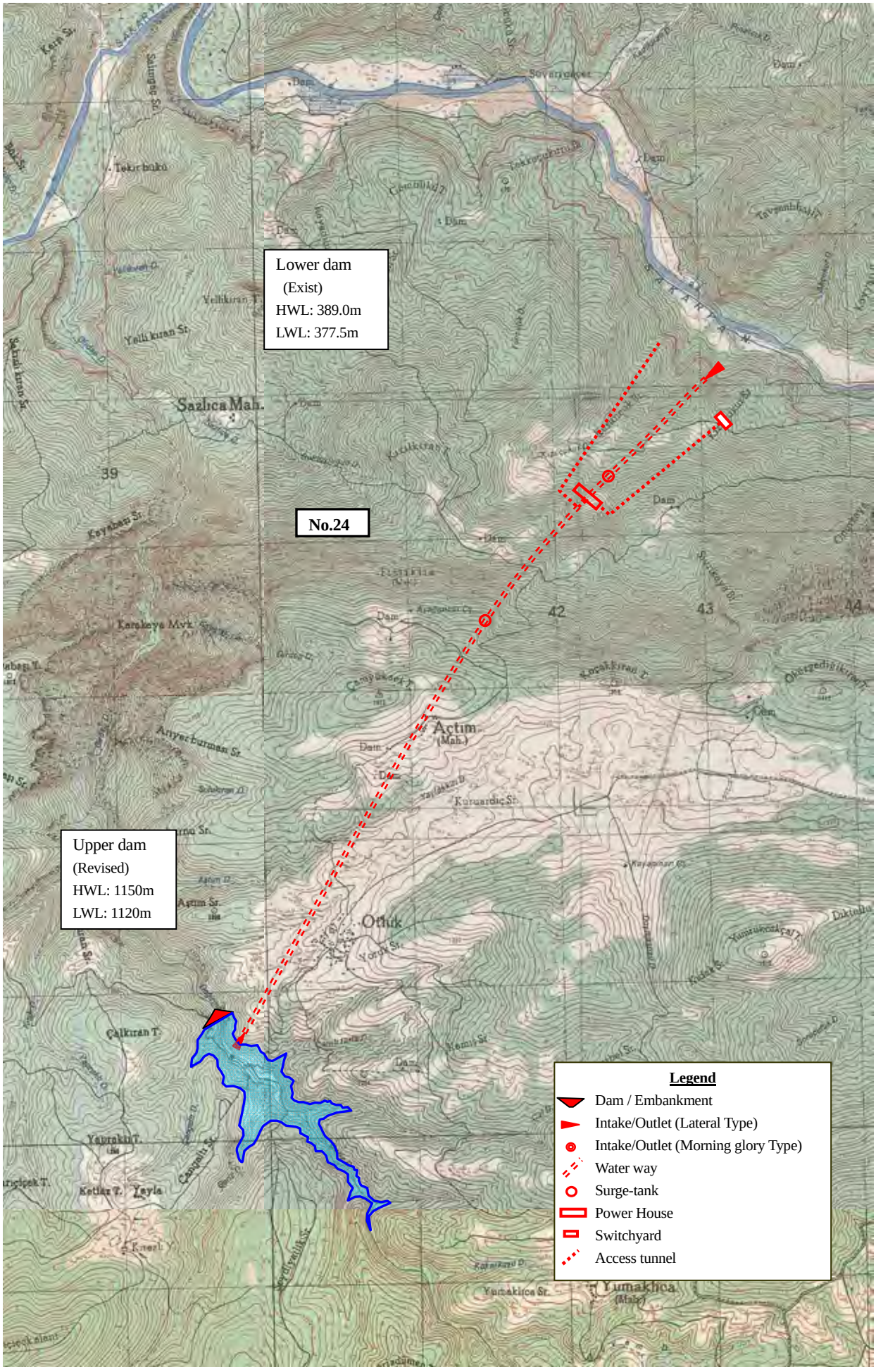
Splitting off in placibis along joints which intersect with schistosities

Photo 7 Schist distributed on the left bank slope of Gökçekaya reservoir

Photo 8 Outlet site

Photo 9 Gökçekaya reservoir, which water quality is relatively bad.

Photo 10 Fish cages in front of the outlet in the Gökçekaya reservoir



No.19 Layout of Main Facilities

Characteristics of PSPP Potential Site

Site Name		**No.26**
Location (River name)		Upper Dam / Reservoir : Ankara Nallıhan Salaklar Lower Dam / Reservoir : Ankara (Sakarya River, Gökçekaya Lake)
Profile	Installed Capacity P (MW) Design Discharge Q (m^3/s) Effective Head H (m) Peak Duration Hour (hrs)	1,000 229 552 7
Geography / Geology	General Geology	- Most of the geology of the project site belongs to metamorphic rocks of Gökçekaya formation (PEg) in the upper Paleozoic to Triassic period of Mesozoic era. "PEg" consists of chlorite – sericite schist, phyllite, calcschist, and metabasic lava. - The existing Gökçekaya reservoir is used for the lower reservoir. The geology of the area is Dağküplü mélange (Kd). "Kd" plunges under the "PEg". The boundary is in the mountain slope of the right bank. (referred to 1:100,000 Adapazarı H26 quadrangle) -
	Upper Dam / Reservoir	- The dam site is located on a plateau on the right bank of the Gökçekaya reservoir. - No water but a trace of water flow in the riverbed was observed - The topography of both banks of the dam site is gentle slope, and especially, it is remarkable above EL.950m on the right bank. - Geology around the upper reservoir belongs to Gökçekaya formation (PEg). Some outcrops of chlorite schist are scattered in the reservoir area, and graphite schist was observed at the dam site. Strike / dip of the graphite schist is N40E/30NW, and this strike is almost parallel to the one of bedding of bedrock of the dam. The bedding gently slants to the upper stream of the dam site. The rock is weathered and easily split off by hammering. - Some parts of the calcareous layer with a few mm thickness were dissolved, and which were transferred and deposited in some joints of the outcrop at the dam site. - Calcschist, phyllite, and chlorite – sericite schist of "PEg" are distributed in order from the south to the north. - The topography of the upper reservoir area is gentle, and used for the stock farm. Some calcareous rock boulders, which are deemed to be fragment by weathering, are scattered on the surface. - A sandy schist outcrop was observed at the left abutment of the dam site. This is deemed to be a boulder stone because the bedding plane shows an irregular strike and dip direction of N10W/20SW. - Since the geology is calcareous, no water was observed and topography around the reservoir is rather flat, an artificial pond with full facing type should be applied for the upper reservoir.
	Waterway / Underground Powerhouse	- The waterway route is located in the rather thick ridge, there is no particular issues topographically. - Chlorite – sericite schist of "PEg" is distributed though the waterway route, and it is expected that the geology around the UPH is the same. - No outcrops were observed at the intake site, which slope is covered by meadow grass. Though the depth of top soil will be shallow, the bedrock is deemed to be weathered by several meters. - Meanwhile, it is expected that hard and massive rocks are distributed through the most part of waterway and the UPH, judging from the rock condition of the neighboring No.32-2 site.

	Lower Dam / Reservoir	- Geology of the area belongs to Dağküplü mélange “Kd”, which underlies “PEg”. - Bedrocks are fully cropped out along the Gökçekaya lakeside. Schistosities and joints in the outcrops are developed. Many landsides were observed, especially, loosening by creep of rock due to schistosity with parallel dip of the slope and collapse of rocks which are wedged between joints and schistosities were observed. - Bedrock around the outlet is a partially serpentinized basic rock. Since the outlet is located on the right bank of the reservoir and the dip of layer intersects with the slope, it is expected that the bedrock is hard and massive. However, the distribution discontinuities such as joint and schistosity is to be investigated. - The layer inclines approximately 35 degrees to the north referring to the distribution of limestone developing on the right bank slope. - Sedimentation transferred from the valley, where the original outlet is located, was deposited with 50meters wide and 200 meters length in the lake. - Upon this condition, the outlet was moved to the upstream of around 500m, and the coffer dam length turned longer as a result.
Natural / Social Environment	Natural Park / Protected Area	- There is no designation of national parks, natural parks, or natural protection areas at the project site. And also, the project site is not located in any environmental protection areas.
	Prosperous fauna / flora	- The upper dam and reservoir site is used for meadows. The surrounding area is in a recently rehabilitated forest for erosion protection. The waterway and outlet sites are also in an erosion protection forest. - There is no information of rare and important species of fauna and flora so far, therefore, possibility of existence of rare species in the project area is small.
	Resettlement / Compensatory assets	- No involuntary resettlement is anticipated. - There are water collection structures at the upper dam site, which is used for animal breeding by local people, and there are several tombs in the upper reservoir site, but the number is limited. Those will be directly affected.
	Historical / Cultural Heritage	- There is no historical and cultural heritage to be affected. And there is no important tourism resource to be affected.
	Others	- The existing Gökçekaya reservoir, which will be used as the lower reservoir, shows eutrophic phenomenon. Since the project might affect water quality of the upper reservoir, impact assessment should be carried out carefully.
Others’ Special Note		- Although it is possible to access from the Gökçekaya dam to the upper reservoir and upper penstock, the access road is a punishing road and needs to be upgraded. - It is necessary to construct new road of around 10 km from the upper reservoir to the UPH and the outlet. - Length of new power line is estimated about 20km from the nearest 400kV substation.

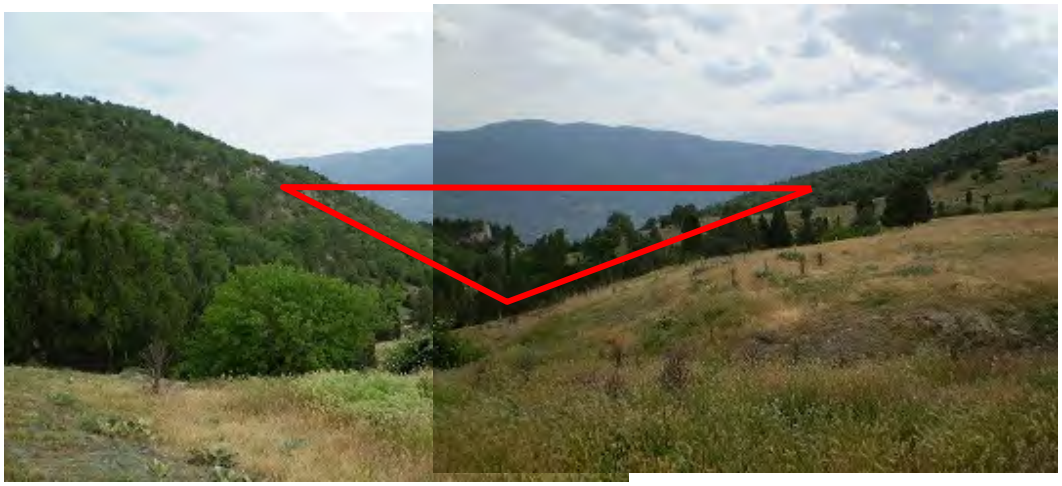


Photo 1 The original upper dam site, viewing from the upperstream.

Photo 2 The upper dam site and the reservoir, viewing from the upstream

Photo 3 A river at the upper dam site (There is no river flow at the ground surface of the river.)

Photo 4　Outcrops of chlorite and graphite schist at the dam site

Photo 5　Lime which were dissolved and transferred along joints were deposited on the surface of the outcrop at the dam site

Photo 6　Some parts of the calcareous layer with a few mm thickness were dissolved

Photo 7 Outcrop of sandy schist on the left bank of the dam

Photo 8 Water tank in the riverbed

Photo 9 Water tank on the right bank of the upper dam site

Photo 10　Watering places in the upper reservoir

Photo 11 Local residents are raising their livestock (cows) in the upper reservoir. There are several tombs.

