Using Stratasampler™ Multi-Level Wells to Examine the Hyporheic Zone within a Riparian Wetland

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USING STRATASAMPLERTM MULTI-LEVEL WELLS TO EXAMINE THE HYPORHEIC ZONE WITHIN A RIPARIAN WETLAND

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Abstract

The hyporheic zone is the distinct transition region between groundwater and surface water. The characteristics of this groundwater-surface water interface, which extends both vertically and laterally, are functionally and structurally significant to the hydrology and ecology of a riparian wetland.

The initial objectives of this research are to establish a baseline and monitor the influences of local scale hydrology and biogeochemical behavior within the hyporheic zone at an unimpacted, uncontaminated site. A riparian wetland site along the headwaters of Fourmile Branch has been selected. Multi-level wells have been installed at thirteen locations along the headwaters of the Fourmile Branch at the groundwater-surface water interface site. Four of the multi-level wells have three StrataSamplersTM and nine of the wells have two StrataSamplersTM.

Six of the thirteen multi-level wells were installed by hand auger in October, 1997. Hydrographs for the StrataSamplersTM show that the samplers were successfully isolated from each other as indicated by consistent differences in water levels. The water quality in these zones is also consistently different and provides additional evidence that the materials and methods selected for installation of the multi-level wells were successful in establishing depth discrete groundwater sampling points that are isolated from each other.

This network of multi-level wells will facilitate planned studies of the hyporheic zone, the groundwater-surface water interface, and will enable us to develop methods applicable at impacted sites.

Background

The hyporheic zone is the distinct transition region between groundwater and surface water. The characteristics of this groundwater-surface water interface, which extends both vertically and laterally, are functionally and structurally significant to the hydrology and ecology of a riparian wetland.

The initial objectives of this research are to establish a baseline and monitor the influences of local scale hydrology and biogeochemical behavior within the hyporheic zone at an unimpacted, uncontaminated site. A riparian wetland site along the headwaters of Fourmile Branch has been selected. Thirteen multi-level wells were installed and equipped with StrataSamplersTM to allow for depth discrete water level measurements, and for the collection of depth discrete groundwater samples. Instrumentation at the site includes a data logger for the collection of climatological and water level data and an automated sampler for the collection of routine surface water samples.

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(Name and Title)
Date: 4/21/98

The collection of multi-disciplinary data should significantly strengthen our understanding of contaminant transport mechanisms as controlled by the integrated effect of natural processes and surface chemistry as it occurs at the groundwater-surface water interface.

Study Site

Fourmile Branch originates in the center of the Savannah River Site and flows 24.2 miles (39 km), draining into the Savannah River at river mile 152.1. Fourmile Branch drains a watershed of approximately 22 miles² (57 km²), including several SRS facilities: C Area (Reactor), F and H Areas (separations and seepage basins), and the Solid Waste Disposal Facility (SWDF). Fourmile Branch receives process effluents from F- and H-Area operations. Fourmile Branch also receives effluent from C Area which included heated Savannah River water from C Reactor before it was placed on standby in 1985. The reference location chosen for this study is along the headwaters of the Fourmile Branch and has no known history of contamination (Figure 1).

Materials and Methods

The multi-level wells used for this project have been equipped with Depth Discrete Sampling Ports (DDSP). See Figure 2. The design of the DDSP allows the collection of discrete samples from several depths within a single borehole. The StrataSamplerTM DDSP is manufactured by Timco Mfg., Inc. and is constructed of stainless steel components common in the groundwater monitoring industry. These components include slotted or wire wrapped well screens, flush joint threads (i.e. TrilocTM) and sample tube, see attached Figure 2. The pass-through is also made of stainless steel. A sample chamber is formed by sealing the annulus between the well screen and pass-through with a continuous tungsten inert gas (TIG) weld. A TIG weld is also used to connect the sample tube to the sample chamber. Flexible tubing is connected to the sample tube using a standard stainless steel compression fitting such as a Swagelok fitting. These fittings are designed to provide leak proof connections for process, power, and instrumentation applications. Samples are pumped individually from the sample chamber to the surface.

Installation

Multi-level wells were installed at 6 locations using a 3.75 inch diameter hand auger in October 1997. Each multi-level well included 2 -3 StrataSamplersTM, PVC casing and polyethylene tubing. In some cases temporary casing was used to stabilize the borehole during placement of the StrataSamplersTM, casing, and backfill materials. The location of each StrataSamplerTM was determined in the field based on lithologic description, Appendix A, of the material collected during hand augering. StrataSamplersTM were placed at permeable sediment depths identified in the lithologic descriptions. See Figure 3 for a representative view of two well heads at the site.

