Well Installation Report for Monitoring Wells TCM4, TCM5, and TCM8 and Pilot Hole TGSC-2A

by

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Background

The shallow groundwater and sediments beneath the TNX Area are contaminated with both *dissolved* and *residual* chlorinated volatile organic compounds (CVOCs) such as trichloroethylene (TCE) , carbon tetrachloride and perchloroethylene (PCE)..The Savannah River Technology Center (SRTC) is studying a new technology for remediating CVOCs known as GeoSiphon. The GeoSiphon Cell is a large diameter well uses granular cast iron for filter pack material and is operated by inducing a siphon to draw contaminated groundwater through the iron filter pack. As groundwater flows through the granular cast iron CVOCs are reduced to ethane, ethene, methane, and chloride ions. Previous laboratory and field studies (ETI, 1996, and Phifer et. al., 1997) conducted by SRTC have shown that granular cast iron is capable of remediating contaminated at TNX. SRTC will be conducting a Dual Cell test of the GeoSiphon technology in 1999 to study the hydraulic interaction of multiple cells operating simultaneously.

This report documents the installation of 3 monitoring wells and 1 pilot hole that were installed to support the Dual phase test. The three monitoring wells will be used to study the hydraulic interaction between the 2 GeoSiphon cells. Continuous core was collected from the proposed location for the second GeoSiphon Cell TGSC-2. Depth discrete samples collected from the core were analyzed for CVOCs.

TGSC-2A Pilot Hole

Continuous core was collected to a depth of 52 feet at the TGSC-2A location using steam cleaned hollow stem augers and split spoon sampling tubes. The total depth of the core was determined by the location of the confining layer at the base of the unconfined aquifer. Depth discrete bulk sediment samples were collected from TGSC-2A core, Table 1. Once the core had been removed from the ground, 3 -5 cm^3 samples of the bulk sediment were immediately collected at 2 feet intervals and at significant lithologic changes using a modified plastic syringe. The samples were transferred to 22.5 mL glass vials and 7.5 mL of deionized water was added to each vial as a suspending solution. Each vial was then sealed with a Teflon® lined rubber septa and aluminum crimp top. All samples were refrigerated until analysis. After the depth discrete bulk sediment samples had been collected the geologist providing technical oversight of the drilling prepared a detailed lithologic description of the core, (Appendix A).

Prior to sampling the average weight of 10 each 22.5 mL glass vials with 7.5 mL pure deionized water and a Teflon lined rubber septa and aluminum crimp top (tare) was determined to be 21.79gm. The weight of the sediment sample was determined by weighing the sealed sample bottle and subtracting the average tare weight. Each sample was then analyzed using a Hewlett Packard (HP) 5890 gas chromatograph (GC) equipped with an electron capture detector, a flame ionization detector, an HP 19395 headspace sampler, and a 60 m widebore capillary column coated with a nonpolar silicone phase. The samples are heated to 70 degrees C in the autosampler prior to injection into the GC to maximize the transfer of CVOCs into the vapor phase (Looney et al, 1993). A complete set of standards was run with each set of samples for calibration. This method is a slightly modified version of the newly approved EPA Method 5021 (EPA, 1995) for headspace analysis of CVOCs in soil and water samples.

Results of the depth discrete sediment sampling and analysis Table 1, show that there are residual CVOCs present in the saturated sediments at the TGSC-2A location. Figure 1 contains contaminant profile for CVOCs in the TGSC-2A pilot hole. These results are similar to the contaminant profile reported by Phifer et. al., 1997. A geophysical log of the pilot hole was conducted to measure natural gamma, spontaneous potential (SP), and resistivity of the sediments around the borehole and a caliper log was performed to measure the diameter of the borehole, Figure 1.

Table 1 Results from headspace analysis of bulk sediment samples collected from the TGSC-2A pilot hole.