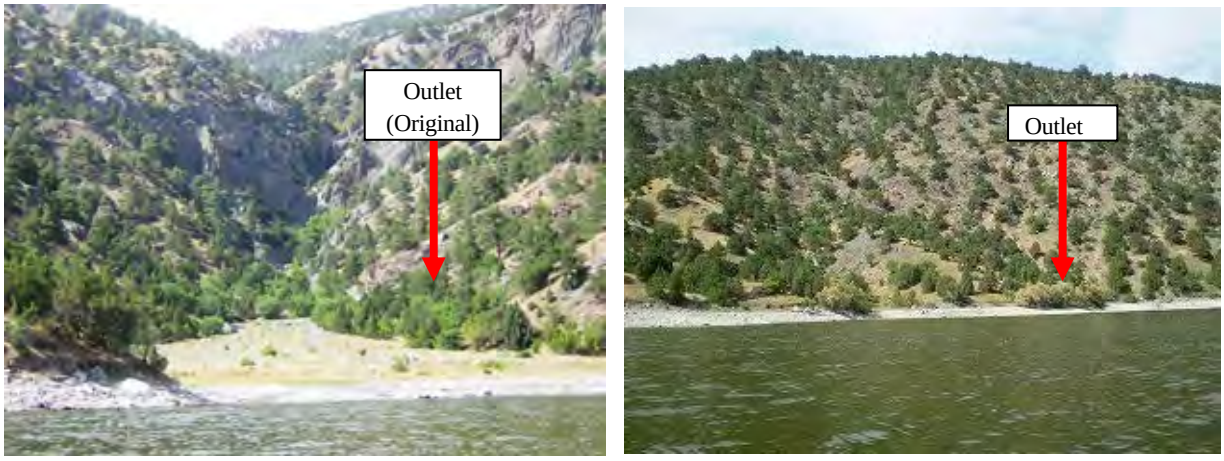


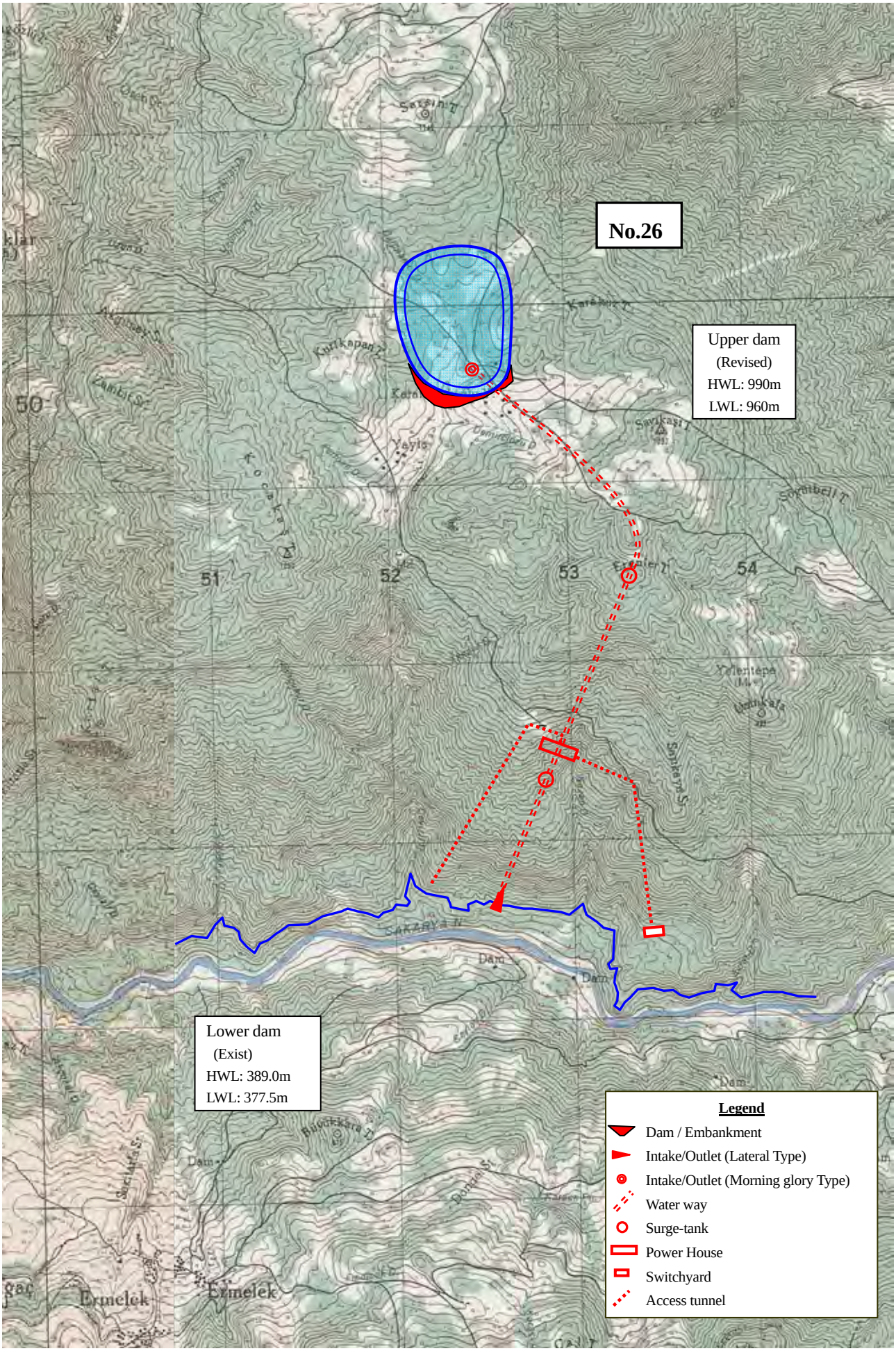
Photo 12　Outlet site

Photo 13 Serpentinized basic rock around the outlet site

Photo 14 Existing Gökçekaya Dam, the lower reservoir of No. 26 Project

Photo 15 Gökçekaya Reservoir, which water quality is relatively bad.

Photo 16　Fish cages in the Gökçekaya reservoir



No.26 Layout of Main Facilities

Characteristics of PSPP Potential Site

Site Name		**No.27-1**
Location (River name)		Upper Dam / Reservoir : Samsun Bafra Baskaya (Degirmen River) Lower Dam / Reservoir : Samsun (Kizilirmak River, Altınkaya Lake)
Profile	Installed Capacity P (MW) Design Discharge Q (m^3/s) Effective Head H (m) Peak Duration Hour (hrs)	1,000 214 591 7
Geography / Geology	General Geology	- Geology of the Project area belongs to Yemışlıçay formation (Ky) and Cankurtaran formation (Kc) of the upper Cretaceous period. - " Ky" consistes of tuffite, tuff, agglomerate, sandstone, marl and shale. " Kc" consists of sandstone, siltstone, silty sandstone, and sandy limestone. Actually rhythmic alternation of non-volcanic sedimentary rocks was observed in the site reconnaissance. (referring to the 1:100000 geologic map of Aralık quadrangle (2000)).
	Upper Dam / Reservoir	- Water flow of 0.5m3/s was observed in the Degirmen river at the dam site. - The area from the bottom to 10m high of riverbed is formed gentle slope and covered by sand and silt sediment. The gentle slope has width of approximately 30m on the left bank and 50m on the right bank, respectively. - Aquatic plants and shrubbery grow thick and wild along the river and tributary. - Alternation of sedimentary rocks with several meters thickness crops out widely on the left bank, riverbed, and some part of the right bank. - Measured strike / dip of the bedding plane is N70W/15SW on the right bank. - Most of rocks on the right bank are hard, however, small scale holes were observed in some of the calcareous strata with around 5 meters of thickness, and slaking due to weathering was observed at some surface of mudstone. - Since both abutment slopes of the dam site are inclined at around 35 degrees, bedrocks around the dam site are hard and massive and there is little soil material around the upper reservoir, concrete gravity type or concrete faced fill type is suitable to be applied.
	Waterway / Underground Powerhouse	- The waterway route is located in the rather thick ridge, there is no particular issues topographically. - Alternation of conglomerate, sandstone, and mudstone was observed on the mountain through the waterway route. The strata seem to be the same as that at the upper dam site. - Two types of weathering have been taken place in the conglomerate and mudstone, one is a chemical weathering in the calcareous gravels of conglomerate, and the other is a physical weathering on the surface of mudstone. However, both types of weathering seem to be limited to only the surface. Upon these conditions, it is expected that hard and fresh rocks are distributed at the level of the UPH. - Geological layer surrounding the upper reservoir seems so simple having E-W strike and gentle South dip. However, various types of fold were observed in many places on the southern slope of the project area. Most of the fold axes show E-W strike and plunge approximately 20 degrees to the west. They are symmetric and the degree of folding is week, and the wave span is about 100m near the outlet site.

	Lower Dam / Reservoir	- The existing Altınkaya reservoir is planned to use for the lower reservoir. - Rocks weaken by slaking crop out on the surface of mudstone along the lake side road. It is necessary to investigate weathering conditions such as depth by borehole drilling and seismic prospecting exploration at around the outlet site. - Detail field survey along the reservoir or the lake side road is recommended. The survey results will help interpret of the folds and clarify weathering condition. - The active water depth of the Altınkaya reservoir is as deep as 30m, therefore, in order to select optimal location of the outlet and coffer dam, a wide range of topography (ground sureface and underwater) map of 1:5,000 is to be prepared.
Natural / Social Environment	Natural Park / Protected Area	- There is no designation of national parks, natural parks, or natural protection areas at the project site. And also, the project site is not located in any environmental protection areas.
	Prosperous fauna / flora	- The upper dam and reservoir site is partially used for meadows, but mainly covered by a relatively dense forest of pin trees, hornbeams, spruces and chestnut trees. - There is no information of rare and important species of fauna and flora so far.
	Resettlement / Compensatory assets	- No involuntary resettlement is anticipated. And also, there is no asset to be compensated.
	Historical / Cultural Heritage	- There is no historical and cultural heritage to be affected. And there is no important tourism resource to be affected.
	Others	- None.
Others' Special Note		- Although it is possible to access from the Altınkaya dam to the upper reservoir, headrace surge tank, UPPH and outlet, all access roads are punishing roads and need to be upgraded. - Length of new power line is estimated about 10km from the nearest 400kV substation.

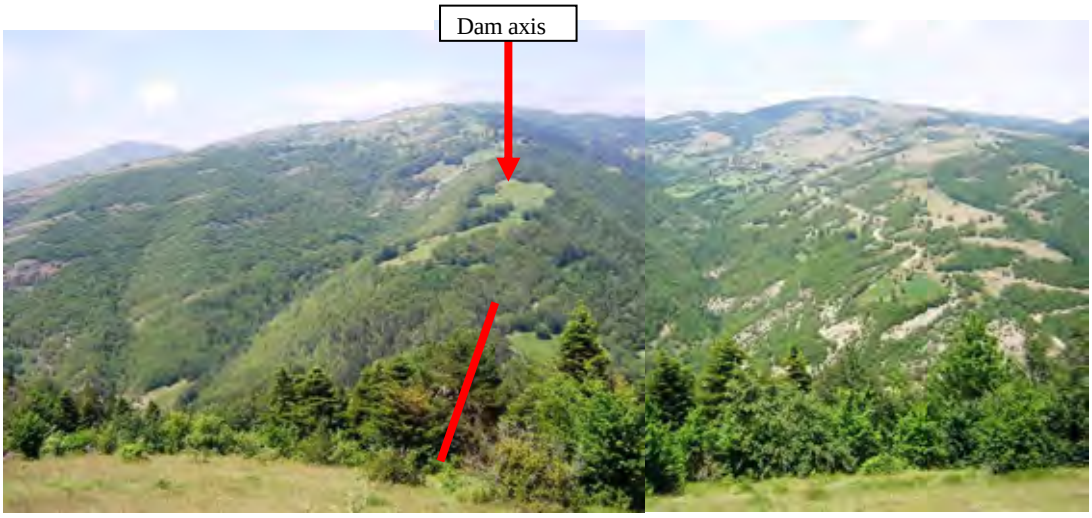


Photo 1 The upper dam site, viewing from the right bank

Photo 2 The upper reservoir, viewing from the downstream

Photo 3 Sandstone cropped out on the slope of logging road at the right bank of Upper dam site

Alternation of sedimentary rocks, most of rocks on the right bank are hard, however, small scale holes were observed in the thick calcareous strata

Photo 4　Outcrops at the left bank of the upper dam site

Photo 5　The river flow at the upper dam site

Slaking due to weathering at some surface of mudstone

Photo 6　Mudstone cropped out at the riverbed of the upper dam site

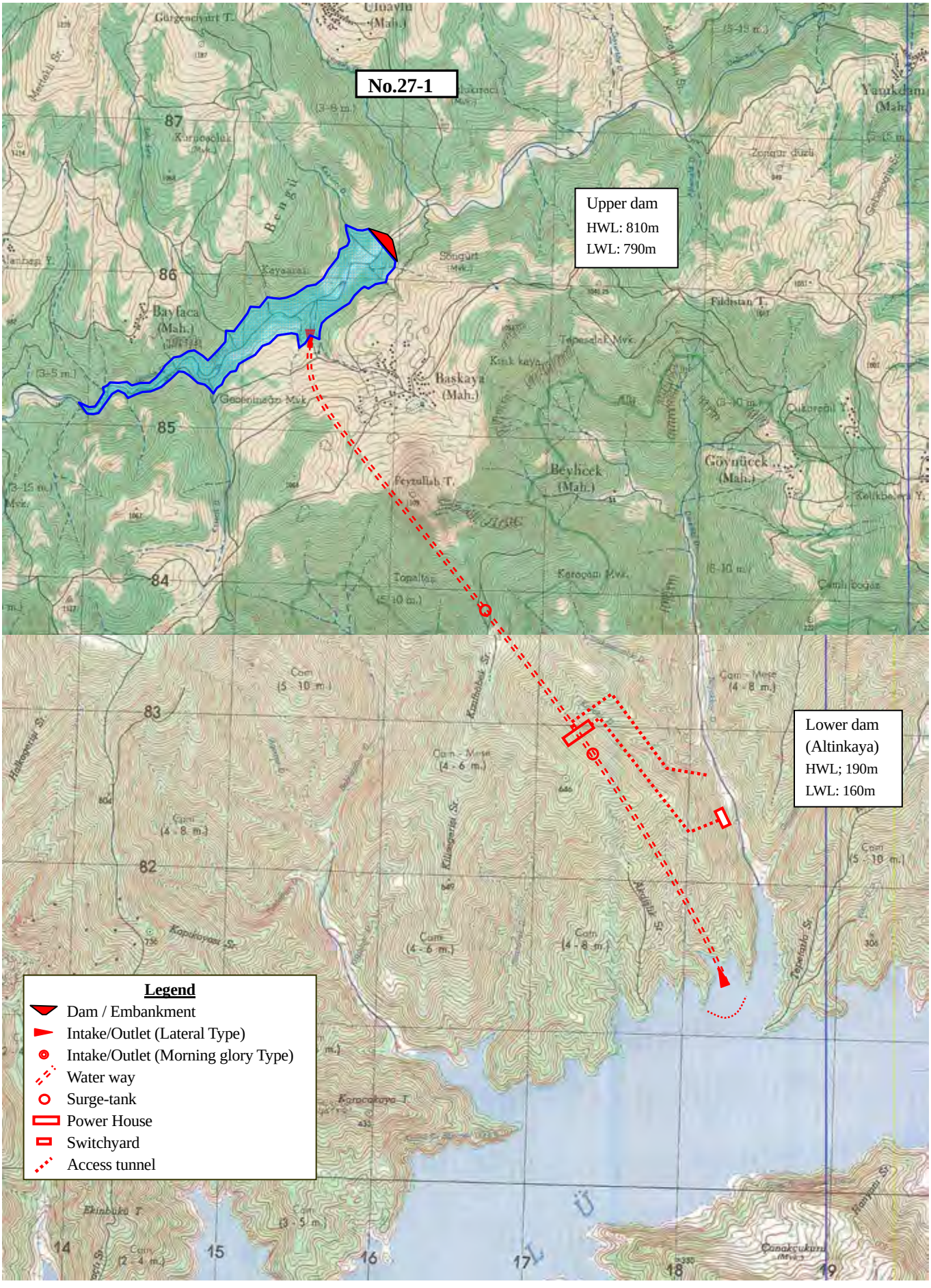
Photo 7 The waterway route

Photo 8 The existing Altınkaya Dam, which its reservoir is used as the lower reservoir of No. 27-1 Project

Photo 9 The outlet site.