Two inch diameter PVC well casing is used to properly arrange the StrataSamplersTM in each borehole. Polyethylene tubing, color coded for identification purposes, has been connected to each StrataSamplerTM and extended to the surface. Filter packs were installed around each StrataSamplerTM using Foster Dixiana FX50 sand (.45 - .55mm grain size). Bentonite pellets

were placed between StrataSamplers™ to prevent vertical leakage in the borehole. See Figure 2 and Appendix 2.

Vibrocoring was used to install multi-level wells at 7 additional locations in January 1998. Vibrocoring consisted of vibrating a core barrel made of 15 feet of 3 inch diameter aluminum pipe into the ground and extracting it using a winch. The recovered core barrel was split open and a lithologic description of the contents was prepared. A second aluminum tube was vibrated into the resulting borehole as a temporary casing to prevent hole collapse. A two-inch hand auger was used to clean out the cased borehole. The multi-level well was assembled and placed in the cased borehole with the StrataSampler™ screen zones aligned with the depth of the permeable layers. Filter sand was poured around the multi-level well and within the cased borehole to coincide with the screened zones. Bentonite pellets were poured around the multi-level well and within the cased borehole to seal between the screened zones. Sand and bentonite layers were alternated as needed to provide a filter pack at the screened intervals and seals to prevent vertical mixing within the borehole. The three inch casing was slowly extracted to allow settling and collapse around the multi-level well. Each multi-level well was constructed from the materials described above.

Sampling and Measurements

Water levels were measured one to two times per week in each of the StrataSamplers™ installed in October 1997. These measurements are presented in Table 2 and Figures 4 -9. Hydrographs for the StrataSamplers™ installed in October show that the samplers were successfully isolated from each other as indicated by the consistent differences in water levels, Figures 4 -9. StrataSamplers™ 31F-R and 31F-Y, in multi-level well GSW031F had similar water levels as did StrataSamplers™ 33F-Y and 33F-G in multi-level well GSW033F. The water quality in these zones is consistently different, as shown below, and indicates that the StrataSamplers™ were successfully isolated from each other.

Water samples were collected from the stream and each of the StrataSamplers™ installed in October 1997 at least once a week using a peristaltic pump. Water was pumped from each of the StrataSamplers™ until it appeared clear. After the murky water had been pumped from a StrataSampler™ a water sample was collected for measurement of pH and specific conductivity. The results of the pH and specific conductivity measurements are presented in Table 3. The pH and conductivity probes were calibrated prior to taking readings each day. Figures 10 and 11 show the time series for specific conductivity measurements in multi-level wells 31F and 33F. The specific conductivity of samples collected from StrataSampler™ 31F-R is consistently higher than the specific conductivity of samples collected from StrataSampler™ 31F-Y which indicates that there is no leakage between these samples. A similar trend was observed for StrataSamplers™ 33F-Y and 33F-G, Figure 11, as well as in the other multi-level wells, Table 3.

Once the water sample for pH and conductivity readings was collected, an AquaPrep™ 0.45 µm single use, groundwater sampling filter was attached to the discharge tubing on the peristaltic pump. The sampled water was pumped through the filter and into two 250 ml vials. An acid

preserved sample was sent to be analyzed for target analyte metals and the second water sample was analyzed by ion chromatography for anions (chloride, fluoride, formate, nitrate, nitrite, oxalate, phosphate, and sulfate).

Results

Multi-level wells have been installed at thirteen locations along the headwaters of the Fourmile Branch at the groundwater-surface water interface site. Four of the multi-level wells have three StrataSamplers™ and nine of the wells have two StrataSamplers™.

Six multi-level wells were installed by hand auger in October, 1997. See Table 1. Field Geologic Logs (OSR 30-3) and Well Construction Diagrams were prepared and are included as Appendix 1 and Appendix 2 respectively. Hydrographs for the StrataSamplers™ installed in October 1997 show that the samplers were successfully isolated from each other as indicated by consistent differences in water levels, Figures 4 -9. The water quality in these zones is also consistently different and provides additional evidence that the materials and methods selected for installation of the multi-level wells were successful in establishing depth discrete groundwater sampling points that are isolated from each. The results from analyses of the trace metals and anions are not yet complete and will not be included in this report.