Depth (ft)	Sample Weight (gm)	mg/kg			
		c-dce	ccl4	tce	pce
1	1.91	< 1.4E-02	< 3.6E-05	< 1.3E-04	6.22E-04
2	4.70	< 1.4E-02	< 3.6E-05	5.73E-04	1.37E-03
3	3.74	< 1.4E-02	< 3.6E-05	1.10E-03	1.84E-03
4	4.37	< 1.4E-02	< 3.6E-05	1.63E-03	1.48E-03
4.5	4.90	< 1.4E-02	< 3.6E-05	2.74E-03	6.17E-04
5	4.28	< 1.4E-02	< 3.6E-05	2.58E-02	4.17E-04
6.5	4.22	< 1.4E-02	2.94E-04	2.83E-02	5.66E-04
7	3.51	< 1.4E-02	1.25E-04	2.02E-02	4.49E-04
8.5	4.61	< 1.4E-02	4.82E-04	1.56E-02	9.51E-03
9	4.40	< 1.4E-02	1.33E-03	2.32E-02	3.69E-04
10.5	4.01	< 1.4E-02	1.19E-03	2.55E-02	1.63E-03
11.5	4.31	< 1.4E-02	3.00E-03	3.24E-02	3.97E-04
12.5	4.36	< 1.4E-02	2.89E-03	3.20E-02	1.28E-03
13.5	4.09	< 1.4E-02	2.61E-03	2.99E-02	7.07E-04
14.5	3.77	< 1.4E-02	9.76E-04	1.42E-02	7.59E-03
15.5	4.83	< 1.4E-02	1.45E-04	3.75E-03	7.24E-04
16.5	4.68	< 1.4E-02	9.03E-05	1.78E-03	2.68E-03
17.5	4.61	< 1.4E-02	< 3.6E-05	2.13E-03	5.36E-03
18.5	4.05	< 1.4E-02	< 3.6E-05	< 1.3E-04	< 3.6E-05
19	4.40	< 1.4E-02	< 3.6E-05	2.52E-03	9.42E-03
19.5	4.33	< 1.4E-02	< 3.6E-05	< 1.3E-04	2.12E-04
20.5	4.61	< 1.4E-02	< 3.6E-05	1.45E-02	8.24E-03
21.5	3.69	< 1.4E-02	< 3.6E-05	1.13E-03	3.68E-03
22.5	4.86	< 1.4E-02	< 3.6E-05	1.43E-03	1.76E-03
23.5	4.22	< 1.4E-02	< 3.6E-05	1.26E-03	7.03E-03
24.5	3.69	< 1.4E-02	< 3.6E-05	2.54E-03	3.11E-03
25.5	5.16	< 1.4E-02	< 3.6E-05	4.07E-04	3.17E-03
25.75	3.91	< 1.4E-02	< 3.6E-05	< 1.3E-04	1.21E-03
26.5	3.76	< 1.4E-02	< 3.6E-05	1.56E-03	1.03E-02
27.5	4.53	< 1.4E-02	< 3.6E-05	1.92E-03	2.19E-02
28.5	5.51	< 1.4E-02	< 3.6E-05	1.48E-03	7.89E-03
29.5	4.62	< 1.4E-02	< 3.6E-05	3.31E-04	3.17E-03
30.5	3.94	< 1.4E-02	< 3.6E-05	< 1.3E-04	1.75E-03

