Ilısu Second Site Visit (June 2008)

The Siirt, Batman, and Diyarbakır municipalities were visited on 2-5 June, 2008. The site visit was followed with a meeting with the DSİ staff in Ankara. The purpose of the visit was to obtain information about the latest status of the wastewater treatment plants and data collection studies the PIU has started. The results of this site visit were discussed with the DSİ staff in Ankara.

Point & Non Point Pollution Sources & Measurements

Point Sources

27 point source measurement (sampling) sites were selected by PIU, making total number of measurement sites on the Tigris River 60.

During the discussions on site with the local DSİ laboratory staff and hydrologists, more measurement points were added to be able to make the approximate pollutant mass balances in the Tigris (Dicle) River. These points were mainly before and after the WWTPs (Diyarbakır & Siirt WWTPs), and Bismil and Silvan wastewater discharge points. The flow measurements constitute the tedious part of the measurements as the cross section of each measurement point has to be measured before each velocity measurement.

As a result of these measurements, the point pollution loads at important sections of the Tigris River will be known.

The parameters that will be measured every two weeks are:

1. Flowrate
2. pH
3. Electrical Conductivity
4. Dissolved Oxygen
5. Turbidity
6. Color
7. Alkalinity
8. Chloride
9. Suspended Solids
10. Organic Matter (Using $KMnO_4$)
11. TKN
12. Ammonium ion-N (NH_4N)
13. Nitrate
14. BOD5
15. COD
16. o-PO4-P
17. TP
18. Mineral Oil
19. Total Coliforms
20. Fecal Coliforms
21. Heavy Metals (Four Times / year)

The Non-Point Sources

The non-point sources will also be measured. The main irrigation discharge points will be located by PIU and will be shown on a map.

The flow rate of the irrigation discharges and the above listed parameters will be measured for these discharge points. During the rainy seasons, the flow and the quality change between the consequent stations will also be observed to have an estimate on the run-off contributions.

Siirt WWTP

The Siirt Municipality was visited on 2nd June 2008. Meetings were conducted with the Mayor of Siirt, Mr. Mervan Gül.

Separate meetings were held with the contractor Sistem Yapı staff and the technical staff of the municipality on the WWTP site (see Photo 1 and Photo 2).

The WWTP under construction was visited on site (Photos 3, 4, and 5). The solid waste dumping site was also visited (Photos 6 and 7).

Construction of the Siirt WWTP is proceeding at an accelerated rate. Most of the concrete work is finished and some of the mechanical equipment has arrived on site.

The Siirt Municipality is a role model for the project region. The treatment plant is designed to remove carbon and nitrogen (advanced biological treatment). Chemical phosphorous removal can be easily achieved by adding the coagulant-precipitant $FeCl_3$ before the final settling tanks. However, the Municipality wants to sell the treated effluent for irrigation and thinks that there is enough demand for it. The stabilized sludge from the WWTP will be used in the Pistachio fields.

The Municipality is changing the old water transmission lines with the new HDPE pipes to reduce the loss of water. 183 km of HDPE piping is being laid. The storm water is being separated from the sewer lines.

The water unaccounted for in Siirt is 70 % of the total amount supplied. Most of it is due leaks from older pipes. The old asbestos pipes are being changed with HDPE pipes.

The cost of a m3 of water from the residences is 96 kurus (0.96/1.91= 0.50 € cents). This includes also the wastewater discharge costs. The average (of household, commercial, and industrial) cost of a m3 is 74 € cents.

10 000 water meters have been changed. The meter readings which were repeated once every two months are now made every month. There are 23 000 water meters (registered consumers) in the City. There were 19 600 registered consumers 4 years ago, collecting only 60 000 YTL every month. Currently, 220 000 YTL is collected every month. This issue is very important, because a successful increase in the number of registered consumers and a concomitant increase in income will help finance the operation of the wastewater treatment plant under construction.

Currently, the untreated wastewater is discharged to the Botan Creek, which is used as a drinking water source by some 40 dwellings. Furthermore, a part of Siirt's drinking water source comes from wells located near the Botan Creek.

There is no significant industry that contributes to the wastewater. The WWTP is designed for 127 000 people equivalent. The population of Siirt is 117 000.

The WWTP Qwet (wet whether flow) is 59 000 m3. The average design flow is 18 700 m3/day.