Photo 10 Mudstone cropped out at the outlet site, which is slaked by weathering

Photo 11 The reservoir of Altınkaya Dam, which water is relatively clean



No.27-1 Layout of Main Facilities

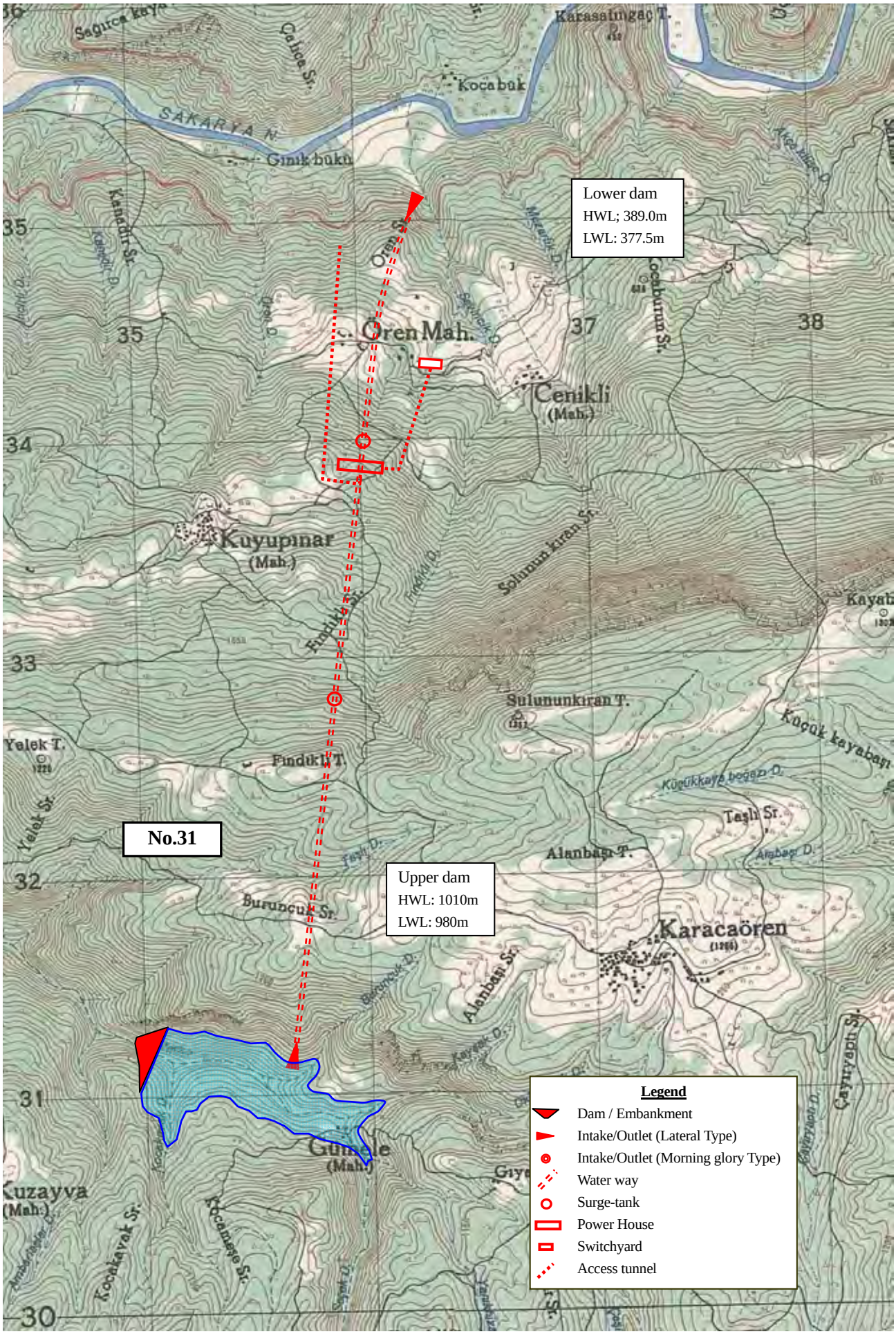
Characteristics of PSPP Potential Site

Site Name		**No.31**
Location (River name)		Upper Dam / Reservoir : Eskisehir Alpu Kuyupinar (Sacakdere River) Lower Dam / Reservoir : Ankara (Sakarya River, Gökçekaya Lake)
Profile	Installed Capacity P (MW) Design Discharge Q (m^3/s) Effective Head H (m) Peak Duration Hour (hrs)	1,000 219 577 7
Geography / Geology	General Geology	- Following strata are distributed in order from south to north, Göktepe metamorphics (PEg) of Precambrian era, Kayapınar marble (Pk) of Permian period, Otluk metamorphics (Eo) of lower Triassic period, Mıhlıkaya formation (TRKm) of middle Triassic to lower Cretaceous period. They are overlain in unconformity by Girdapdere metaolistostrome (Kg) of Torid-Anatorid zone in Triassic period, furthermore, and overlain at upmost by Dağküplü mélange (Kd) of Izmir-Ankara zone in Cretaceous period. - "PEg" consists of schist, metagranite, metarhyolite, and metabazite. "Eo" consists of metaconglomerate, metasandstone, and metasiltstone. "TRKm" consists of recrystalized limestone, cherty limestone, and metaclastics. "Kg" consists of metacalciturbidite, metagreywacke, metasiltstone, and blocks of metavolcanic. "Kd" consists of undifferentiated Ophiolitic mélange and olistostrome. - These are described based on the published geological map (1:100,000 Eskisehir I-26 quadrangle).
	Upper Dam / Reservoir	- According to the published geologic map, the Sacakdere tributary is the boundary of "PEg" and "Pk" in the upper reservoir area. However, limestone but no metamorphic rock was observed on both left and right bank in our field reconnaissance. Therefore, it is estimated that this limestone belongs to the Kayapınar marble (Pk). - Some caverns were observed in the limestone of the dam site. Furthermore, no water flow but trace of river flow was observed on the riverbed. - Judging from above mentioned conditions, this site is not suitable for the upper dam and reservoir from the viewpoint of impermeability.
Natural / Social Environment	Natural Park / Protected Area	- There is no designation of national parks, natural parks, or natural protection areas at the project site. However, the project site is located in Eskisehir Catacik Wildlife Projection Site, and Sundiken Daglari Key Biodiversity Area (KBA No. ORT001).
	Prosperous fauna / flora	- The upper dam, reservoir, and waterway sites are filly covered by dense and well grown forest of pin trees, oak trees, poplar, and wild nuts trees. - Though there is no information of rare and important species of fauna and flora so far, the project site is located in the wildlife protection site and the KBA a mentioned above. Therefore, detailed environmental survey and impact assessment on wildlife is required.
	Resettlement / Compensatory assets	- No involuntary resettlement is anticipated. - Fish cages for salmon breeding are located in front of the outlet site. Relocation of the cages or some compensation is required.

	Historical / Cultural Heritage	- There is no historical and cultural heritage to be affected. And there is no important tourism resource to be affected.
	Others	- The existing Gökçekaya reservoir, which will be used as the lower reservoir, shows eutrophic phenomenon. Since the project might affect water quality of the upper reservoir, impact assessment should be done carefully.
Others' Special Note		- Since some caverns were observed in the limestone of the dam site and no water flow was observed on the riverbed, it is judged that possibility of water leakage from the upper reservoir is high. Therefore, this project site is abandoned.

Photo 1 Upper dam site, viewing from the upstream

Photo 2 Limestone outcrops on the left bank of the upper dam axis



No.31-1 Layout of Main Facilities

Characteristics of PSPP Potential Site

Site Name		**No.32-2**
Location (River name)		Upper Dam / Reservoir : Ankara Nallıhan Eğri (Right bank of Sakarya River) Lower Dam / Reservoir : Ankara (Sakarya River, Gökçekaya Lake)
Profile	Installed Capacity P (MW) Design Discharge Q (m^3/s) Effective Head H (m) Peak Duration Hour (hrs)	1,000 330 382 7
Geography / Geology	General Geology	- Gökçekaya metamorphics (PEg), Kızlıçay formation (TPek), and Gemiciköy formation (Temg) are distributed in order from south to north. - Gökçekaya metamorphics (PEg) which is Permian to Triassic system is overlain in unconformity by Kızlıçay formation (TPek) which is Paleocene to lower Eocene series, and overlain in unconformity at upmost by Gemiciköy formation (Temg) which is upper Eocene to lower Miocene series. - "TPek" consists of alternation of conglomerate, sandstone and mudstone (continental). And "Temg" consists of conglomerate, sandstone, claystone, marl and lacustrine limestone. - "PEg" consists of chlorite-sericite schist, Phyllite, Metabasic lava and calcschist, and contains some huge blocks of recrystallized limestone and marble which are members of Eğriköy marble (PEge). - Geology around the Gökçekaya dam and the outlet is Dağküplü mélange "Kd" which plunges under "PEg". - These are described based on the published geological map (1:100,000 Adapazarı H-25(2002) and H-26(2002)).
	Upper Dam / Reservoir	- The upper dam site is located on the right bank of the existing Gökçekaya reservoir. - A little water flow was observed on the riverbed. - Topography of both banks of the upper dam reservoir is gently undulated. - The original dam site is located at the boundary of Eğriköy marble (PEge) and Gemiciköy formation (Temg). Only "Temg" crops out on the ridge of the left bank and is highly weathered. The boundary of them gently inclines to the north, and which strike / dip is estimated N40E/20NW. - New dam site is moved 200m upstream from the original one. "Temg" will be the bedrock of the upper dam, and "Temg" and a part of "PEg" will be the bedrock of the upper reservoir. - The upper reservoir area is on a gently undulating plain and has few outcrops, therefore, this gentle topography might be formed due to weathering of "TPek" and "Temg". - Judging these topographic and geologic conditions, the dam site was moved about 200m upstream and artificial pond full facing type dam is suitable from the view points of impermeability and ensuring required reservoir capacity.
	Waterway / Underground Powerhouse(UPH)	- The intake and some part of the waterway route will go through "Temg" and "PEge", however, most part of the waterway and the UPH will be located in "PEg", which is little weathered, hard and massive. - It is necessary detailed investigation concerning permeability of "Temg" and "PEge" at around the intake and part of the headrace, and the boundary with "PEg". - It is possible to apply vertical shaft for the penstock, because the ridge on the left bank of the upper dam is continued long up to near the lower reservoir with high elevation.

	Lower Dam / Reservoir	- The existing Gökçekaya reservoir is planned to use as a lower reservoir. - Slope of the right bank of the lower reservoir is steep and a series of hard rock outcrops were observed at around the outlet site. Strike / dip of bedding plane of outcrop is N70E/70 - 80NW. - Massive and hard bedrock expose on the right bank of the Gökçekaya Lake, however, there is a creep rock mass slipped down from the halfway of the slope at the outlet site. - The rock mass should be removed, and the upper slope of the outlet should be protected for the safety during and after construction.
Natural / Social Environment	Natural Park / Protected Area	- There is no designation of national parks, natural parks, or natural protection areas at the project site. And also, the project site is not located in any environmental protection areas.
	Prosperous fauna / flora	- The upper dam and reservoir site is used for wheat fields, and the waterway site is covered with a recently rehabilitated forest for erosion protection. - There is no information of rare and important species of fauna and flora so far, therefore, possibility of existence of rare species in the project area is small.
	Resettlement / Compensatory assets	- No involuntary resettlement is anticipated. - Osmanköy village is located near by the upper reservoir site. Even though it will not be directly affected, its consideration during construction should be taken. - There are two water pumping facilities in the upper reservoir site. Relocation of the facilities is required.
	Historical / Cultural Heritage	- There is no historical and cultural heritage to be affected. And there is no important tourism resource to be affected.
	Others	- The existing Gökçekaya reservoir, which will be used as the lower reservoir, shows eutrophic phenomenon. Since the project might affect water quality of the upper reservoir, impact assessment should be done carefully.
Others' Special Note		- It is easy to access to the upper reservoir. - Although it is possible to access from the upper reservoir to the upper penstock through Kavak and Eğriköy village, the access road is punishing road and very narrow in the Eğriköy village, hence, needs to be upgraded. - The access road from the right bank of Gökçekaya dam to the UPH, the outlet and switch yard needs to be constructed newly. - Length of new power line is only 2km from the existing switch yard of the Gökçekaya HES.