Depth (ft)	Sample Weight (gm)	mg/kg			
		c-dce	ccl4	tce	pce
31	4.62	< 1.4E-02	< 3.6E-05	< 1.3E-04	3.72E-04
31.5	4.07	< 1.4E-02	< 3.6E-05	< 1.3E-04	3.41E-04
32.5	4.24	< 1.4E-02	< 3.6E-05	1.15E-03	1.29E-02
33.5	5.11	< 1.4E-02	< 3.6E-05	< 1.3E-04	1.70E-04
34.5	3.35	< 1.4E-02	< 3.6E-05	6.50E-03	3.32E-03
35.5	3.75	< 1.4E-02	< 3.6E-05	< 1.3E-04	3.90E-04
36	4.48	< 1.4E-02	< 3.6E-05	< 1.3E-04	1.48E-03
37	3.91	< 1.4E-02	< 3.6E-05	< 1.3E-04	2.25E-04
38.5	3.52	< 1.4E-02	< 3.6E-05	4.31E-03	3.54E-03
39	4.10	< 1.4E-02	< 3.6E-05	< 1.3E-04	2.65E-04
40.5	3.92	< 1.4E-02	< 3.6E-05	5.38E-04	4.62E-04
42.5	4.86	< 1.4E-02	< 3.6E-05	1.62E-03	6.73E-03
45	3.87	< 1.4E-02	< 3.6E-05	< 1.3E-04	1.72E-04
47	3.62	< 1.4E-02	< 3.6E-05	2.09E-03	9.13E-04
48	4.15	< 1.4E-02	< 3.6E-05	< 1.3E-04	3.00E-04
48.5	4.50	< 1.4E-02	< 3.6E-05	< 1.3E-04	< 3.6E-05
49	4.13	< 1.4E-02	< 3.6E-05	< 1.3E-04	< 3.6E-05
50.5	4.40	< 1.4E-02	< 3.6E-05	9.78E-04	3.98E-03
51.5	3.86	< 1.4E-02	< 3.6E-05	< 1.3E-04	1.29E-04

Monitoring Well Installation

Three monitoring wells, TCM,4, TCM5, and TCM8, were installed through a hollow stem auger. A 4 ½ " diameter hole was augered 20 feet for the installation of each monitoring well. Two inch diameter Schedule 40 PVC casing and slotted well screen was used to construct each well. An artificial filter pack of sand was tremied into the hole using the hollow stem augers. Bentonite pellets were used to complete the well to the surface. Table 2 and Figures 2 - 4 contain the well construction details for each well. After the wells were installed they were developed using air pumping and a submersible electric pump until the water was clear, < 15 NTU.

Table 2 Well construction details for monitoring wells TCM4, TCM5, and TCM8 and pilot hole TGSC-2A.

Well ID	SRS North (ft)	SRS East (ft)	Surface Elev. (ft, msl)	Depth to Top of Screen (ft)	Length of Screen (ft)	Depth to Top of Filter Pack (ft)	Depth to Bottom of Filter Pack (ft)	Total Drilled Depth (ft)
TGSC-2A	71094.12	16173.29	97.27	n.a.	n.a.	n.a.	n.a.	52
TCM4	71140.75	16174.67	96.83	2.25	15	1	20	20
TCM5	71122.37	16174.26	97.11	2.25	15	1	20	20
TCM8	71125	16130	97	2.25	15	1	20	20

References

ETI, 1996. ETI Reference : 31054.10, EnviroMetal Technologies, Inc., *Feasibility Study Report, CVOC Iron Degradation Study Using Groundwater from the TNX Area, Savannah River Technology Center, Aiken, South Carolina*, July 1996.

Phifer, M.A., F.C. Sappington, M.E. Denham, 1997. *TNX GeoSiphon Cell (TGSC-1) Phase 1 Deployment / Demonstration Final Report (U)*, WSRC-TR-98-00032, Rev.0. Westinghouse Savannah River Company, Aiken South Carolina, 29808.

EPA, 1995. *Test Methods for Evaluating Solid Waste, Method 5021 Volatile Organic Compounds in Soils and Other Solid Matrices Using Equilibrium Headspace Analysis*. EPA Publication SW 846.

Looney, B. B., C. A. Eddy, and W. R. Sims, 1993. *Evaluation of Headspace Method for Volatile Constituents in Soils and Sediments*. I n Measuring and Interpreting VOCs in Soils: State of the Art and Research Needs, US Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas NV 89193.

Figure 1 Geophysical log and trichloroethylene profile for TGSC-2A.