The capital cost of the plant is 9.34 million €. The operational cost for every year is 120 000 €. The first year's operational cost will be paid as a donation. The second year SİSKİ will pay 40 % of the 120 000 € and the third year SİSKİ will pay 60 % of the operational cost.

Siirt Municipality Solid Waste Disposal Site

Siirt Solid Waste Disposal Site will be constructed in two phases. For the first phase 5.6 ha of area is reserved. This area will be excavated and will be made ready as the solid waste disposal site. The solid waste will be deposited in 2.7 ha of this area. The excavation of this area has started (see Photos 6 and 7). and will be covered with a clay layer. There will be a separate disposal site for the medical wastes. There will also be a lagoon to collect the leachate. The site will also accommodate an administration building and a machine shop. The work has started in April 2008 and is expected finish in December 2008. The site is expected to accommodate 15 years of solid waste disposal from the Siirt city. Right now the solid waste of the city is disposed to several wild dumping sites.

Batman WWTP

The Batman Municipality was visited. A technical meeting was held with the Vice Mayor Mr. Sait Kelekçioğlu, who is responsible for technical affairs. In the meeting, Mr. İsa Yıldız, (Civil Engineer) was also present. Also present were the representatives of Schneider & Partners (supervisor) & of Su Yapı (consultant).

A meeting was held separately in Mr. İsa Yıldız's office to study the feasibility study and the bid offers presented by the contractor (Passavant Roediger). The feasibility report was studied and the raw water data on which the design was based was searched for. Unfortunately, a full analysis of the raw water is not presented in the feasibility study. Only measurements for a single day were found and they are presented below:

Location	pH	Temp C	COD	BOD	SS	NH4N	TP
Komando Street	7.6	24	1135	249	304	23.6	7
Komando Street-Storm water	7.7	24.9	693	432	442	20.8	7
Güney Cad. Sewer	7.16	25.2	1541	339	768	36.8	13
Iluh Deresi	9.31	28	332	73	74	19.4	11
AVERAGES	7.91	25	1135	263	316	22.9	8

The design values chosen are

	pH	Temp C	COD	BOD	SS	TKN	TP
Design Values	-	----	--	243	----	36.3	---

Location		L/s	m3/d
Komando	Qav-d	317	27388.8
Cadd.	Qwwf	499	43113.6
	Qmin	193	16675.2
Komando	Qav-d	130	11232
Cadd.	Qwwf	216	18662.4
Storm	Qmin	69	5961.6
Güney			
Cad	Qav-d	28	2419.2
Sewer	Qwwf	68	5875.2
	Qmin	13	1123.2
İluh	Qav-d	236	20390.4
Deresi	Qwwf	270	23328
	Qmin	135	11664
Totals	Qav-d		61430.4
	Qwwf		90979.2
	Qmin		35424

The design value of the plant 61 000 m3/d was assumed to be the value calculated as the sum of the flow rates shown above.

The bid offers presented by the contractor were:

Offered Option Types	Description	Capital Cost. Million €	3 years of operational cost, Million €
Biological Treatment	Inlet Works*, Nitrification and Denitrification, One (1) Primary Sludge & waste activated sludge Anaerobic Digestion tank	13.78	2.105

Mechanical Treatment	Inlet works*, Primary Sedimentation only, Anaerobic Primary Sludge Digestion	11.3	0.375
Sludge Dewatering	Inlet works*, Primary Sedimentation only, no primary sludge anaerobic digestion, the sludge is stabilized by using lime.	11.3	1.63

* Inlet works: Pump station, coarse and fine screens, grit removal.

The second option was chosen as a result of the bid evaluation and the winning price was 11.87 million € due addition of new items such as extra facilities within the WWTP.

The process chosen is the same as the Diyarbakır WWTP under operation. As will be discussed in the Diyarbakır section of this report, the operational cost of the existing plant is 200 000 YTL/month or 2.4 million YTL/year (about 1.3 million €), much higher than the Contractor 's offer of 0.375 million €.

Credits given to Batman Municipality:

KfW 20.5 million €

EIB 13.8 million €

Total 34.3 million €, 9 million € of the KfW 's credit is donation.

The bid contract was signed on 17/03/2008.

A copy of the contract between the Batman Municipality & the Contractor will be requested by an official letter by PIU.