Photo 1　Original upper dam site, viewing from the downstream.

Photo 2　Upper reservoir, viewing from the downstream

Photo 3　Strongly weathered tuff of “Temg” on the ridge of the upper dam site

Photo 4 Original upper dam site (There are tombs at the dam axis.)

Photo 5　Water-pumping facility at the upper dam site

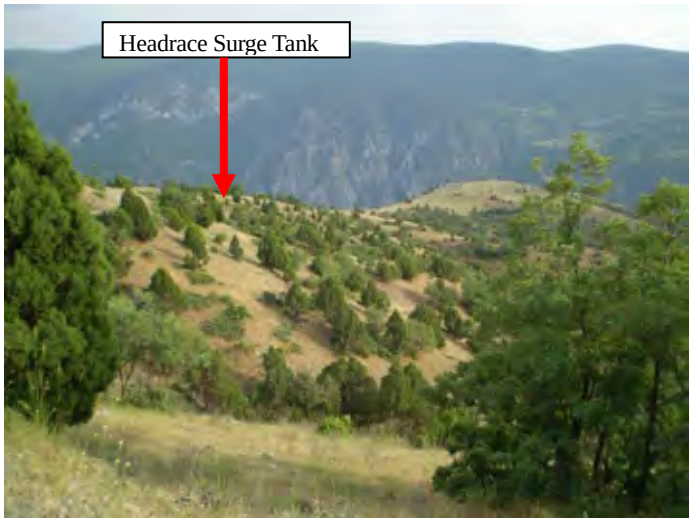


Photo 6　Waterway route and Headrace Surge Tank site

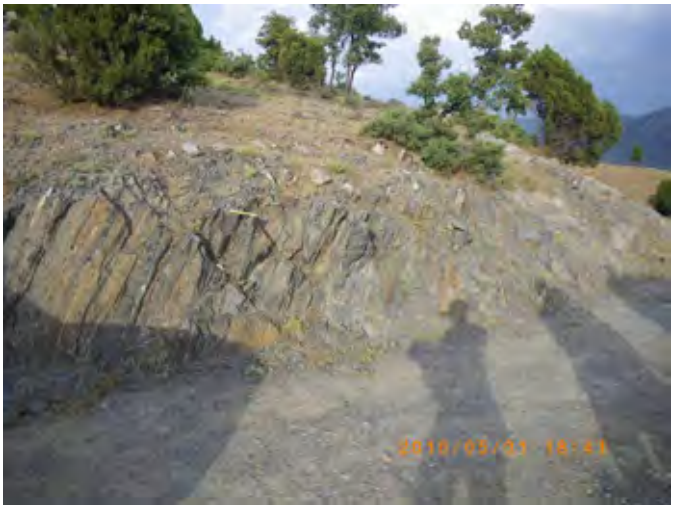


Photo 7　Hard metamorphic rock cropped out along the waterway route

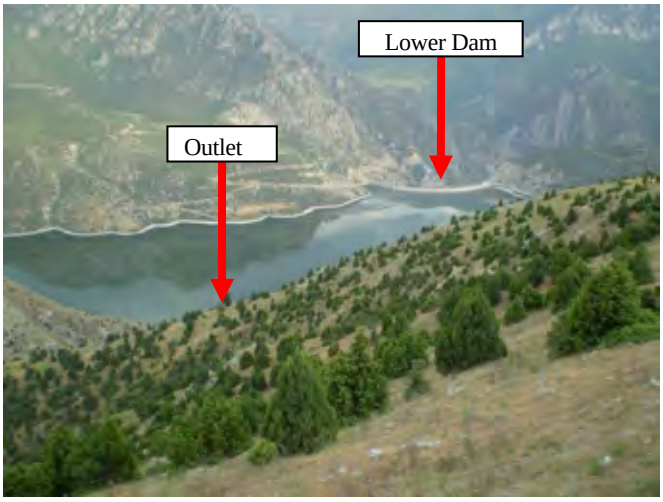


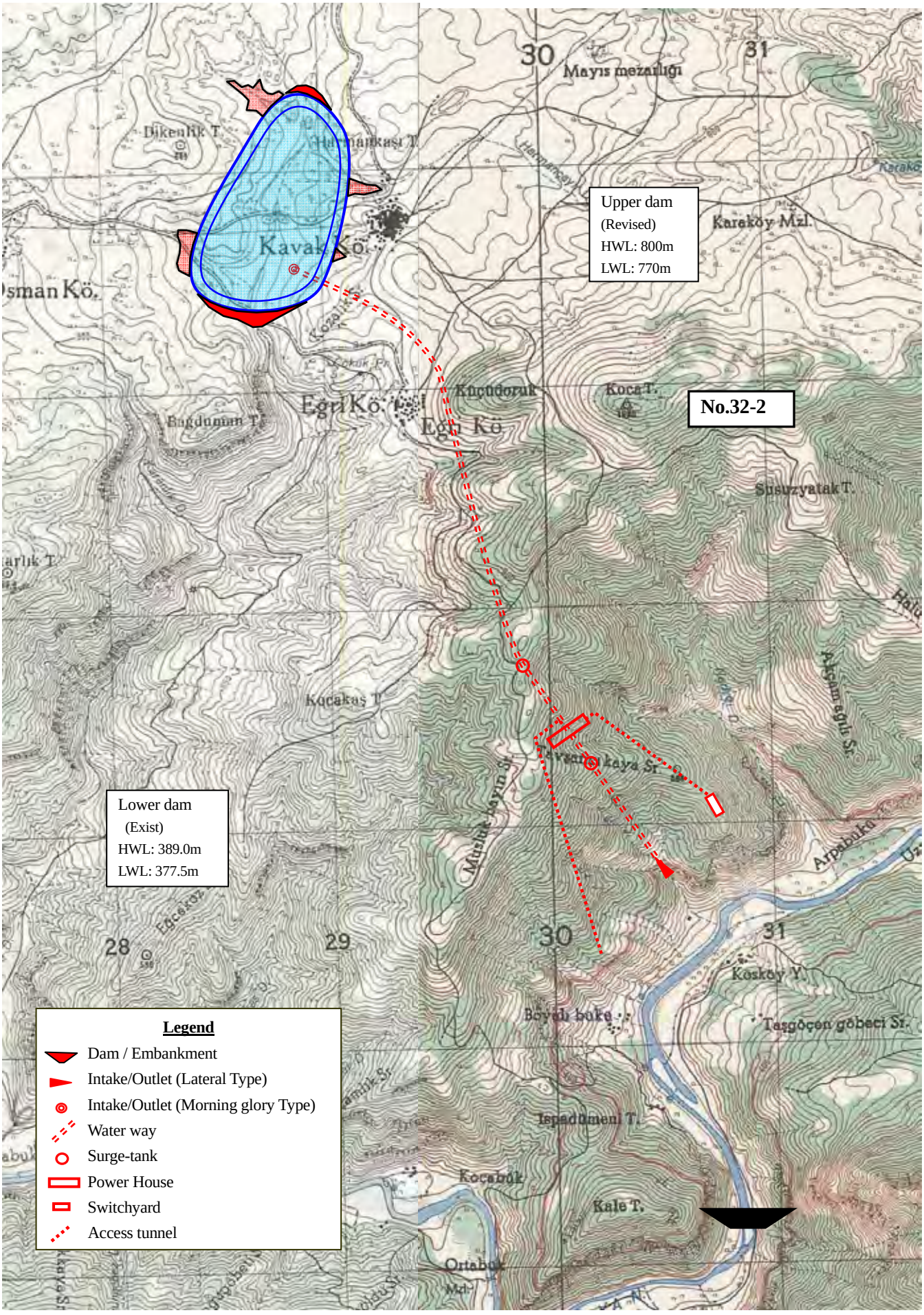
Photo 8　Waterway route and Outlet

Photo 9　Outlet site, viewing from the left bank


Photo 10　Existing Gökçekaya Dam　(Lower reservoir)

Photo 11　Gökçekaya Reservoir, which water quality is relatively bad

Photo 12　Fish cages in the Gökçekaya reservoir



No.32-2 Layout of Main Facilities

Characteristics of PSPP Potential Site

Site Name		**No.37-1**
Location (River name)		Upper Dam / Reservoir : Kayseri Aladağ Kovkeleri （Bozuluk River） Lower Dam / Reservoir : Kayseri Aladağ （Zamantı River）
Profile	Installed Capacity P (MW) Design Discharge Q (m^3/s) Effective Head H (m) Peak Duration Hour (hrs)	1,000 195 649 7
Geography / Geology	General Geology	- In this area, Dıvrıkdağı formation (JKd) of Jurassic to Cretaceous period, ophiolitic mélange (KOm) of upper Cretaceous period and Mesozoic ophiolite (hd), which overlies them by Napping, are distributed. - "JKd" is overlain by "KOm" according to the published geologic map, however, we could not observe that in the field reconnaissance. Furthermore, "JKd" overlies Küçüksu formation (TRk) of lower Triassic system according to the published geologic map, not sedimentary rock but some basic rocks were observed under the layer of "JKd". "TRk" consists of variegated shale, marl and clayey limestone. - "JKd" consists of limestone and dolomite. Near the boundary of "JKd" and "TRk" some limestone caves were observed. And there is a thin conglomerate layer which thickness is less than 1m just on "TRk". "JKd" overlies "TRk" with N30-50E / 30NW strike and dip near a colony. - "hd" consists of peridotite and dunite, and contains an important ore of chromium. (source ; KOZAN - J20 (1987), 21 (1988) 1/100,000 geologic map)
	Upper Dam / Reservoir	- The upper dam is located at the upmost stream of Dömber river which is a tributary of left bank of Zamantı river. - Water flow of around 0.1m3/s was observed on the riverbed - "KOm", "JKd", "TRk" and "hd" are distributed at the upper dam site. - Bedrock of the dam site is a basic rock of "hd", and is covered by surface soil which thickness is less than 2m. No weathering is observed there, and rock is relatively hard and fresh though there are some joints. - Rock of the reservoir area also belongs to "hd". It is a massive basic rock with few joints, fresh and hard. - Although "KOm", which is a lower layer of "hd", is drawn on the published geological plan, neither the rock of "KOm" nor the boundary of them was observed.
	Waterway / Underground Powerhouse	- Basic rock of "hd" is distributed along the waterway from the intake to the outlet. Some part of the waterway will pass the bottom of 'Nappe' which inclines from the east to the west, and the UPH will be located in the layer of "JKd". - Joints may be developed at the bottom of 'Nappe', therefore, it should be paid attention when excavate the UHP cavern.

	Lower Dam / Reservoir	- Since the original dam site is located in successive steep cliff of limestone valley, it is hard to construct access road. The possibility of water leakage from the dam is high. Judging from the above conditions, the dam site was moved around 2km upstream. - Bedrock of the alternative dam site is basic rock of "hd". Topography of both right and left bank is quite steep, and the rock seems to be hard and massive, although the surface color of rock is brown by weathering. - The topography of dam site is a precipitous valley and the hard and massive rock crops out at the dam site. Judging from the above conditions, arch concrete dam type or concrete gravity dam type is suitable to be applied.
Natural / Social Environment	Natural Park / Protected Area	- There is no designation of national parks, natural parks, or natural protection areas at the project site. However, the project site is located in Zamantı Nehri Wet Land, and Aladağlar Key Biodiversity Area (KBA No. AKD053).
	Prosperous fauna / flora	- The upper dam and reservoir site is covered by wheat fields and a pine tree forest. The trees were replanted under the forest rehabilitation project of Authority of Kozan District. Animal breeding in the forest is strictly prohibited. - Main animals in the area are wolfs, foxes, and many kinds of birds. Rainbow trout lives in Zamantı River. - Though there is no information of rare and important species of fauna and flora so far, the project site is located in the wet land and the KBA as mentioned above. Therefore, detailed environmental survey and impact assessment on wildlife is required.
	Resettlement / Compensatory assets	- Involuntary Resettlement of a house in the upper reservoir and houses along its access load is anticipated.
	Historical / Cultural Heritage	- There is no historical and cultural heritage to be affected. - There is Aladağlar National Park near the end of the proposed lower reservoir area. The National Park is utilized as a tourism resource. In the case that the reservoir water level becomes higher, it might affect the facilities related to the National Park.
	Others	- There is a conflict with a concession of chromium mining around the lower dam and reservoir site. - Also, there are conflicts with other hydropower development projects around the lower reservoir. In the case that it becomes joint projects, the water level of the lower reservoir would be higher so that the projects would affect the facilities related to the National Park. - As for water quality, it is concerned that water contamination might be caused by Chromium Mining Activity upstream of Zamantı River when impounding water in the lower reservoir.
Others' Special Note		- It is easy to access to the upper reservoir. - Although it is possible to access to the upper reservoir through Divrikcakiri village, the access road is punishing road and very narrow in the village, hence, needs to be upgraded. - The access road from the upper dam to the upper penstock needs to be constructed newly. - As for the lower reservoir, it may be possible to approach from the Adana but a long access road is to be constructed newly. - Length of new power line is estimated about 30km from the nearest 400kV substation.

