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IMPORTANCE OF GÖRDES DAM FOR İZMİR METROPOLITAN CITY

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ABSTRACT

Izmir is a metropolitan municipality which is the third the most populated city with 4.223.545people in 2016. Fifty-six percent of the drinking water of İzmir city is provided from groundwater resources. The rest comes from Tahtalı and Balçova Dams. The population and water consumption of the city increase each year. Although Gördes dam in Gediz Graben was constructed in between 1998 and 2004 by the Turkish State Hydraulic Works (DSİ), it could not store the water due to geological problems like leaching. Most recently, these problems were solved and the dam will start storing water. The storage capacity of the dam is 448.46 hm^3. It is planned to provide for the annual average of 59.00 hm^3 for the domestic uses of İzmir Metropolitan Region and for the irrigation of 14,809 hectares areas in Akhisar Plain.

Keywords: dam, drinking water, irrigation, domestic water

1. INTRODUCTION

İzmir city has a surface area of 12.019 km^2, three river basins and significant groundwater resources. Water consumption of İzmir has increased in recent years. The total water resources of İzmir Metropolitan Municipality (IMM) is about 2630 hm^3/year, which corresponds to 3.5% of the water potential of Turkey (Baba, 2013; Baba, 2014; Murathan and Baba, 2015).According to General Directorate of Water and Sewerage Administration's (IZSU)2016 data, 56% of the waters are provided from groundwater and 44% from surface water. The surface water of city comes from Tahtalı and Balçova Dams. The Gördes Dam is a concrete - face rock-fill dam, that has 187,50 m thalweg and 430,16 hm^3 active volume, on the Gördes River located 13 km northeast of Gölmarmara in Gediz Graben (Figure 1). It was constructed in between 1998 and 2004 by the Turkish State Hydraulic Works (DSİ). The primary purpose of the dam is to supply water for drinking and irrigation. Although Gördes dam in Gediz Graben was constructed in between 1998 and 2004 by the Turkish State Hydraulic Works (DSİ), it could not store the water due to geological problems like leaching. Most recently, these problems were solved and the dam will start storing water. The storage capacity of the dam is 448.46 hm3. It is planned to provide for the annual average of 59.00 hm3 for the domestic uses of İzmir Metropolitan Region and for the irrigation of 14,809 hectares areas in in Selendi, Gölmarmara and Lütfiye plains.

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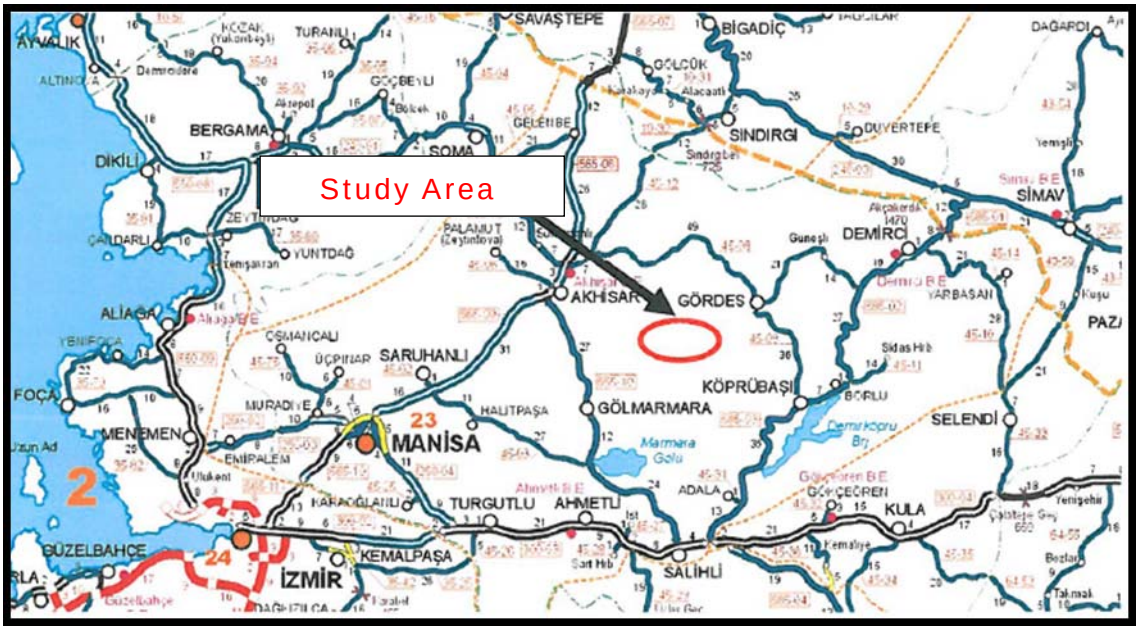