The WWTP will have a Q design = 61 000 m3/d

Qmax= 5000 m3/h (120 000 m3/d)

The design of the treatment plant will be made in accordance with ATV-131 ordinance. The wastewater treatment plant project was sent to the Ministry of Environment & Forestry of Turkey for approval. The units of the WWTP that will be constructed are the same as those of the Diyarbakır WWTP (see Photo 18). Therefore, problems observed in Diyarbakır WWTP are expected to arise in this plant as well. The Archimedes pumps that are used in the Diyarbakır WWTP inlet pump station will not be used in this plant. Submersible pumps will be used instead. Also the belt filters that are used in Diyarbakır are replaced by centrifuges that are expected to give a sludge with higher solids content. The sludge from the centrifuges will be dried on drying beds therefore, the sludge must be completely stable, not to cause odor or fly problems.

Batman Municipality Wild Dumping Site

The site was visited on June 3, 2008 (Photo 8 and Photo 9). The site has an area of 12 hectares and belongs to The Treasure (i.e. the government). The staff of the Batman municipality reported that a total of 350 tons of solid waste are generated daily in Batman. 165 tons of this are domestic wastes, whereas the remaining 185 tons are construction and demolition wastes plus animal wastes (dung). The area is about 15 km from the city center. It has been in operation for the last five years and the accumulated waste has not been covered. It was observed that certain wastes were picked up by scrape dealers. Medical wastes are buried daily at a certain location in the area and they are covered with lime. Previously used area has been covered with soil and trees have been planted over it. No leachate was detected during the visit because of the current dry-weather conditions.

A solid waste disposal plant is currently planned by the Batman municipality. An environmental impact report and application projects for the plant have been prepared by the GAP (South East Anatolia Project) Regional Development Administration and have been submitted to the Ministry of the Environment and Forestry. It is reported by the representatives of the Ministry of the Environment and Forestry that the project will be evaluated under the umbrella of IPA (Instrument for Pre-Acession Assistance), 2006 SEI (Secretariat for European Integration) program. As a result, work is underway for a feasibility report, an IPA application form, and new application projects.

Diyarbakır WWTP

Diyarbakır WWTP (Wastewater Treatment Plant)

Diyarbakır WWTP was visited for the second time with PIU on June 4, 2008 (see Photos 16, 17, 18, and 19). During this visit the flow rate was 5000 m3/h (60 000 m3/d). During the visit, the performance of the plant was studied.

1. **Raw Water Inlet Pumps:** There are (4+1) (Four plus one spare) Archimedes pumps at the inlet of the plant. Each pump has an original capacity of 0.9 m3/s (77 760 m3/d). During the visit only one of the pumps was in operation and there were occasional overflows to the by-pass line. Due to the erosion of the pumps , the capacity of the pumps has dropped down to around 0.7 m3/s (60 560 m3/d). The capacities of the pumps were measured by filling one of the sedimentation tanks and recording the volume with respect to time. The main cause of the erosion is the sand present in the raw wastewater. This experience shows the necessity of sand traps on the trunk line. Precaution should be taken for the Batman plant not to have similar problems of pump erosion and sand accumulation in tanks.
2. **The Coarse Screens:** There are two coarse screens located after the screw pumps each with 60 mm openings. Since the rough screens are located after the pumps the coarse objects such as plastic bottles etc. accumulate in the wet well of the intake pumps. To eliminate this problem, the newly constructed by-pass system contains one (1) 100 mm coarse screen located before the wet well entrance (Photo 19).
3. **The "by-pass" structure and the sand accumulation problem:** The by-pass structure makes it possible to by-pass half of the wet well which is now separated by a new separation wall (Photos 16 and 17). In case one of the wet wells before the inlet pumps needs to be cleaned due to sand accumulation, the plant does not need to be by passed now, as it was observed in the first site visit.

   The next extension of the plant needs to include another aerated grit chamber to cope with the sand accumulation problem.

The sand also causes erosion of the progressive cavity sludge recirculation pumps used to re-circulate and heat the sludge in the digesters.