Photo 1　Upper dam and reservoir site, viewing from the upstream

Photo 2　Upper dam site, viewing from the upstream

Photo 3　Waterway route

Photo 4 Limestone of Dıvrıkdağı formation (JKd) and Küçüksu formation (TRk) of lower Triassic system or ophiolitic mélange (KOm)

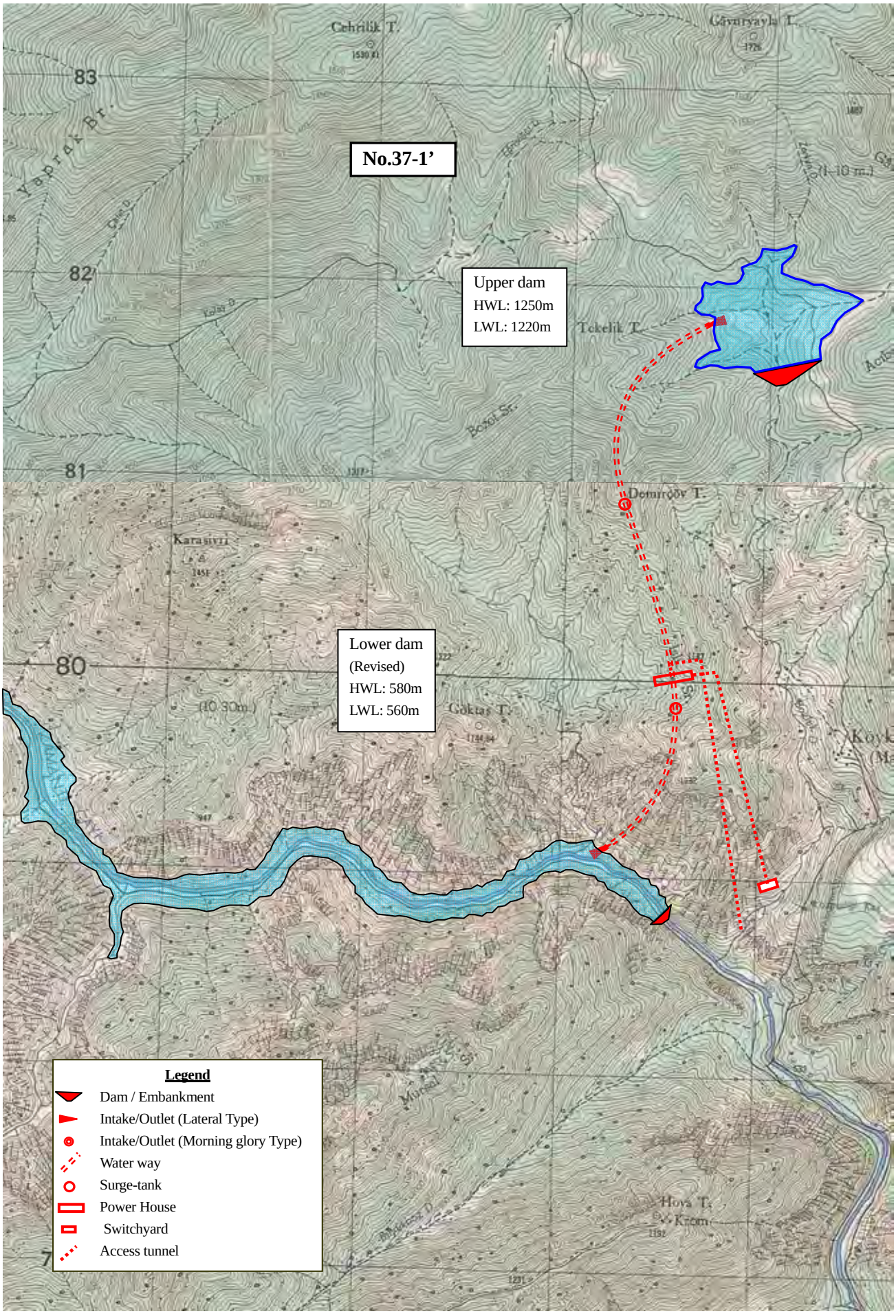
Photo 5 Original lower dam site, viewing from the left bank of upstream.

Photo 6 Alternative lower dam site, viewing from left bank of downstream.

Photo 7 Lower reservoir, viewing from upstream.

Photo 8 The water fall in Aladağlar National Park just upstream of the lower reservoir

Photo 9 The Chromium Mining at the upstream of the lower reservoir



No.37-1 Layout of Main Facilities

Appendix 5-5

Results of Detailed Site Survey of Conceptual Design Sites

Altinkaya PSPP Survey Route Map

Source : Google Earth

Appendix 5-5-2

Checklist of Environmental Parameters: Altinkaya PSPP

NOTE: The remarks are made based on the current plan. The assessments are based on the information obtained during the survey and should be reviewed and corrected, if necessary, at the next stage.

	Anticipated negative impacts			**Evaluation**
	Major	Unknown or can be mitigated	No significant impact	
A. Environmental Problems Due to Project Location				
A-1. Social Environment				
1. Effects on ethnic minorities			×	There are no minorities in the Project area.
2. Resettlement			×	There is no people and no houses to be resettled in the upper dam and reservoir area. There are the existing roads from provincial road to the site, and one of the road will be expanded for the construction. In addition, there are two units of water mills at the upstream of the dam site, which might be affected by the upper reservoir. The existing Altınkaya reservoir will be used as the lower reservoir for the Project. Therefore, there is no resettlement for the lower reservoir.
3. Loss of land (e.g. agricultural land)		×		A part of the upper reservoir area is used for wheat field or meadow for animal breeding. Other area is a forest Rice field and grazing land will be lost. The waterway is an underground structure. So, limited land for adits, disposal yards and access road to the adits will be lost. Since the existing Altınkaya reservoir will be used as the lower reservoir for the Project, land will not be lost for the lower reservoir.
4. Encroachment into watershed			×	The watershed is expected not to be affected.
5. Encroachment on historical and cultural values			×	There is no historical and cultural site in the Project site.
6. Impairment of navigation			×	There is no shipping traffic along Degirmen River. As for Altınkaya reservoir, construction of outlet and operation of the PSPP will not disturb shipping traffic because of the wide reservoir area.
7. Inundation of mineral resources			×	There is no mineral resource in the Project site.

8. Decline of fisheries			×	Fishery is not practised in Degirmen River. Large-scale of fishery such as salmon breeding is not observed in Altınkaya reservoir. Only small-scale fishery for people's own consumption may be practised in the area.
9. Downstream impacts		×		Discharge of Degirmen River will not be affected by the upper reservoir because the same volume of water will be released. Sediment transportation will be cut by the upper dam. However, since Degirmen River joins with Ilyasli River in about 17 kilo-meter from the upper dam site, impact of reduction of sediments will be limited. Installation of a bypass channel is a mitigation measure to reduce the impact as much as possible. Its necessity should be discussed during EIA process. As for the lower reservoir, since Altınkaya reservoir is utilized, there is no impact to the down stream.
A-2. Natural Environment				
1. Encroachment into precious ecosystem		×		The **terrestrial ecosystem** at upper dam / reservoir has already been degraded due to human activities. Secondary forests are left, and they need to be maintained as much as possible. The **aquatic ecosystem** of both areas is not fully understood. However, the impacts can be limited because the upper reservoir and the lower reservoir are in the same river basin.
2. Encroachment into existing protected areas			×	The Project site is not in any protected areas.
3. Migrating fish species		×		According to Fishery Law, a fish path or a fish ladder is required to structures, which are crossing rivers. However, since the dam height of the upper reservoir is 79m, it is not practical to construct a fish path. The river discharge is very small so that fish species are not abundant. Therefore, its impact is expected to be limited. Mitigation measures for fish migration should be coordinated with the related authorities. As for the lower reservoir, there is no impact because of utilization of the existing Altınkaya reservoir.
4. Effects on scenic value			×	Impact on scenic value is limited because the upper dam site is located in the valley, and other open structures are very limited.
5. Downstream impacts			×	Impacts on the **terrestrial ecosystems** surrounding the Project site are limited and are expected small. The **aquatic ecosystem** of both areas is not fully understood. However, the impacts can be limited because the upper reservoir and the lower reservoir are in the same river basin.
A-3. Physical Environment				

1. Watershed erosion / silt runoff		×		There are no activities related to the Project in the watershed. Therefore, there is no risk of increase of watershed erosion and silt runoff by the Project. As for possibility of land slide caused by drawdown of reservoir water level, necessary protection is required if there are geologically weak slopes.
2. Effects on groundwater hydrology			×	Pumping up of groundwater is not necessary for operation of the PSPP. Impact on groundwater hydrology by the construction of waterway is not fully understood, but it is expected to be limited and small.
3. Downstream water flow variations			×	Once the reservoirs are filled with water, the water flows from the dams are regulated to the same amount as before. It means that there will be no change in water flow variations.
4. Change of sedimentation transportation balance		×		Sediment transportation will be cut by the upper dam. However, since Degirmen River joins with Ilyasli River in about 17 kilo-meter from the upper dam site, impact of reduction of sediments will be limited.
B. Environmental Problems Associated with Construction Stage		×		All the items in this section should be carefully considered and technical specifications must be given to contractors to conduct all necessary mitigation measures. Expansion of the approach road should be carefully planned in order to avoid villages and agricultural areas as much as possible and to prevent soil erosion and landslides as much as possible. Workers' camp is expected to be big and its social impacts are to be carefully assessed and fully mitigated. Careful consideration should be paid to select disposal area to prevent secondary impacts. It is ideal to site the disposal area within the reservoir areas. Poaching and introduction of alien species must be well controlled to prevent disturbance to the local ecosystem and biodiversity (even if they are already degraded). Especially at the upper dam / reservoir site, the biodiversity of the surrounding forests should be protected.
B-1. Construction Monitoring				
1. Construction monitoring				
B-2. Construction				
1. Soil erosion / silt runoff				
2. Toxic wastes from equipment and cement factory				
3. Environmental degradation at quarry site				
B-3. Workers				
1. Safety of workers				
2. Sanitation at workers' camp				
3. Dust/ odors / fumes / noise / vibrations				
4. Quarrying hazards				
B-4. Social Environment				
1. Negative perception of local people				
2. Traffic accidents				
3. Traffic congestion and damage to road and bridge				
4. Environmental aesthetics				
B-5. Natural Environment				
1. Poaching by workers				

2. Firewood collection				
3. Introduction of alien species				
C. Environmental Problems Related to Project Operations		×		All the items in this section should be carefully considered and necessary mitigation measures must be undertaken by operation organisation to reduce impacts as much as possible. Insect vector / waterborne diseases are at the moment not prevailing in the areas. The water levels of reservoirs of PSPP change everyday, which may not make insects (e.g. mosquito) actively breed. It is therefore likely that the diseases will not prevail. However, such insect vector / waterborne diseases should be monitored, and take necessary countermeasures in case. Impacts on the natural environment should be carefully assessed and necessary countermeasures should be undertaken.
C-1. Operation Monitoring				
1. Operation monitoring				
C-2. Operation				
1. Warning system				
2. Downstream erosion				
3. Eutrophication of the reservoir				
4. Downstream water quality				
5. Reservoir bank stability				
C-3. Social Environment				
1. Insect vector / waterborne diseases hazards				
2. Estuarine and marine fisheries impacts				
C-4. Natural Environment				
1. Poaching due to new access methods				
2. Illegal logging due to new access methods				
3. Encroachment due to new access methods				
D. Additional Consideration for Hydropower Projects		×		All the items in this section should be carefully considered and necessary mitigation measures must be undertaken. At the moment, it is unlikely that avian hazards from transmission lines and towers occur. This is because such avian hazards related to the transmission line from the existing Altınkaya Hydropower Plant have not reported. At the moment, it is unlikely that aircraft hazards from transmission lines and towers occur. This is because there is not an airfield in the region.
D-1. Transmission Lines				
1. Encroachment on precious ecosystem				
2. Impairment of wildlife movement				
3. Avian hazards from transmission lines and towers				
4. Impairment of environmental aesthetics				
5. Soil erosion from construction and areas left exposed				
6. Inviting new encroachment				
7. Aircraft hazards from transmission lines and towers				
8. Induced effects from electromagnetic fields				

Altinkaya PSPP Site

Photo-1 Interview with Head of Village Village.