Figure 1.Location map of Gördes Dam

2. CLIMATE

The project area is located in Mediterranean climate system that is the hot- dry in summer and warm-rainy in winter. Akhisar and Kavakalan Meteorological stations data (precipitation and evaporation) from 1962 to 2011 were used forthe dam reservoir estimation. The average annual precipitation is around 600 mm, of which 50% falls during the winter season in Akhisar Plain .The average rainfall, temperature and evaporation values of this study area are given in Tables 1 and 2, respectively.

Table 1. Average monthly rainfall distribution (mm)and Average monthly temperature values C° (1962-2011)

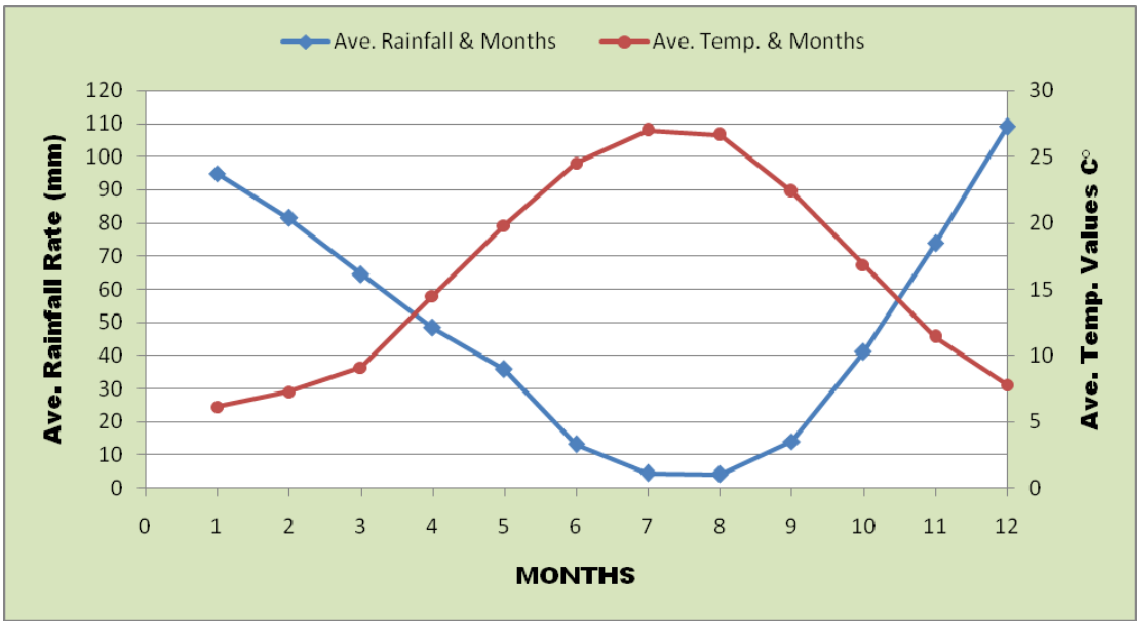

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Table 2. Average monthly total evaporation values (mm) (1962-2011)

Station Name	Months												Cumulative
	1	2	3	4	5	6	7	8	9	10	11	12	
Akhisar				104.12	167.37	229.82	288.13	272.58	185.68	104.23	40.39		1392.32

3. DAM SITE

Gördes Creek after passing through the town of Gördes, it flows southwards. It returns to the western direction at Gıdırcık settlement.In the north, the waters of Karoğlan and Katırcı mountains are collected and combined with Kayacık. It merges with the Kayacik River and goes down to the Akhisar Plain in the north of Gölmarmara.Then it merges with the Medar Creek and flow into the GedizRiver. The Inflows to Gördes dam is given in Table 4.