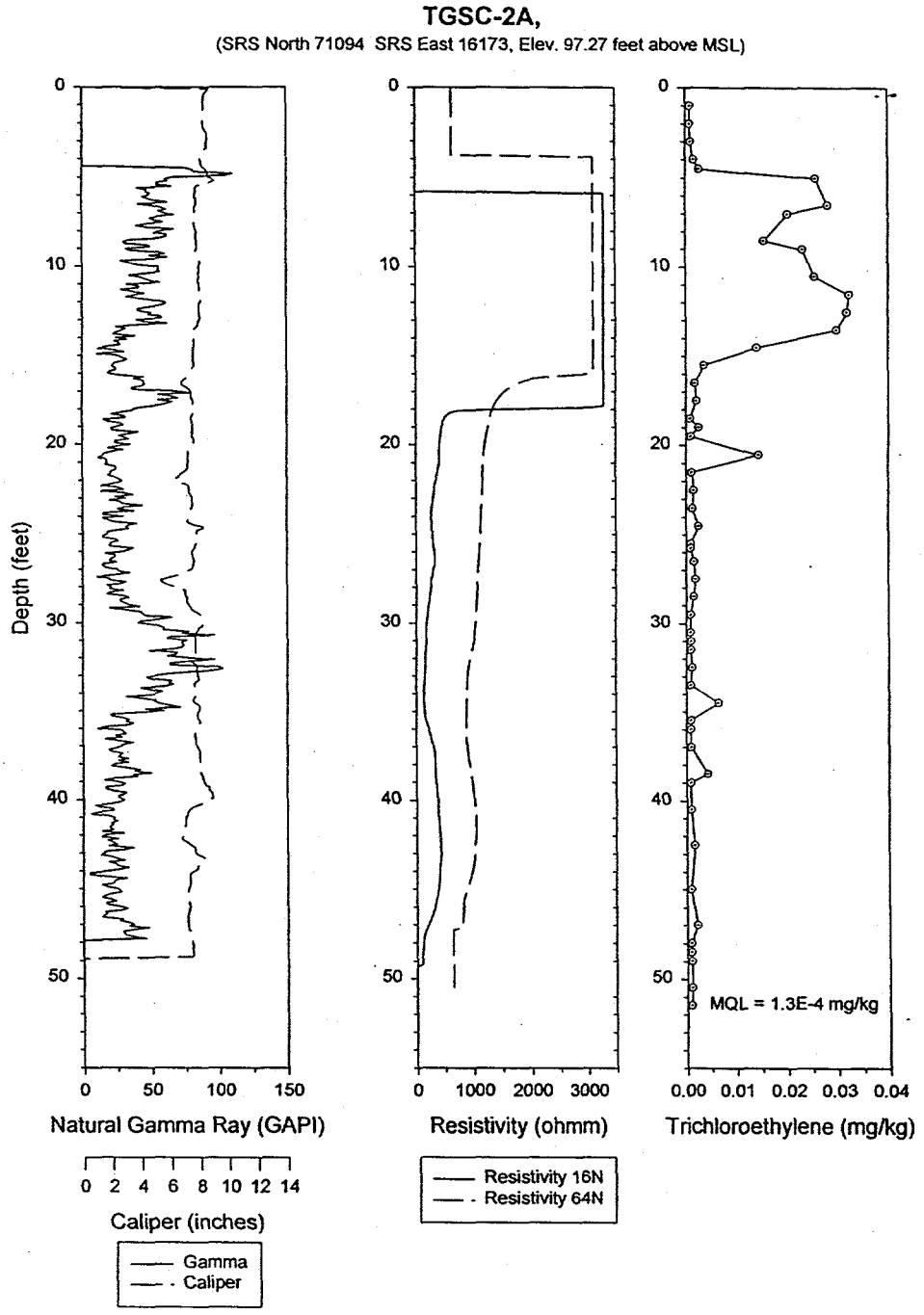
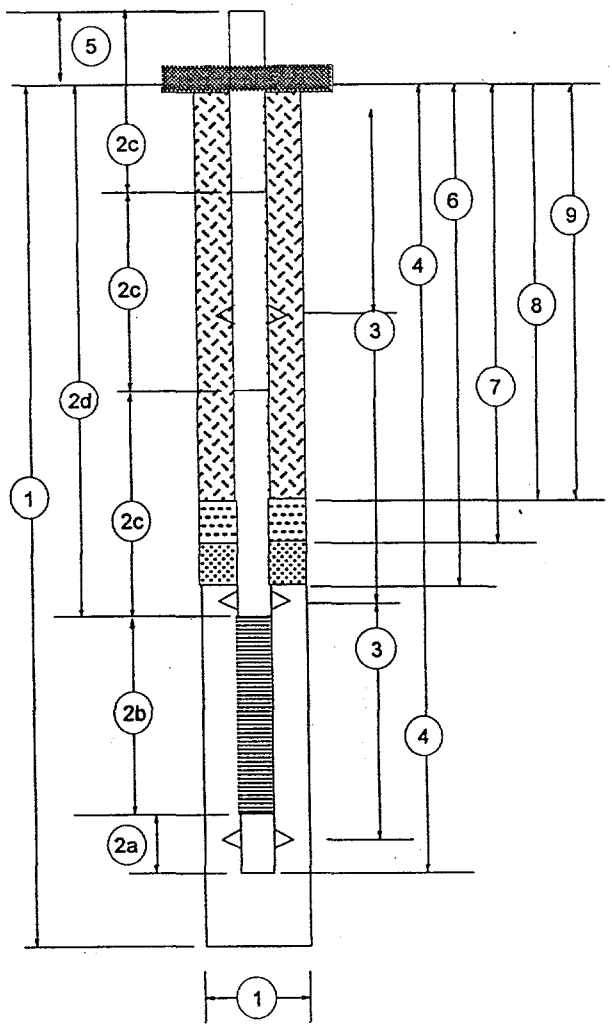