Photo-2 Site confirmation with Head of

Photo-3 Discussion with Forestry Dept. of Bafra

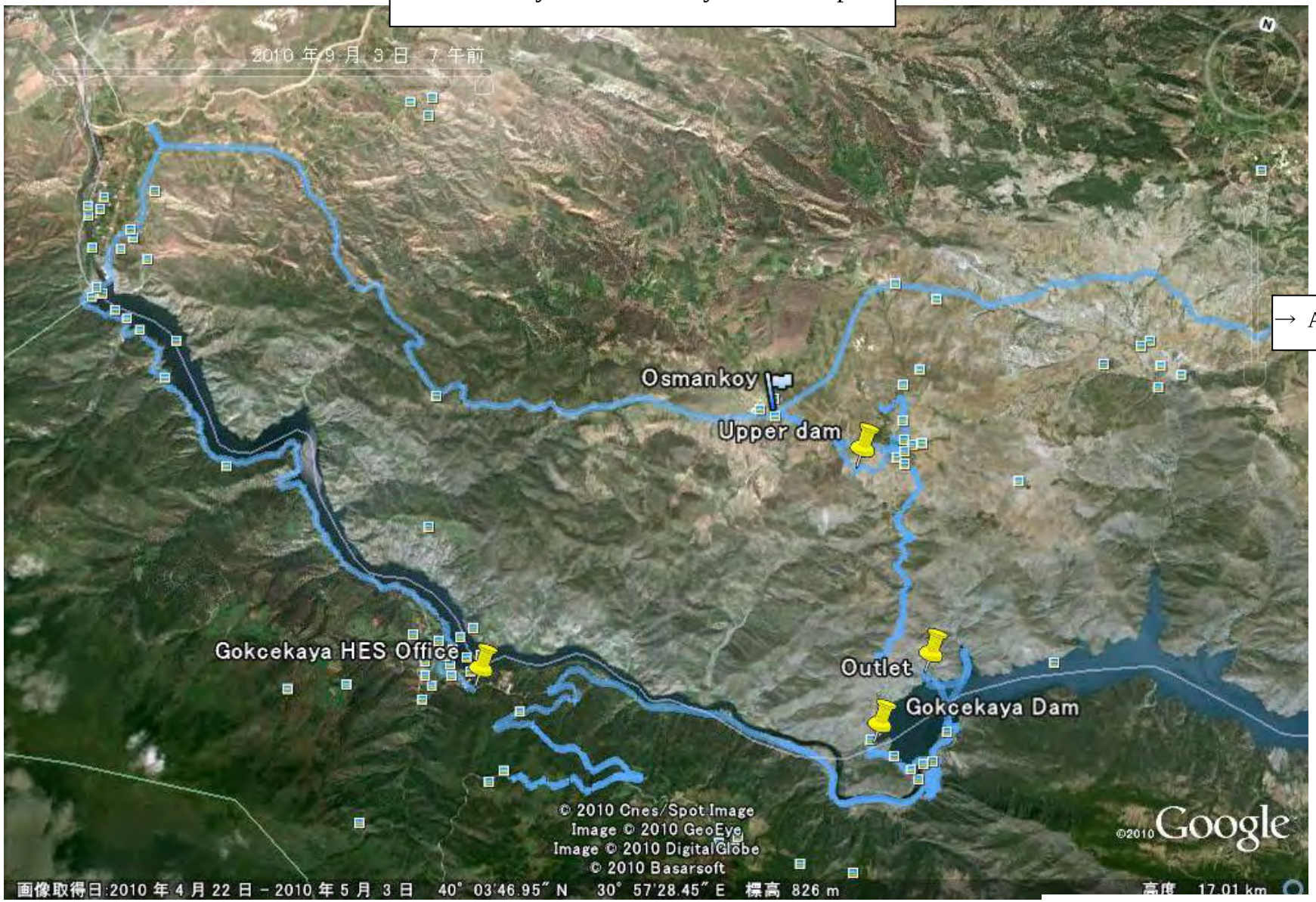
Photo-4 Discussion with DSI Bafra

Gökçekaya PSPP Site

Photo-5 Discussion with Heads of Villages (Kavak, Egri, Osman)

Photo-6 Discussion with Director of Forestry Department of Nallihan

Gokcekaya PSPP Survey Route Map



Source : Google Earth

Checklist of Environmental Parameters: Gökçekaya PSPP

NOTE: The remarks are made based on the current plan. The assessments are based on the information obtained during the survey and should be reviewed and corrected, if necessary, at the next stage.

	Anticipated negative impacts			**Remarks**
	Major	Unknown or can be mitigated	No significant impact	
A. Environmental Problems Due to Project Location				
A-1. Social Environment				
1. Effects on ethnic minorities			×	There are no minorities in the Project area.
2. Resettlement	×			The following three houses will be forced to resettle by the upper reservoir: ➢ A house which is the second house and owned by a resident in Kavak Village. ➢ A house which is the second house and owned by the person who is living outside of the Village. The owner stays in the house for limited days a year. ➢ Two storages for animal breeding. The existing Gökçekaya reservoir will be used as the lower reservoir for the Project. Therefore, there is no resettlement for the lower reservoir.
3. Loss of land (e.g. agricultural land)		×		The land at the upper reservoir area is mainly used for wheat field. Vegetable gardens and mixed orchards exist in the reservoir area. Such agricultural land will be lost. The waterway is an underground structure. So, limited forest land for adits, disposal yards and access road to the adits will be lost. Since the existing Gökçekaya reservoir will be used as the lower reservoir for the Project, land will not be lost for the lower reservoir.
4. Encroachment into watershed			×	The watershed is expected not to be affected.
5. Encroachment on historical and cultural values	×			Several ten graves of the cemetery of Kavak Village will be affected by the upper reservoir. So, compensation for the graves is required for those relocation.
6. Impairment of navigation			×	There is no shipping traffic along Kisla River. As for Gökçekaya reservoir, construction of outlet and operation of the PSPP will not disturb shipping traffic because of the wide reservoir area.
7. Inundation of mineral resources			×	There is no mineral resource in the Project site.

8. Decline of fisheries			×	Fishery is not practised in Kisla River. Salmon breeding is practiced in Gökçekaya reservoir, and small-scale fishery for local people's own consumption is practised in the area. However, construction of outlet and operation of the PSPP will not disturb fishery activities because of the wide reservoir area.
9. Downstream impacts			×	Discharge of Kisla River will not be affected by the upper reservoir because the river flow will be bypassed to the downstream. As for the lower reservoir, since Gökçekaya reservoir is utilized, there is no impact to the down stream.
A-2. Natural Environment				
1. Encroachment into precious ecosystem		×		The **terrestrial ecosystem** at upper dam / reservoir has already been degraded due to human activities. Some secondary forests are left, and they need to be conserved as much as possible. The **aquatic ecosystem** of both areas is not fully understood. However, the impacts can be limited because the water in the upper reservoir is pumped up. The river flow of Kisla River will be bypassed to the downstream.
2. Encroachment into existing protected areas			×	The Project site is not in any protected areas.
3. Migrating fish species			×	Since the river flow of Kisla River will be bypassed to the downstream, the upper dam/reservoir will not affect the migration of fishes. As for the lower reservoir, there is no impact because of utilization of the existing Gökçekaya reservoir.
4. Effects on scenic value			×	The current wheat filed will be converted to a lake with an embankment at the upper reservoir area, but it seems not to damage the scenic value of the area. As for the waterway route, impact on scenic value is limited because most of facilities are underground structures.
5. Downstream impacts			×	Impacts on the **terrestrial ecosystems** surrounding the Project site are limited and are expected small. The **aquatic ecosystem** of both areas is not fully understood. However, the impacts can be limited because the upper reservoir and the lower reservoir are in the same river basin.
A-3. Physical Environment				
1. Watershed erosion / silt runoff		×		There are no activities related to the Project in the watershed. Therefore, there is no risk of increase of watershed erosion and silt runoff by the Project. As for possibility of land slide caused by drawdown of reservoir water level, necessary protection is required if there are geologically weak slopes.
2. Effects on groundwater hydrology		×		Pumping up of groundwater is not necessary for operation of the PSPP. Therefore, impact on groundwater hydrology by the construction of waterway is not fully understood, but it is expected to be limited and small.

				Local people of Kaval and Egri Village are pumping-up underground water for drinking. Some deep wells will be submerged. Therefore, relocation of deep wells should be carried out.
3. Downstream water flow variations			×	Once the reservoirs are filled with water, the water flows from the dams are regulated to the same amount as before. It means that there will be no change in water flow variations.
4. Change of sedimentation transportation balance			×	Since the river flow of Kisla River will be bypassed to the downstream, the upper dam/reservoir will not affect the sedimentation transportation balance. As for the lower reservoir, there is no impact because of utilization of the existing Gökçekaya reservoir.
B. Environmental Problems Associated with Construction Stage		×		All the items in this section should be carefully considered and technical specifications must be given to contractors to conduct all necessary mitigation measures. Expansion of the approach road should be carefully planned in order to avoid villages and agricultural areas as much as possible and to prevent soil erosion and landslides as much as possible. Workers' camp is expected to be big and its social impacts are to be carefully assessed and fully mitigated. Careful consideration should be paid to select disposal area to prevent secondary impacts. Poaching and introduction of alien species must be well controlled to prevent disturbance to the local ecosystem and biodiversity (even if they are already degraded). Especially at the upper dam / reservoir site, the biodiversity of the surrounding forests should be protected.
B-1. Construction Monitoring				
1. Construction monitoring				
B-2. Construction				
1. Soil erosion / silt runoff				
2. Toxic wastes from equipment and cement factory				
3. Environmental degradation at quarry site				
B-3. Workers				
1. Safety of workers				
2. Sanitation at workers' camp				
3. Dust/ odors / fumes / noise / vibrations				
4. Quarrying hazards				
B-4. Social Environment				
1. Negative perception of local people				
2. Traffic accidents				
3. Traffic congestion and damage to road and bridge				
4. Environmental aesthetics				
B-5. Natural Environment				
1. Poaching by workers				
2. Firewood collection				
3. Introduction of alien species				
C. Environmental Problems Related to Project Operations		×		All the items in this section should be carefully considered and necessary mitigation measures must be undertaken by operation organization to reduce impacts as much as possible. Insect vector / waterborne diseases are at the moment not prevailing in the areas. The water levels of reservoirs of PSPP change everyday, which
C-1. Operation Monitoring				
1. Operation monitoring				
C-2. Operation				

1. Warning system				may not make insects (e.g. mosquito) actively breed. It is therefore likely that the diseases will not prevail. However, such insect vector / waterborne diseases should be monitored, and take necessary countermeasures in case. Impacts on the natural environment should be carefully assessed and necessary countermeasures should be undertaken.
2. Downstream erosion				
3. Eutrophication of the reservoir				
4. Downstream water quality				
5. Reservoir bank stability				
C-3. Social Environment				
1. Insect vector / waterborne diseases hazards				
2. Estuarine and marine fisheries impacts				
C-4. Natural Environment				
1. Poaching due to new access methods				
2. Illegal logging due to new access methods				
3. Encroachment due to new access methods				
D. Additional Consideration for Hydropower Projects		×		All the items in this section should be carefully considered and necessary mitigation measures must be undertaken. At the moment, it is unlikely that avian hazards from transmission lines and towers occur. This is because such avian hazards related to the transmission line from the existing Gökçekaya Hydropower Plant have not reported. At the moment, it is unlikely that aircraft hazards from transmission lines and towers occur. This is because there is not an airfield in the region.
D-1. Transmission Lines				
1. Encroachment on precious ecosystem				
2. Impairment of wildlife movement				
3. Avian hazards from transmission lines and towers				
4. Impairment of environmental aesthetics				
5. Soil erosion from construction and areas left exposed				
6. Inviting new encroachment				
7. Aircraft hazards from transmission lines and towers				
8. Induced effects from electromagnetic fields				

Appendix 6

Calculation results on Chapter 6.

1. Comparison of Base supply capacity (Chapter 6.2.2)

(1) Economics

C=100%

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total Cost	2468783	2649666	2847016	2957734	3069666	3199726	3342814	3475106	3606164	3727777	3855644	3979252	4114935	4255566	4395352
Fixed Cos	1065833	1170338	1268386	1328971	1392306	1451816	1504073	1566098	1641374	1713310	1788841	1861342	1923368	1987752	2055039
Fuel Cost	1402950	1479328	1578631	1628763	1677360	1747910	1838741	1909008	1964791	2014467	2066803	2117909	2191567	2267814	2340313

C=75%

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total Cost	2468783	2657263	2860693	2972616	3086244	3223976	3369731	3522432	3657166	3777425	3906700	4031376	4180273	4320863	4478036
Fixed Cos	1065833	1163661	1252518	1313103	1376439	1423822	1481528	1524748	1602536	1671960	1747491	1819992	1875340	1939724	2000334
Fuel Cost	1402950	1493602	1608175	1659512	1709805	1800155	1888203	1997684	2054630	2105465	2159210	2211383	2304933	2381139	2477702

C=50%

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total Cost	2475216	2673688	2878198	2989638	3103296	3242608	3398137	3552702	3688708	3809434	3950132	4074770	4238338	4393046	4549631
Fixed Cos	1059155	1144856	1233713	1294298	1357634	1410466	1456045	1499266	1577054	1646478	1715330	1787832	1836503	1894209	1952306
Fuel Cost	1416060	1528832	1644485	1695340	1745662	1832142	1942092	2053436	2111655	2162957	2234802	2286938	2401835	2498837	2597325

C=25%

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total Cost	2482872	2681178	2885484	2998385	3112661	3271066	3427050	3582982	3728418	3851279	3981826	4108153	4273219	4451052	4635931
Fixed Cos	1052478	1138178	1227036	1287621	1350956	1384984	1430563	1479233	1547831	1617255	1692786	1765287	1813957	1852858	1897601
Fuel Cost	1430394	1542999	1658449	1710764	1761705	1886082	1996487	2103749	2180587	2234024	2289041	2342866	2459262	2598193	2738330

C=0%

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Total Cost	2482872	2685616	2899575	3012780	3128095	3287366	3454084	3621551	3770808	3894336	4037986	4165570	4344418	4529076	4710283
Fixed Cos	1052478	1128988	1211168	1271753	1335089	1369116	1408018	1444560	1515670	1585094	1653948	1726449	1768442	1812793	1849573
Fuel Cost	1430394	1556628	1688407	1741027	1793006	1918250	2046067	2176991	2255138	2309241	2384039	2439120	2575976	2716283	2860710