Table 4. Gördes Dam inflows (hm^3) (1962-2011)

Gördes Creek Watershed Area:1045.4 km^2 Unit: hm^3													
Year	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May	June	July	August	Sep.	Annual
1962	1.32	1.07	7.35	3.73	31.39	64.76	48.83	18.31	2.17	2.36	0.31	0.26	181.86
1963	1.41	9.98	77.84	118.03	105.9	44.28	30.44	17.21	6.46	1.03	0.75	0.66	413.99
1964	1.03	1.4	2.29	1.72	5.07	28.73	5.85	3.16	2.15	1.55	0.12	0.52	53.59
1965	0.88	1.05	36.89	24.18	202.4	62.48	89.4	70.82	11.39	1.57	1.09	1.28	503.43
1966	1.43	14.69	71.58	155.76	45.61	69.31	35.94	20.2	6.53	1.38	1.05	1.91	425.37
1967	1.94	2.72	27.79	57.17	15.31	16.62	16.71	11.12	3.48	1.7	0.98	1.24	156.78
1968	1.41	1.83	5.7	89.59	92.06	96.99	18.36	7.52	3.31	1.66	1.64	2.23	322.3
1969	2.4	2.61	8.52	23.05	36.51	21.72	16.09	5.55	2.76	2.17	0.86	0.94	123.18
1970	0.88	1.41	25.13	31.77	49.97	69.69	42.01	10.46	3.39	1.64	1.28	1.28	238.91
1971	1.17	2.65	12.6	16.47	26.65	69.12	31.2	8.35	5.51	2.32	1.07	1.22	178.33
1972	1.28	2.21	13.3	2.87	20.01	10.23	14.67	7.58	2.48	0.83	0.56	0.41	76.43
1973	2.48	1.6	2.65	2.06	25.51	17.51	14.72	5.3	1.7	0.54	0.58	0.79	75.44
1974	0.66	0.92	9.68	1.34	77.65	72.72	18.69	12.9	3.04	0.73	0.35	0.85	199.53
1975	0.75	6.02	8.86	19.82	20.58	19.44	8.81	19.44	4.88	0.98	0.73	0.92	111.23
1976	1.77	6.74	15.12	11.71	20.96	9.74	37.45	13.51	7.52	1.21	1.11	0.81	127.65
1977	3.58	1.62	15.2	21.53	20.58	28.73	14.23	6.08	1.32	0.64	0.3	0.37	114.18
1978	0.41	2.67	10.7	58.69	72.53	68.93	64.95	21.91	5.41	1.15	0.81	3.61	311.77
1979	5.85	6.76	14.36	69.46	27.68	12.93	10.48	9.69	3.67	0.32	0.14	0.13	161.47
1980	0.05	1.9	16.3	76.7	36.85	44.88	13.32	10.92	7.01	0.88	0.35	0.38	209.55
1981	0.39	1.97	76.83	116.28	32.08	35.44	9.51	8.74	1.19	0.06	0.48	0	282.97
1982	0.43	4.07	135.82	35.31	23.02	33.5	25.61	24.96	4.63	2.33	0.32	0.08	290.08
1983	1.01	1.25	4.1	17.2	17.59	14.88	14.23	5.86	2.38	2.55	0.93	0.09	82.07
1984	0.31	15.52	18.37	33.24	81.49	40.74	33.63	11.87	1.46	0.03	0	0	236.66
1985	1.94	2.04	1.93	29.1	22.77	16.56	9.46	6.16	0.56	0.01	0.01	0.03	90.57
1986	0.03	1.54	1.71	50.06	44.88	12.93	0.21	0.04	1.2	0	0	0	112.6