Figure 2 Monitoring well construction diagram for monitoring well TCM4.

OSR 30-58 (Rev 4-7-97)

Monitoring Well Construction Diagram

Drilling Subcontractor		Driller
EMTC		Jim Hill Jr.
Date of Well Installation	Tech O.S./CO. Name	
6.15.1998	Jay Noonkester	
Well Number	SRS Coordinates	Sanitary Seal Elevation
TCM4	North 71140.75, East 16174.67	96.83 ft. m.s.l



Note—All measurements are from ground surface at start of boring (measurements to nearest 0.1 foot).

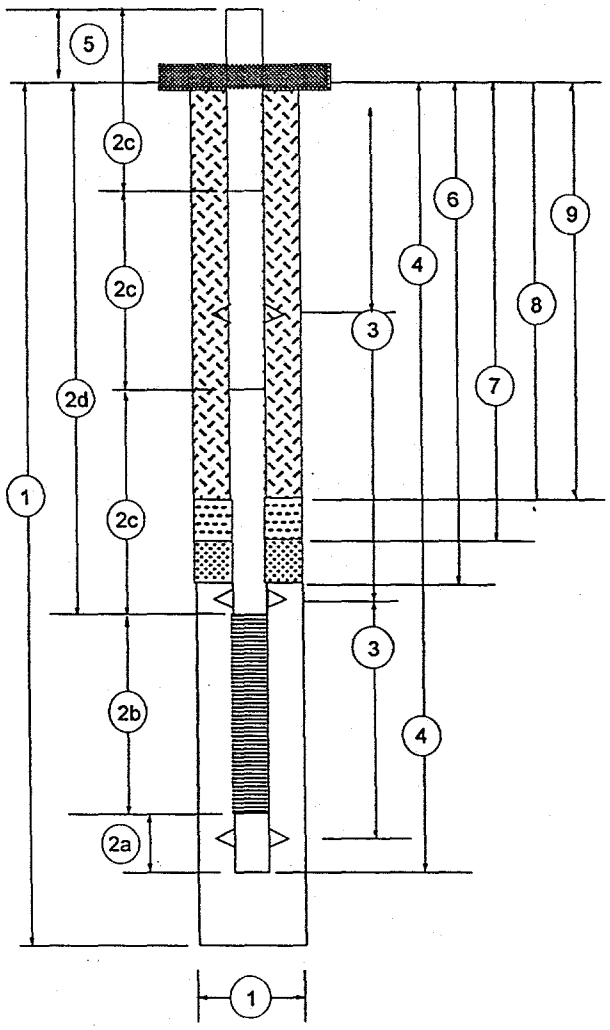
1. Total Drilled Depth/Hole Diameter 20 feet /4 1/2 inches
2. Casing/Screen Tally (Measured to Nearest 0.01 foot)
   a) Sump and Plug Length 2.75 feet
   b) Screen Length 15 feet
   c) Casing Joint Lengths (Measured in Uphole Sequence from Top of Screen) 5 feet
   d) Depth to Top of Screen 2.25 feet
3. Depths to Centralizers n.a.
4. Total Depth of Installed Well 20 feet
5. Casing Stick Up (Standard 2.5' A.G.S.) 2.75 feet
6. Depth to Top of Filter Pack 1 foot
7. Depth to Top of Fine Sand Seal n.a.
8. Depth to Top of Bentonite Seal 0 feet
9. Thickness of Grout n.a.