4. **Fine Screens & the Aerated Grit Chambers:** There are four (2 +2) fine screens with 6 mm openings. There are no problems with the fine screens. The aerated grit chambers cannot cope with the quantities in the raw sewage. They have been designed for 10 m3 sand/day capacity with a 200 m3 sand accumulation troughs which are easily filled during rainy seasons. The grit pumps were changed by pumps with higher capacities to solve this problem. Also the 90 degrees turns of the grit collection pipes were changed with pipes with smoother angles due to clogging problems at the joints. The grit chambers have 4 blowers to supply the coarse bubble aeration system. Only one blower was in operation and it was throttled to increase the amount of grit that will be captured. The grease collected in the aerated grit chambers is sent to the digesters.

5. **The Primary Sedimentation Tanks:** There are four (4) rectangular primary sedimentation tanks with two bridges. One bridge is dedicated to two sedimentation tanks. Each tank has 3 sludge collection hoppers. Homogenous sludge could only be obtained by careful adjustment of the sludge valve system.

6. **Gravity Thickeners**: There are two (2) gravity thickeners that thicken the primary sludge. The thickened sludge is fed to digesters every 12 hours. If biological phosphorous removal is planned for the extension of the plant, these units have to be out of operation due anaerobic conditions that will prevail.

7. **Anaerobic Digesters**: There are two (2) mesophilic anaerobic digesters that digest the thickened primary sludge. Each digester has a capacity of 5500 m3. The SRT (Sludge Retention Time) in the digesters are between 29-30 days. The design SRT value is 22 days. The digesters are mixed with compressed digester gas circulated with compressors. The gas is ejected at the bottom of the digester using 8 ejectors. Foam clogging problems associated with such mixing systems are also observed here from time to time. The sludge recirculation pumps that pump the sludge to the heat exchangers also help the mixing. The grit collects at the center bottom of the digesters.

8. **The Gas Collection Tanks**: The gas collection tank has leakage problems.

9. **Mechanical Sludge Thickeners**: Two (2) belt filter presses are used to thicken the digested sludge. The digested sludge is sent to the landfill. The analysis of the sludge does not show any heavy metal accumulation. The Mardin cement factory was interested in incinerating the dewatered sludge.

The capital cost of the plant was 20.2 million €. The sum of the operation and maintenance costs of the plant is around 200 000 YTL/month. 40 000 YTL/month of this cost is due to electricity consumption.

Diyarbakır Municipality Wild Dumping Site

The site was visited and examined on June 4, 2008 (Photos 14 and 15). The area is about 36 km from the city center. The municipality collects 700 tons of solid waste daily. This waste is first transported to a waste transfer station. Large vehicles are then used to transfer the waste to the current dumping site. Emanating smoke from the waste heaps as well as a large number of scrape dealers

were observed in the area. The site has been in use since 1994. The wastes collected from Diyarbakır are daily placed and spread over the area. They are covered with soil twice every year. The local DSİ officials reported that the soil in the site is permeable and the Göreli water supply is within the underground watershed area of the site.

The environmental impact report and application projects of the integrated solid waste plant planned by the Diyarbakır municipality have been prepared and the project has been approved by the Ministry of the Environment and Forestry. The plant will serve Yenişehir, Sur, Bağlar, Kayapınar, Çarıklı, Bismil, Ergani, and Eğil municipalities. The site has an area of 1 207 000 square meters. The municipilaty is currently searching for funds for the project.

Meeting with COWI Company

A meeting was held in Ankara with COWI (Mr. Merih Keresticioğlu, Senior Ditector of COWI SNS, Mr. Emre Tokcaer, Environmental Expert from COWI SNS, and Ms. Gabriele Klein attended) regarding the upgrade of the Diyarbakır WWTP. We have been informed that they do not yet have wastewater analysis and have not yet selected a process for the upgrade of the WWTP to biological treatment. The COWI company was informed about the problems experienced in the existing primary treatment system and the parameters that must be measured in the raw and primary-treated wastewater for a correct process selection and design.

Summary and Recommendations

At the end of the site visit (on June 5, 2008) a meeting was held in DSİ, Ankara. The following conclusions were shared with the DSİ staff involved in the Ilısu Project:

1. The communication between DSİ, other ministries, and the municipalities should be improved. For example, wastewater treatment plants must have tertiary treatment (carbon, nitrogen, and phosphorus removal). The Batman municipality has continued its plans with the mechanical treatment plant (which has only preliminary-primary treatment). Official notifications must be sent to the municipalities informing them on the necessity of tertiary treatment.