1987	0.04	0.23	30.01	110.08	32.85	26.9	19.4	34.15	1.72	0.17	0.04	0.04	255.63
1988	0.08	0.27	10.32	2.76	4.65	41.31	13.43	3.65	0.56	0.05	0.04	0.04	77.13
1989	0.28	0.81	16.69	2.85	1.63	4.94	1.27	0.48	0.05	0.01	0.01	0.04	28.86
1990	0.28	0.58	17.28	5.76	20.01	6.44	5.79	1.94	1.24	0.86	0.35	0.14	60.67
1991	0.05	0.05	19.79	7.18	8.96	4.42	13.97	12.4	5.7	0.18	0.13	0.14	72.97
1992	0.22	0.28	1.69	3.62	2.47	11.03	15.52	2.46	1.15	1.01	0.06	0.04	39.55
1993	0.29	1.77	2.74	2.56	11.62	28.44	13.14	10.35	1.72	0.04	0.03	0.02	72.71
1994	0.07	0.65	5.05	7.75	14.2	13.2	8.25	5.99	0.95	0.66	0.12	0.11	57.00
1995	0.19	0.65	1.42	26	7.31	26.2	25.92	4.37	0.25	0.41	0.02	0.48	93.21
1996	0.12	3.48	7.58	4.48	35.58	16.13	17.55	3.52	0.59	0.76	0.05	0.22	90.06
1997	0.14	0.94	2.7	7.2	1.75	5.86	45.03	5.06	0.42	0.1	0.1	0.1	69.41
1998	2.79	1.57	35	20.36	38.27	27.63	15.32	25.25	5.12	0.77	0.1	0.1	172.3
1999	0.61	5.57	24.76	24.76	92.13	44.64	23.19	5.59	1.38	1.47	0.28	0.11	224.49
2000	0.44	3.87	3.03	4.04	28.7	24.84	19.02	8.32	0.92	0.1	0.1	0.1	93.47
2001	0.27	0.1	0.1	0.1	0.63	0.48	2.85	2.43	0.1	0.1	0.1	0.1	7.36
2002	0.1	2.67	49.36	26.49	8.52	22.36	27.96	4.47	0.59	0.21	0.1	1.51	144.33
2003	0.19	2.71	4.49	22.19	61.1	27.06	31.3	10.3	1.38	0.14	0.1	0.1	161.07
2004	0.32	0.93	1.73	35.88	24.1	14.98	6.88	4.29	0.65	0.1	0.1	0.1	90.08
2005	0.1	0.34	0.11	1.79	24.35	61.18	8.42	4.22	2.4	1.11	0.46	0.54	105.03
2006	0.47	6.45	6.78	17.35	53.25	60.22	11.67	4.8	0.64	0.13	0.1	2	163.85
2007	1.18	1.56	0.6	1.95	3.66	2.44	1.35	1.03	0.25	0.1	0.1	0.1	14.3
2008	0.12	1.29	15.24	1.43	1.39	8.93	7.62	0.9	0.1	0.1	0.1	0.1	37.29
2009	0.1	0.52	0.1	10.3	41.67	38.43	30.08	10.21	0.91	4.6	3.11	0.68	140.72
2010	0.17	3.82	16.08	4.07	36.28	17.6	9.18	7.86	7.24	6.16	5.25	4.97	118.68
2011	10.3	76.27	122.6	6.08	6.44	6.29	5.72	5.25	18.44	3.46	31.62	24.76	317.21
Cum.	35.52	98.46	716.4	1199.09	1225.64	1077.9	694.18	392.74	106.02	31.9	16.45	20.45	7787.32
Ave.	1.15	3.18	23.11	38.68	39.54	34.77	22.39	12.67	3.42	1.03	0.53	0.66	181.12
%	0.63	1.76	12.76	21.36	21.83	19.2	12.36	7	1.89	0.57	0.29	0.36	100