Figure 3 Monitoring well construction diagram for monitoring well TCM5.

OSR 30-5# (Rev 4-7-97)

Monitoring Well Construction Diagram

Drilling Subcontractor		Driller
EMTC		Jim Hill Jr.
Date of Well Installation	Tech O.S./CO. Name	
6.15.1998	Jay Noonkester	
Well Number	SRS Coordinates	Sanitary Seal Elevation
TCM5	North 71122.37, East 16174.26	97.11 ft. m.s.l



Note—All measurements are from ground surface at start of boring (measurements to nearest 0.1 foot).

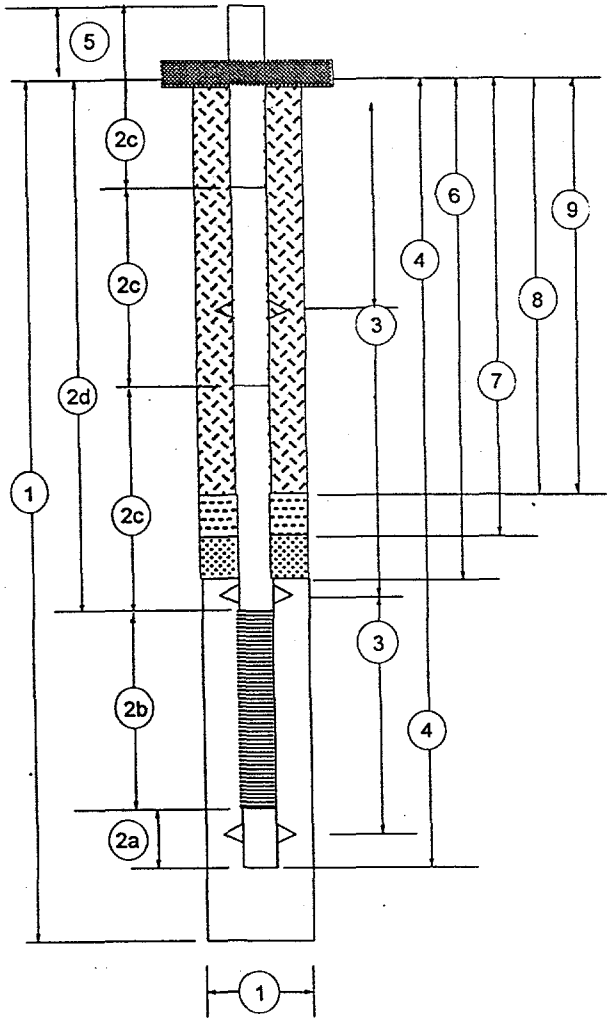
1. Total Drilled Depth/Hole Diameter 20 feet /4 1/2 inches
2. Casing/Screen Tally (Measured to Nearest 0.01 foot)
   a) Sump and Plug Length 2.75 feet
   b) Screen Length 15 feet
   c) Casing Joint Lengths (Measured in Uphole Sequence from Top of Screen) 5 feet
   d) Depth to Top of Screen 2.25 feet
3. Depths to Centralizers n.a.
4. Total Depth of Installed Well 20 feet
5. Casing Stick Up (Standard 2.5' A.G.S.) 2.75 feet
6. Depth to Top of Filter Pack 1 foot
7. Depth to Top of Fine Sand Seal n.a.
8. Depth to Top of Bentonite Seal 0 feet
9. Thickness of Grout n.a.