2. The communication pathways between the upper management within DSİ and the DSİ staff involved in the Ilısu project should be kept open and active.

3. The Batman municipality has received three different offers (three alternative processes) one of which included biological treatment. Unfortunately, they have selected the process with mechanical treatment only to avoid the operational costs of tertiary treatment. This is the same as the process used in Diyarbakır WWTP. Actually, information received from the Diyarbakır WWTP operators indicate that the operational costs of mechanical treatment may be much larger than estimates given by the contractor to the Batman municipality. The Batman municipality must utilize the experiences of the Diyarbakır WWTP operators to make correct decisions.

4. The municipalities must move forward more rapidly with their planned solid waste handling facilities.

5. The PIU/DSİ may have to support Batman and Diyarbakır municipalities for the operation of the biological tertiary WWTPs that must be constructed.

6. Laboratories of DSİ and DİSKİ in Diyarbakır were inspected during this site visit (Photos 10, 11, 12, and 13). Both laboratories have recently acquired new and high quality equipment for the analysis of source waters and wastewaters.

APPENDIX PHOTOS

Photo 1:Meeting with the staff of Siirt municipality .

The mayor, technical staff of the municipality, engineers from Sistem Yapı (the contractor), and staff from DSİ tended the meeting.

Photo 2:Meeting with the staff of Siirt municipality .

The mayor, technical staff of the municipality, engineers from Sistem Yapı (the contractor), and staff from DSİ tended the meeting.

Photo 3:Siirt WWTP under construction.

The picture shows the aeration tanks where carbon and nitrogen removal will be accomplished.

Photo 4: Siirt WWTP under construction.

Final sedimentation tanks wherein the bacteria from the aeration tanks will be settled and removed as sludge. The tank in the front (left) was being filled with wastewater for leakage testing during the site visit.

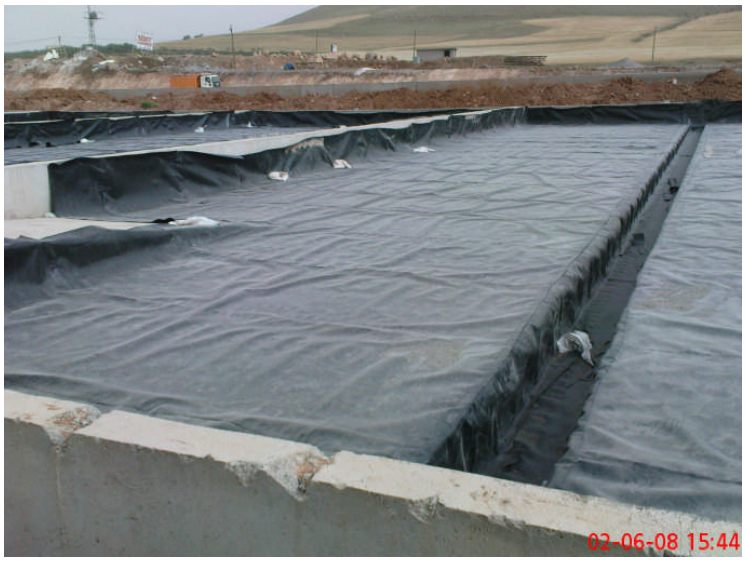

Photo 5: Siirt WWTP under construction.

Sludge drying beds in the final phase of construction.

Photo 6: Siirt solid waste disposal site.

The disposal site is under construction.

Photo 7: Siirt solid waste disposal site.

The disposal site is under construction

Photo 8: Batman solid waste dumping site.

Photo 9: Batman solid waste dumping site.