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4. GÖRDES DAM AND CONDUIT LINE

Gördes Dam's front face is constructed of concrete filled coated rock fill. Thalweg of the dam is 187,50 m,its crest elevation is 270,40 m, the minimum water level is 205,50m, and the maximum water level is 268,20m. The total storage volume is 448,46 hm^3 and the active volume is 430,16 hm^3. From the valve room defined as 0 + 000, there is a single line to 0 + 176, 65 km (Figure 2). Here, the line is divided into drinking-use and irrigation water.In the same trench, there are two separate pipes 15 + 663, 98 km (Figure 3).The outer diameter of pipe is 2235, 00 mm in 0 + 000 to 0 + 176, 65 km of conduit line which is made of steel and single pipe. Hereafter, the entire outside of the drinking water pipeline is manufactured with a pipe outer diameter of 2032, 00mm.

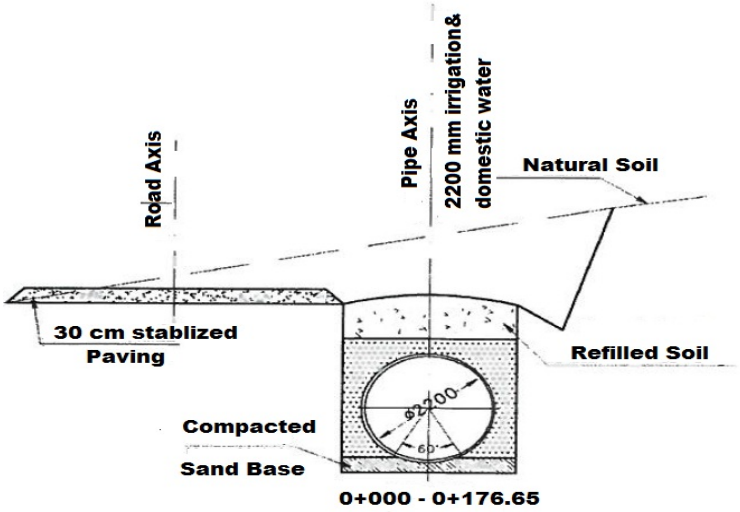

Figure 2.Gördes conduit line cross section (0+000-0+176,65)

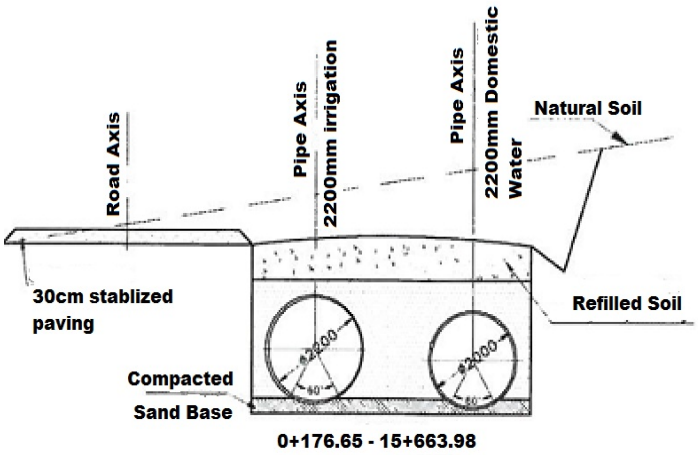

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Figure 3.Gördes conduit line cross section (0+176,65-15+663,98)