Figure 4 Monitoring well construction diagram for monitoring well TCM8.

OSR 30-58 (Rev 4-7-97)

Monitoring Well Construction Diagram

Drilling Subcontractor		Driller
EMTC		Jim Hill Jr.
Date of Well Installation	Tech O.S./CO. Name	
6.15.1998	Jay Noonkester	
Well Number	SRS Coordinates	Sanitary Seal Elevation
TCM8	North 71125, East 16130	~97 ft msl



Note—All measurements are from ground surface at start of boring (measurements to nearest 0.1 foot).

1. Total Drilled Depth/Hole Diameter 20 feet /4 1/2 inches
2. Casing/Screen Tally (Measured to Nearest 0.01 foot)
   a) Sump and Plug Length 2.75 feet
   b) Screen Length 15 feet
   c) Casing Joint Lengths (Measured in Uphole Sequence from Top of Screen) 5 feet
   d) Depth to Top of Screen 2.25 feet
3. Depths to Centralizers n.a.
4. Total Depth of Installed Well 20 feet
5. Casing Stick Up (Standard 2.5' A.G.S.) 2.75 feet
6. Depth to Top of Filter Pack 1 foot
7. Depth to Top of Fine Sand Seal n.a.
8. Depth to Top of Bentonite Seal 0 feet
9. Thickness of Grout n.a.

Appendix A

Field Geologic Log for

Pilot Hole TGSC-2A

Field Geologic Log

Project: Geosiphon		Date: 6/16/98	Sheet: 1 of 3
Well Number: TGSC-2A	Location: TNX	Drilling Subcontractor: EMTC	
Logs Prepared By: Jay Noonkester		Driller: Jim Hall, Jr.	
Company: WSRC		Drilling Method: Auger/split spoon	

Fin Number	Depth Below Ground Surface (Feet)	Lithology	Percent Recovery	Sample Description	Drilling Comments/Remarks
1	0–2		100	Sand, 85-70%, med, gray 5Y 5/1 first 3" Then dark yellowish brn 10YR 4/6 well sorted. Clay, 80-90%, dark brn, 7.5YR 3/2. Silty, fine sand grading into sandy clay, grayish brn 10YR 5/2	
2	2–4		100	Sandy clay, some muscovite present, hard-v.hard dark gray, 2.5Y 4/1 to v.dark gray sand is v-fine.	
3	4–6		75	Sand, fine-med, light grayish brn 2.5YR 6/2, mod sorted Clay, light grayish brn, 2.5YR 6/2, mixed muscovite present	
4	6–8		75	Same as above Sand, 80-90%, V fine-med, muscovite present, occasional v. coarse, grayish brn, 2.5YR 5/2, soft.	
5	8–10		80	Sand, fine-coarse, 85-95%, some v. coarse and occasional granules, grayish brn, 2.5YR 5/2, soft, muscovite and dark minerals present.	
6	10–12		90	Same as above except for color change to reddish yellow 7.5YR 6/8 at bottom	
7	12–14		80	Sand 90-98% fine-med, occasional coarse, light brownish yellow 2.5YR 6/3, mod sorted, muscovite & dark minerals present. Sand, 90-98% fine-med, occasional pebbles, strong brn 7.5YR 5/8 some banding of v.dark brn.	
8	14–16		75	Sand 90-98% med-coarse, yellowish brn 10YR 5/8, dark minerals present, well sorted.	
9	16–18		100	Sand, Fine-coarse, 90-98%, light yellowish brn, 10YR 6/4 grading into yellowish brn, 10YR 5/8, occasional v. coarse, scever-l pebbles, some v. fine muscovite.	
10	18–20		100	Sand, med-coarse, 85-95%, yellowish brn 10YR 5/8, one gray thin clay lamina at 18.5 FT. Clay, v. dark gray 2.5Y 3/1, v. fine muscovite present. Sand, silty, v. dark gray, v. fine-med from below clay, 3" Thick, From 19.7 To 20', Sand, yellowish brn 10YR 5/8 as above.	