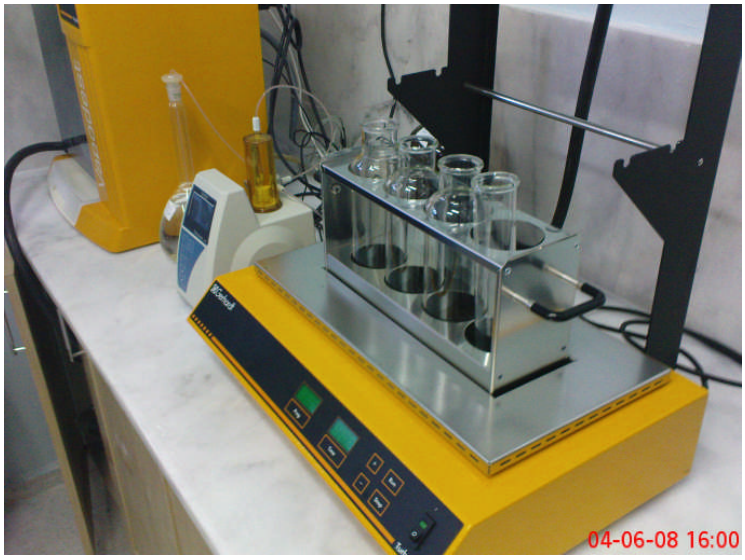

Photo 10: DSİ Region-10 Laboratory in Diyarbakır

Seen in the photo is the new TKN (Total Khejdahl Nitrogen) measurement equipment. The determination of TKN is necessary for the correct design and operation of wastewater treatment plants in the project region. The lab staff has very recently received training on the use of the equipment.

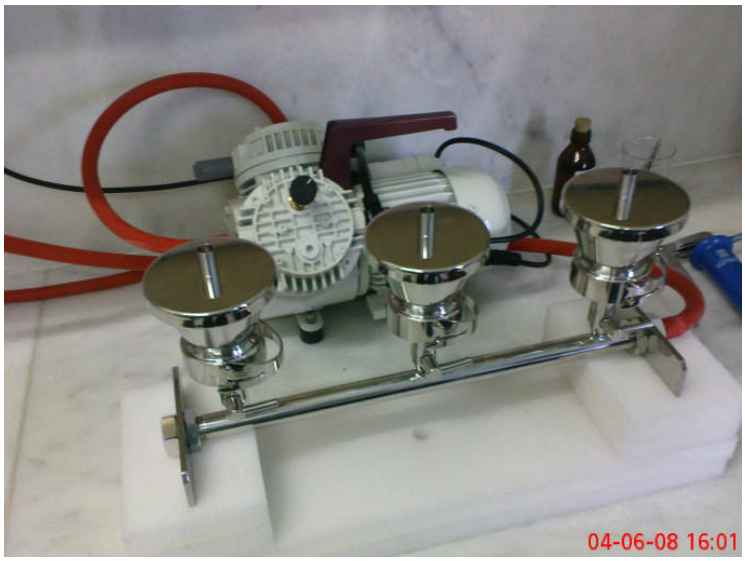

Photo 11: DSİ Region-10 Laboratory in Diyarbakır

Seen in the photo is the new coliform bacteria measurement equipment. The determination of coliform concentration is needed for monitoring hygienic quality of drinking water and the pollution of the Tigris River. It is also useful in the monitoring of WWTP performances.

Photo 12: DİSKİ (Diyarbakır Municipality) Laboratory in Diyarbakır

The new AAS (atomic absorption spectroscopy) equipment in Diyarbakır. AAS can be used to analyze the concentration of over 62 different metals in a solution.

Photo 13: DİSKİ (Diyarbakır Municipality)Laboratory in Diyarbakır

This laboratory is located near the Diyarbakır drinking WTP (water treatment plant) built by DSİ and currently operated by DİSKİ.

Photo 14: Diyarbakır solid waste dumping site.

Photo 15: Diyarbakır solid waste dumping site.

Photo 16: Diyarbakır WWTP in December 2007.

This is the entrance point to the WWTP. On the right (not seen here, see the first site visit report) are screw pumps.

Photo 17: Diyarbakır WWTP in June 2008.

This is the entrance point to the WWTP (see Photo 16). Note that a separating wall has been added. This wall allows half of the plant to continue operating while the second half is by-passed to purge accumulated sand at the entrance.

Photo 18: Diyarbakır WWTP.

This plant contains only mechanical treatment. Unfortunately, most of the carbon, nitrogen, phosphorus, suspended solids, pathogenic organisms, and other pollutants remain in the wastewater and are therefore discharged into the Tigris River. As of this writing, the Batman municipality is planning to construct essentially the same plant, again with KfW support.

Photo 19: Diyarbakır WWTP.

The new coarse screen located ahead of the entrance point to the screw pumps. These screens prevent the entrance of large objects into the plant.