Fixed cost

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
C: 100%	1065833	1170338	1268386	1328971	1392306	1451816	1504073	1566098	1641374	1713310	1788841	1861342	1923368	1987752	2055039
C: 75%	1065833	1163661	1252518	1313103	1376439	1423822	1481528	1524748	1602536	1671960	1747491	1819992	1875340	1939724	2000334
C: 50%	1059155	1144856	1233713	1294298	1357634	1410466	1456045	1499266	1577054	1646478	1715330	1787832	1836503	1894209	1952306
C: 25%	1052478	1138178	1227036	1287621	1350956	1384984	1430563	1479233	1547831	1617255	1692786	1765287	1813957	1852858	1897601
C: 0%	1052478	1128988	1211168	1271753	1335089	1369116	1408018	1444560	1515670	1585094	1653948	1726449	1768442	1812793	1849573

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-10	10658	11703	12684	13290	13923	14518	15041	15661	16414	17133	17888	18613	19234	19878	20550
B: Coal-75	10658	11637	12525	13131	13764	14238	14815	15247	16025	16720	17475	18200	18753	19397	20003
C: Coal-50	10592	11449	12337	12943	13576	14105	14560	14993	15771	16465	17153	17878	18365	18942	19523
D: Coal-25	10525	11382	12270	12876	13510	13850	14306	14792	15478	16173	16928	17653	18140	18529	18976
E: Coal-0%	10525	11290	12112	12718	13351	13691	14080	14446	15157	15851	16539	17264	17684	18128	18496

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
B: Coal-75	1.00	0.99	0.99	0.99	0.99	0.98	0.99	0.97	0.98	0.98	0.98	0.98	0.98	0.98	0.97
C: Coal-50	0.99	0.98	0.97	0.97	0.98	0.97	0.97	0.96	0.96	0.96	0.96	0.96	0.95	0.95	0.95
D: Coal-25	0.99	0.97	0.97	0.97	0.97	0.95	0.95	0.94	0.94	0.94	0.95	0.95	0.94	0.93	0.92
E: Coal-0%	0.99	0.96	0.95	0.96	0.96	0.94	0.94	0.92	0.92	0.93	0.92	0.93	0.92	0.91	0.90

2015	10%	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
111325	A: Coal-10	9689	9672	9530	9077	8645	8195	7718	7306	6961	6606	6270	5931	5571	5234	4920
109480	B: Coal-75	9689	9617	9410	8969	8547	8037	7603	7113	6796	6446	6125	5799	5432	5108	4789
107783	C: Coal-50	9629	9462	9269	8840	8430	7962	7472	6994	6688	6348	6012	5697	5320	4988	4674
106470	D: Coal-25	9568	9406	9219	8795	8388	7818	7341	6901	6564	6235	5933	5625	5254	4879	4543
104828	E: Coal-0%	9568	9330	9100	8686	8290	7728	7225	6739	6428	6111	5797	5501	5123	4774	4428

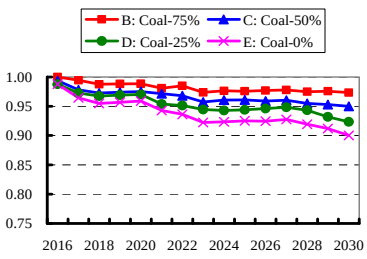
Fuel cost

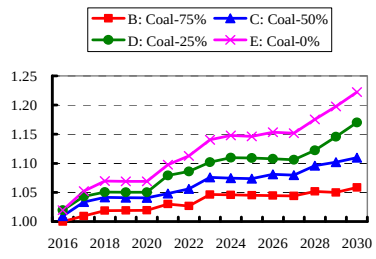
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
C: 100%	1402950	1479328	1578631	1628763	1677360	1747910	1838741	1909008	1964791	2014467	2066803	2117909	2191567	2267814	2340313
C: 75%	1402950	1493602	1608175	1659512	1709805	1800155	1888203	1997684	2054630	2105465	2159210	2211383	2304933	2381139	2477702
C: 50%	1416060	1528832	1644485	1695340	1745662	1832142	1942092	2053436	2111655	2162957	2234802	2286938	2401835	2498837	2597325
C: 25%	1430394	1542999	1658449	1710764	1761705	1886082	1996487	2103749	2180587	2234024	2289041	2342866	2459262	2598193	2738330
C: 0%	1430394	1556628	1688407	1741027	1793006	1918250	2046067	2176991	2255138	2309241	2384039	2439120	2575976	2716283	2860710

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-10	14030	14793	15786	16288	16774	17479	18387	19090	19648	20145	20668	21179	21916	22678	23403
B: Coal-75	14030	14936	16082	16595	17098	18002	18882	19977	20546	21055	21592	22114	23049	23811	24777
C: Coal-50	14161	15288	16445	16953	17457	18321	19421	20534	21117	21630	22348	22869	24018	24988	25973
D: Coal-25	14304	15430	16584	17108	17617	18861	19965	21037	21806	22340	22890	23429	24593	25982	27383
E: Coal-0%	14304	15566	16884	17410	17930	19183	20461	21770	22551	23092	23840	24391	25760	27163	28607

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-10	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
B: Coal-75	1.00	1.01	1.02	1.02	1.02	1.03	1.03	1.05	1.05	1.05	1.04	1.04	1.05	1.05	1.06
C: Coal-50	1.01	1.03	1.04	1.04	1.04	1.05	1.06	1.08	1.07	1.07	1.08	1.08	1.10	1.10	1.11
D: Coal-25	1.02	1.04	1.05	1.05	1.05	1.08	1.09	1.10	1.11	1.11	1.11	1.11	1.12	1.15	1.17
E: Coal-0%	1.02	1.05	1.07	1.07	1.07	1.10	1.11	1.14	1.15	1.15	1.15	1.15	1.18	1.20	1.22

2015	10%	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
134602	A: Coal-10	12754	12226	11860	11125	10415	9866	9436	8906	8333	7767	7244	6748	6348	5972	5603
138625	B: Coal-75	12754	12344	12082	11335	10617	10161	9689	9319	8714	8117	7568	7046	6677	6270	5931
142339	C: Coal-50	12873	12635	12355	11579	10839	10342	9966	9579	8955	8339	7833	7287	6957	6580	6218
145415	D: Coal-25	13004	12752	12460	11685	10939	10646	10245	9814	9248	8613	8023	7465	7124	6842	6555
149119	E: Coal-0%	13004	12865	12685	11891	11133	10828	10500	10156	9564	8903	8356	7772	7462	7153	6848





(2) Share of Natural Gas

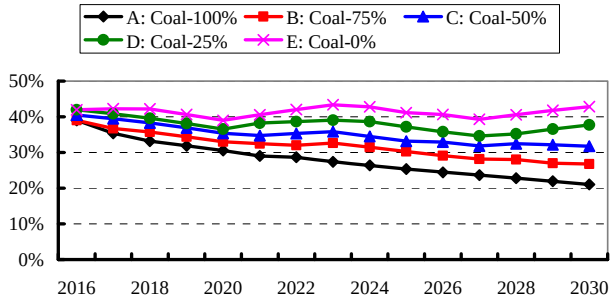
Gas	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-100%	115185	111397	111302	109826	107809	106402	109054	107784	107445	106734	106104	106007	105073	104286	102847
B: Coal-75%	115185	115725	120025	118418	116313	118874	121628	128514	128014	127136	126374	126171	129192	128189	130706
C: Coal-50%	119625	124211	128342	126903	124749	127351	134215	140958	140424	139485	142861	142529	149743	152759	155220
D: Coal-25%	124025	128630	132792	131220	129031	140064	146777	153777	157400	156372	155492	155137	162308	173484	184251
E: Coal-0%	124025	133045	141586	139858	137611	148643	159655	170637	174210	173112	176369	175934	187257	198603	209162

Gas turbine	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-100%	0	0	100	7	0	0	7	7	7	8	14	23	28	38	36
B: Coal-75%	0	0	7	0	0	0	0	14	16	23	22	31	33	40	36
C: Coal-50%	0	159	268	35	0	0	7	77	82	76	43	66	42	47	44
D: Coal-25%	0	83	136	15	0	0	76	17	16	23	22	31	28	57	44
E: Coal-0%	0	0	14	0	0	0	14	55	45	41	33	45	35	23	45

Total	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-100%	115185	111397	111402	109833	107809	106402	109061	107791	107452	106742	106118	106030	105101	104324	102883
B: Coal-75%	115185	115725	120032	118418	116313	118874	121628	128528	128030	127159	126396	126202	129225	128229	130742
C: Coal-50%	119625	124370	128610	126938	124749	127351	134222	141035	140506	139561	142904	142595	149785	152806	155264
D: Coal-25%	124025	128713	132928	131235	129031	140064	146853	153794	157416	156395	155514	155168	162336	173541	184295
E: Coal-0%	124025	133045	141600	139858	137611	148643	159669	170692	174255	173153	176402	175979	187292	198626	209207

Demand	295519	315023	335815	344365	352915	366487	380059	393631	407203	420775	434346	447918	461490	475062	488634

Share	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-100%	39.0%	35.4%	33.2%	31.9%	30.5%	29.0%	28.7%	27.4%	26.4%	25.4%	24.4%	23.7%	22.8%	22.0%	21.1%
B: Coal-75%	39.0%	36.7%	35.7%	34.4%	33.0%	32.4%	32.0%	32.7%	31.4%	30.2%	29.1%	28.2%	28.0%	27.0%	26.8%
C: Coal-50%	40.5%	39.5%	38.3%	36.9%	35.3%	34.7%	35.3%	35.8%	34.5%	33.2%	32.9%	31.8%	32.5%	32.2%	31.8%
D: Coal-25%	42.0%	40.9%	39.6%	38.1%	36.6%	38.2%	38.6%	39.1%	38.7%	37.2%	35.8%	34.6%	35.2%	36.5%	37.7%
E: Coal-0%	42.0%	42.2%	42.2%	40.6%	39.0%	40.6%	42.0%	43.4%	42.8%	41.2%	40.6%	39.3%	40.6%	41.8%	42.8%



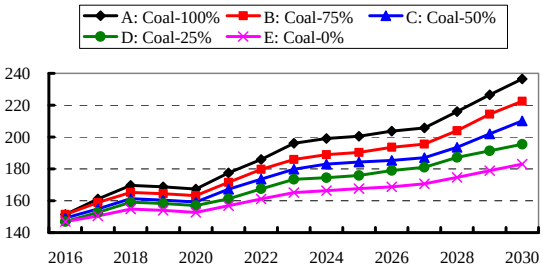
(3) CO2 emissions

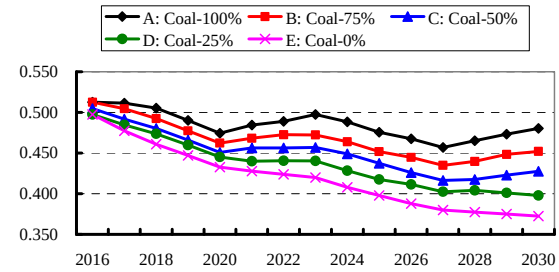
	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-10	41301.4	43935.1	46273.5	46027	45655.7	48429.6	50713.1	53457	54294.1	54685.2	55554.6	56098.2	58922.2	61768.7	64495.3
	0.1398	0.1395	0.1378	0.1337	0.1294	0.1321	0.1334	0.1357	0.1332	0.1297	0.1275	0.1246	0.1269	0.1291	0.131
B: Coal-75	41301.4	43337.3	45083.8	44851.5	44506.7	46793.5	49007.4	50698.5	51545.7	51907.8	52817.4	53345.5	55618.2	58462.9	60681.8
	0.1398	0.1376	0.1343	0.1302	0.1261	0.1277	0.1289	0.1288	0.1265	0.1232	0.1213	0.1186	0.1199	0.1223	0.1233
C: Coal-50	40689.6	42240.4	44003.2	43760	43418.2	45630.6	47343.3	49051.6	49897.3	50258.5	50540.4	51029.1	52798.1	55078.7	57303.3
	0.1377	0.1341	0.131	0.1271	0.123	0.1245	0.1245	0.1246	0.1225	0.1193	0.1162	0.1136	0.1139	0.1153	0.1166
D: Coal-25	40095.6	41638.5	43396.6	43171.9	42834	43966.8	45680.4	47301.3	47584.2	47973.5	48843	49362.7	51069	52204.7	53306.4
	0.1357	0.1322	0.1292	0.1254	0.1214	0.12	0.1202	0.1201	0.1168	0.1139	0.1122	0.1098	0.1102	0.1094	0.1085
E: Coal-0%	40095.6	41027	42204.4	41981.9	41653.8	42786.5	43922.9	45059.9	45351	45720.2	46018.3	46526	47648.2	48785.8	49895.4
	0.1357	0.1302	0.1257	0.1219	0.118	0.1167	0.1156	0.1145	0.1113	0.1085	0.1058	0.1036	0.1029	0.1023	0.1016

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-10	151	161	170	169	167	178	186	196	199	201	204	206	216	226	236
B: Coal-75	151	159	165	164	163	172	180	186	189	190	194	196	204	214	222
C: Coal-50	149	155	161	160	159	167	174	180	183	184	185	187	194	202	210
D: Coal-25	147	153	159	158	157	161	167	173	174	176	179	181	187	191	195
E: Coal-0%	147	150	155	154	153	157	161	165	166	168	169	171	175	179	183