Field Geologic Log

Project	Date	Sheet
Geosiphon	6/16/98	2 of 3

Well Number	Location	Drilling Subcontractor
TGSC-2A	TNX	EMTC

Logs Prepared By	Driller
Jay Noorkestad	Sim Hall Jr.

Company	Drilling Method
USRC	Auger/split spoon

Fin Number	Depth Below Ground Surface (Feet)	Lithology	Percent Recovery	Sample Description	Drilling Comments/Remarks
11	20		100	Sand, med-coarse, sand 75-85%, silt 25-15%, yellowish brn. 10YR 5/8, one v. dk. gray clay lamina, soft	
12	3		100	Sand, fine-coarse 80-90%, yellowish brn. 10YR 5/8. Sand coarse, with v. dk gray - v. thin laminae, sand is dk gray	
13	5		100	Sand, 80-90%, fine-coarse, light yellowish brn 10YR 6/4 Sand, 80-90%, med-coarse, dk gray 10YR 4/1, a 1" v. dk gray clay lamina present.	
14	7		100	Sand, coarse-v. coarse, 80-90%, dk gray. sh brn. 10YR 4/2 grading down to dk. gray 10YR 4/1, well sorted, soft.	
15	9		100	Sand 83-93%, fine-coarse, dk grayish brn. 10YR 4/2, soft, mod sorted.	
16	30 1 2		100	same as above Sandy Clay grading into clay, dk gray 10YR 4/1, in the clay there are several v. thin sand laminae present.	
17	3 4		100	Sand coarse-fine, gray 10YR 5/1, sand is fining down, Sand 80-90% grading down to 70-80% mod sorted. Clay, dk. gray 10YR 4/1, hard.	
18	5 6		100	Sand, 80-90%, with many v. thin-thin gray clay laminae, sand gray, v. fine-fine with some silt, muscovite becoming abundant at 35.5 FT.	
19	7 8		75%	Sand, fine-coarse, 85-95%, gray 10YR 5/1, occa. and v. coarse, mod. sorted, v. thin gray clay laminae present, sand coarsening down.	
20	9 40		50	Sand, fine-med gray, 10YR 5/1, occasional v. coarse, mod sorted.	

Field Geologic Log

Project: Geosiphon		Date: 6/16/98	Sheet: 3 of 3
Well Number: TGSC-2A	Location: TNX	Drilling Subcontractor: EMTC	
Logs Prepared By: Jay Noonkester		Driller: Jim Hall Jr.	
Company: WSRC		Drilling Method: Auger/split spoon	

Run Number	Depth Below Ground Surface (Feet)	Lithology	Percent Recovery	Sample Description	Drilling Comments/Remarks
	4 0			~~Sand, 80-90%, med-fine, gray 10YR 5/1~~	
21	1	X	40		
	2				
				Sand 80-90% med. coarse 2.5YR 5/1	
22	3	X	25	mod. sorted	
	4				
				~~Sand 80-90%, med-coarse, 2.5YR 5/1,~~	
23	5	X	50	mod. sorted.	
	6				
				~~Sand 85-95%, med-coarse, 2.5YR 5/1,~~	
24	7	X	45	mod sorted, gravish brn 2.5Y 5/2.	
	8				
				Sand grading into a sandy silty clay,	
25	9		100	sand med-coarse fining down to a fine sand	
	5 0			many pebbles from 48-99', dk gray 2.5YR 4/1,	
				muscovite abundant	
				Sand grading into a sandy silty clay,	
26	1		100	sand coarse down to med at bottom,	
				much muscovite present, dk gray 2.5YR 4/1	
	5 2				T.D.
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	0				