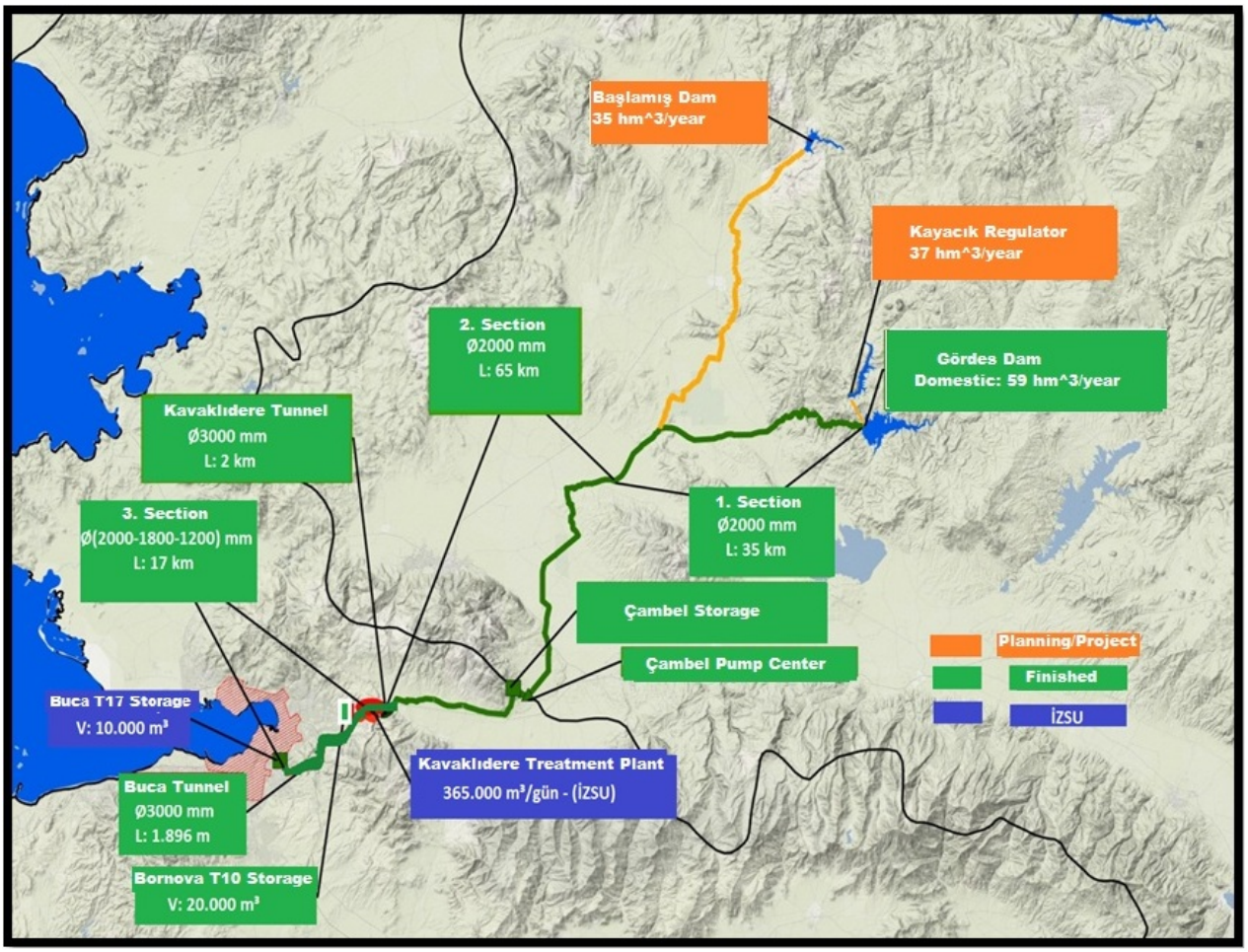

Figure 4.Gördes conduit line

5. SOIL IMPROVEMENT TECHNIQUES

The dam is located on Paleozoic Gördes Massif which is consist of micaschists, calcschists, quartzites, quartzites and recrystallized limestones. The base rock is covered with terraces and old slope rubble at low inclination places, and old and new alluviums at Gördes Creek and lateral rivers. There is also filling material which is 8-10 m thick on the alluvium in the dam excavation in the study area. With the opening of Gördes Dam, it was observed that water leaks occurred on the right bank of the dam lake area and DSİ started to solve the problem.In order to prevent water leaks, between upstream coffer dam and dam embankment, it was decided to place GCL (geosynthetic clay layer) layer at an elevation in between 188m and 206m and concrete layer at an elevation in between 206 m and 220m. The soil improvement process can be summarized in three steps. 1. Between thalweg and 191.00m height; 10 cm layer of fine material, geosynthetic clay, geomembrane, geotextile, geocell mold and 10 cm of thick concrete coverare applied. 2. Between 191,00m and 206,00m elevations; Geosynthetic clay, geomembrane, geotextile, geocell mold and 10 cm thick concrete were

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applied.3.Between 206,00m and 220,00m elevations; 30 cm thick layer of concrete coating supported by anchor and wicker steel were applied. (Figures 5-8).

Figure 5.Gördes Ground Improvement

Figure 6.Gördes Ground Improvement

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Figure 7.Gördes Ground Improvement

Figure 8.Gördes Dam

6. RESULTS

For the purpose of drinking water from Gördes Dam, water is planned to be taken from minimum water level of 205,50m elevation. From this point, the water will flow to Çambel Pump Station at153,52 m elevation (Figure 9). Since there is not enough pressure for the flow at this point, the water will be elevated to Çambel Pump Station at 250, 74 m elevation (Figure 9). After that, the water will be pumped toKavaklıdere Treatment Plant through a tunnel of 3 m inner diameter and 2109 m in length was constructed with Kavaklıdere (Figure 10).

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Figure 9.Çambel Pump Station

Figure 10.Kavaklıdere Treatment Plant

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