	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
A: Coal-10	0.513	0.512	0.505	0.490	0.474	0.484	0.489	0.498	0.488	0.476	0.468	0.457	0.465	0.473	0.480
B: Coal-75	0.513	0.505	0.492	0.477	0.462	0.468	0.473	0.472	0.464	0.452	0.445	0.435	0.440	0.448	0.452
C: Coal-50	0.505	0.492	0.480	0.466	0.451	0.457	0.457	0.457	0.449	0.437	0.426	0.417	0.418	0.423	0.428
D: Coal-25	0.498	0.485	0.474	0.460	0.445	0.440	0.441	0.440	0.428	0.418	0.411	0.403	0.404	0.401	0.398
E: Coal-0%	0.498	0.477	0.461	0.447	0.433	0.428	0.424	0.420	0.408	0.398	0.388	0.380	0.377	0.375	0.373

		2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1382	A: Coal-10	138	133	127	115	104	100	95	91	84	77	71	66	63	60	57
1335	B: Coal-75	138	131	124	112	101	97	92	87	80	73	68	62	59	56	53
1293	C: Coal-50	136	128	121	110	99	94	89	84	78	71	65	60	56	53	50
1257	D: Coal-25	134	126	120	108	98	91	86	81	74	68	63	58	54	50	47
1213	E: Coal-0%	134	124	116	105	95	89	83	77	71	65	59	54	51	47	44

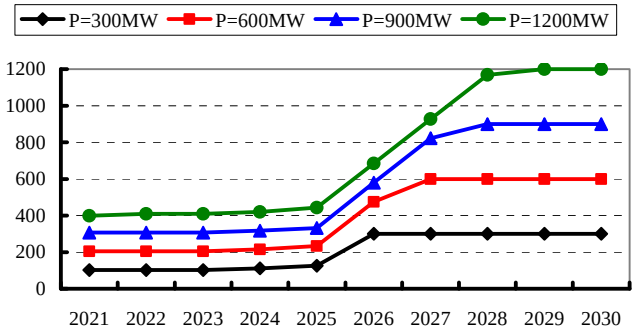




2. Comparison of Peak supply capacity

(1) Relationship between Installed capacity and Supply capacity of PSPP

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
P=300MW	102	102	102	111	126	300	300	300	300	300
P=600MW	204	204	204	215	233	475	600	600	600	600
P=900MW	307	307	307	317	332	580	822	900	900	900
P=1200MW	399	409	409	420	443	685	927	1168	1200	1200



(2) Economics

Fixed cost

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
P1	1410466	1455891	1503828	1581616	1651040	1719893	1792394	1843423	1901129	1959227
P2	1410466	1456045	1501624	1579412	1648836	1717689	1790190	1838861	1894209	1952306
P3	1410466	1456045	1499266	1577054	1646478	1715330	1787832	1836503	1894209	1952306
P4	1408108	1453841	1497062	1572491	1642069	1713280	1785628	1834298	1892005	1952460
P5	1408108	1453841	1497062	1572491	1642069	1713435	1785936	1834607	1892467	1952923

			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
230.0	100330	P1	12822	12032	11298	10803	10252	9708	9198	8600	8063	7554
84.9	100184	P2	12822	12033	11282	10788	10238	9696	9187	8578	8033	7527
0.0	100100	P3	12822	12033	11264	10771	10223	9683	9174	8567	8033	7527
-156.7	99943	P4	12801	12015	11248	10740	10196	9671	9163	8557	8024	7528
-149.0	99951	P5	12801	12015	11248	10740	10196	9672	9165	8559	8026	7529

Fuel cost

	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
P1	1832142	1942101	2053369	2111554	2162909	2234678	2287084	2401495	2498474	2597259
P2	1832142	1942092	2053497	2111647	2162840	2234827	2287204	2401865	2498837	2597325
P3	1832142	1942092	2053436	2111655	2162957	2234802	2286938	2401835	2498837	2597325
P4	1832135	1942060	2053744	2111744	2163127	2234870	2286748	2401744	2499495	2597574
P5	1832135	1942060	2053744	2111744	2163127	2234931	2287334	2402068	2499478	2597353

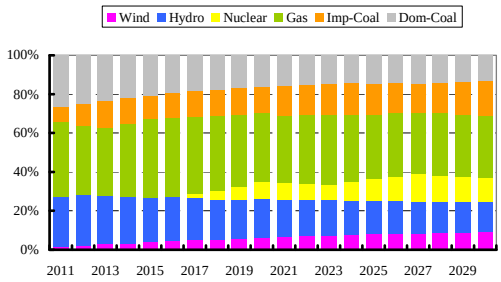
			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
-4.7	132149	P1	16656	16050	15427	14422	13430	12614	11736	11203	10596	10014
1.3	132155	P2	16656	16050	15428	14423	13430	12615	11737	11205	10598	10014
0.0	132154	P3	16656	16050	15428	14423	13430	12615	11736	11205	10598	10014
6.4	132160	P4	16656	16050	15430	14423	13431	12615	11735	11204	10600	10015
10.3	132164	P5	16656	16050	15430	14423	13431	12616	11738	11206	10600	10014

225.2	P1
86.2	P2
0.0	P3
-150.3	P4
-138.7	P5

3. Proposal of optimal power development plan (Chapter 6.3)

(1) Plant type composition ratio

Energy (GWh)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Wind	3592	3854	6658	8760	11563	13666	15768	17870	19973	22776	24878	26981	29083	31186	33989	36091	38194	40296	42398	45202
Hydro	54895	60748	61351	61954	62557	66994	67597	68200	68803	69407	70010	70613	71216	71820	72423	73026	73629	74232	74836	75439
Nuclear	0	0	0	0	0	0	7797	15595	23394	31195	31195	31195	31195	38995	46794	54594	62392	62393	62393	62392
Gas	82196	81584	84685	98290	112282	119625	124211	128342	126903	124749	127356	134219	140978	140431	139497	142870	142527	149750	152786	155237
Imp-Coal	16078	24902	33705	33705	33704	38059	42414	46768	46758	46716	55338	59609	63858	67984	67682	67409	66949	71469	79863	88248
Dom-Coal	57120	57122	57103	57105	57115	57119	57074	58772	58498	58078	57734	57495	57297	56865	60783	61027	65372	65266	65130	64977
PSPP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	24	30	44	57
GT	0	0	0	0	0	0	159	268	35	0	0	8	77	80	74	42	65	42	47	43
Oil	0	0	0	0	0	56	4	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	213881	228210	243502	259814	277221	295519	315024	335815	344364	352921	366511	380120	393704	407361	421242	435068	449152	463478	477497	491595
Demand	213880	228210	243500	259815	277222	295519	315023	335815	344365	352915	366487	380059	393631	407203	420775	434346	447918	461490	475062	488634



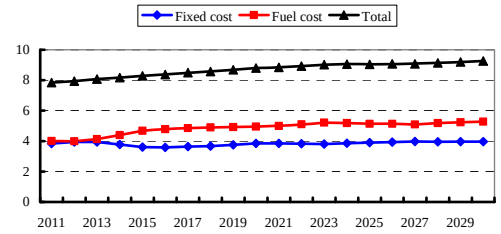
Capacity (MW)	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Wind	1200	1300	2200	3000	3900	4700	5500	6300	7100	8000	8800	9600	10400	11200	12100	12900	13700	14500	15300	16200
Hydro	18092	19935	20135	20335	20535	21935	22135	22335	22535	22735	22935	23135	23335	23535	23735	23935	24135	24335	24535	24735
PSPP	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	300	900	900	1200	1500
Nuclear	0	0	0	0	0	0	1200	2400	3600	4800	4800	4800	4800	6000	7200	8400	9600	9600	9600	9600
Gas	15642	17554	18494	18594	18694	19494	20294	21094	21194	21294	22094	22894	23694	23794	23894	24694	24794	26294	27094	27894
GT	0	0	0	0	0	0	300	600	600	600	600	1200	1500	1800	2100	2100	2100	2100	2100	2100
Oil	2237	2237	2237	2237	2237	2237	2237	2237	2237	2237	1857	1857	1857	1677	1677	1677	1677	1677	1677	1677
Imp-Coal	2215	3431	4644	4644	4644	5244	5844	6444	6444	6444	7644	8244	8844	9444	9444	9444	9444	10044	11244	12444
Dom-Coal	8815	8815	8815	8815	8815	8815	8815	9010	9010	9010	9010	9010	9010	9010	9332	9382	9697	9697	9697	9697
Total	48201	53272	56525	57625	58825	62425	66325	70420	72720	75120	77740	80740	83440	86460	89482	92832	96047	99147	102447	105847

Load factor	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Wind	34.2%	33.8%	34.5%	33.3%	33.8%	33.2%	32.7%	32.4%	32.1%	32.5%	32.3%	32.1%	31.9%	31.8%	32.1%	31.9%	31.8%	31.7%	31.6%	31.9%
Hydro	34.6%	34.8%	34.8%	34.8%	34.8%	34.9%	34.9%	34.9%	34.9%	34.9%	34.8%	34.8%	34.8%	34.8%	34.8%	34.8%	34.8%	34.8%	34.8%	34.8%
PSPP	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.3%	0.4%	0.4%	0.4%
Nuclear	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	74.2%	74.2%	74.2%	74.2%	74.2%	74.2%	74.2%	74.2%	74.2%	74.2%	74.2%	74.2%	74.2%	74.2%
Gas	60.0%	53.1%	52.3%	60.3%	68.6%	70.1%	69.9%	69.5%	68.4%	66.9%	65.8%	66.9%	67.9%	67.4%	66.6%	66.0%	65.6%	65.0%	64.4%	63.5%
GT	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	6.1%	5.1%	0.7%	0.0%	0.0%	0.1%	0.6%	0.5%	0.4%	0.2%	0.4%	0.2%	0.3%	0.2%
Oil	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Imp-Coal	82.9%	82.9%	82.9%	82.9%	82.8%	82.8%	82.9%	82.8%	82.8%	82.8%	82.6%	82.5%	82.4%	82.2%	81.8%	81.5%	80.9%	81.2%	81.1%	81.0%
Dom-Coal	74.0%	74.0%	73.9%	74.0%	74.0%	74.0%	73.9%	74.5%	74.1%	73.6%	73.1%	72.8%	72.6%	72.0%	74.4%	74.3%	77.0%	76.8%	76.7%	76.5%
Total	50.7%	48.9%	49.2%	51.5%	53.8%	54.0%	54.2%	54.4%	54.1%	53.6%	53.8%	53.7%	53.9%	53.8%	53.7%	53.5%	53.4%	53.4%	53.2%	53.0%

(2) Generation cost

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Fixed cost	820678	901453	961460	979566	1000421	1059155	1144856	1233713	1294298	1357634	1408108	1453841	1497062	1572491	1642069	1713280	1785628	1834298	1892005	1952460
Fuel cost	858683	909376	1005320	1141048	1296143	1416060	1528832	1644485	1695340	1745662	1832135	1942060	2053744	2111744	2163127	2234870	2286748	2401744	2499495	2597574
Total	1679361	1810829	1966780	2120614	2296564	2475215	2673688	2878198	2989638	3103296	3240243	3395901	3550806	3684235	3805196	3948150	4072376	4236042	4391500	4550034
Total energ	213880	228210	243500	259815	277222	295519	315023	335815	344365	352921	366512	380120	393705	407358	421241	435066	449153	463478	477496	491596

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Fixed cost	3.837	3.95	3.949	3.77	3.609	3.584	3.634	3.674	3.759	3.847	3.842	3.825	3.802	3.86	3.898	3.938	3.976	3.958	3.962	3.972
Fuel cost	4.015	3.985	4.129	4.392	4.675	4.792	4.853	4.897	4.923	4.946	4.999	5.109	5.216	5.184	5.135	5.137	5.091	5.182	5.235	5.284
Total	7.852	7.935	8.078	8.162	8.284	8.376	8.487	8.571	8.682	8.793	8.841	8.934	9.018	9.044	9.033	9.075	9.067	9.14	9.197	9.256



(3) CO2 emissions

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CO2 Emissic	31435.8	33414.9	35829.9	37272.4	38850.2	40689.6	42240.4	44003.2	43760	43418.2	45630.1	47341.6	49051.6	49897.5	50258.6	50538.9	51027.3	52797	55083.4	57304.3
Emission Inte	0.1470	0.1464	0.1471	0.1435	0.1401	0.1377	0.1341	0.1310	0.1271	0.1230	0.1245	0.1245	0.1246	0.1225	0.1193	0.1162	0.1136	0.1139	0.1154	0.1166
Total energy	213880	228210	243500	259815	277222	295519	315023	335815	344365	352921	366512	380120	393705	407358	421241	435066	449153	463478	477496	491596

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
CO2 Emissio	115.3	122.5	131.4	136.7	142.5	149.2	154.9	161.3	160.5	159.2	167.3	173.6	179.9	183.0	184.3	185.3	187.1	193.6	202.0	210.1
CO2 Emissio	0.5389	0.5369	0.5395	0.5260	0.5139	0.5049	0.4917	0.4805	0.4659	0.4511	0.4565	0.4567	0.4568	0.4491	0.4375	0.4259	0.4166	0.4177	0.4230	0.4274