This network of multi-level wells will facilitate planned studies of the hyporheic zone, the groundwater-surface water interface, and will enable us to develop methods applicable at impacted sites.

Figure 1

Groundwater/Surface Water Interface Project Location

0 0.5 1 1.5 2 Miles

Figure 2

Title: **Depth Discrete Sampling Port**

Sketch No.: SKS-RLN-98-001

Originator: R. L. Nichols

Date: .02.05.98

Figure 3. Photograph of well heads for GSW013C (right) and GSW019D (left).

Table 1 Well construction details for multi-level wells.

Well ID	SRS North	SRS East	Surface Elevation (ft, msl)	Stand Pipe Elevation (ft, msl)	StrataSampler ID	Depth to Top of Screen (ft)	Depth to Bottom of Screen (ft)
GSW013C	64703.63	64324.1	247.8	251.85	13C-R	1.50	4.50
					13C-Y	9.00	10.00
GSW015C	64683.37	64322.21	246.9	251.26	15C-R	0.50	3.50
					15C-Y	8.00	9.00
GSW018C	64654.72	64319.27	248.8	252.78	18C-R	3.00	6.00
					18C-Y	8.00	9.00
GSW019D	64703.7	64314.62	247.5	251.37	19D-R	1.80	4.80
					19D-Y	9.30	10.30
GSW031F	64705.41	64294.7	247.4	251.66	31F-R	1.00	4.00
					31F-Y	8.50	9.50
GSW033F	64686.98	64292.21	247.8	251.79	33F-R	0.67	3.67
					33F-Y	5.58	6.58
					33F-G	10.50	11.50

Table 2 Water level elevations for StrataSamplers™.

Well ID	Date													
	10/6	10/7	10/9	10/15	10/20	10/21	10/23	10/27	10/28	10/30	11/3	11/5	11/6	11/7
	Water Level (ft, msl)													
13C-R	246.27	245.93	246.18	246.35	246.77	246.68	246.85	247.18	246.85	246.68	246.85	246.85	246.85	246.85
13C-Y	246.85	246.68	246.85	246.68	247.26	247.18	247.35	247.52	247.35	247.35	247.35	247.35	247.35	247.35
15C-R	246.59	246.76	246.59	246.26	246.59	246.59	246.76	247.01	246.84	246.76	246.93	246.76	246.76	246.76
15C-Y	246.81	246.73	246.81	246.81	247.23	247.06	247.23	247.56	247.40	247.56	247.40	247.23	247.40	247.48
18C-R	252.78	246.53	246.61	246.61	246.95	246.61	246.95	247.53	247.28	247.11	247.11	246.95	246.95	247.03
18C-Y	This StrataSampler™ DDSP does not produce water.													
19D-R	246.29	245.95	246.04	246.20	246.70	246.54	246.70	247.04	246.79	246.70	246.70	246.70	246.54	246.79
19D-Y	246.84	246.67	246.67	246.67	247.17	247.01	247.17	247.51	247.26	247.17	247.34	247.34	247.17	247.26
31F-R	246.49	246.33	246.49	246.49	246.99	246.83	246.99	247.16	246.99	246.99	246.99	246.99	246.83	246.99
31F-Y	247.34	246.42	246.50	246.50	247.00	246.84	247.00	247.17	247.17	247.00	247.17	247.17	247.00	247.09
33F-R	251.79	245.96	248.04	245.96	246.29	246.12	246.29	246.54	246.29	246.29	246.29	246.29	246.12	246.21
33F-Y	251.78	246.45	246.45	246.45	246.95	246.95	246.95	247.28	247.11	246.95	247.11	246.95	246.95	247.11
33F-G	251.77	251.77	246.44	246.44	247.10	246.94	246.94	247.27	247.10	246.94	247.10	247.10	247.10	247.10

Table 3 Results from measurement of pH and specific conductivity of samples collected from StrataSamplers™.

Well ID	Date											
	8-Oct-97		09-Oct-97		20-Oct-97		23-Oct-97		30-Oct-97		05-Nov-97	
	pH	Cond	pH	Cond	pH	Cond	pH	Cond	pH	Cond	pH	Cond
13C-R	n.m.	112.80	n.m.	100.50	5.71	178.20	5.61	116.90	6.31	180.00	7.70	52.30
13C-Y	n.m.	19.29	n.m.	19.89	5.03	23.80	4.84	27.80	5.77	22.60	7.75	23.00
15C-R	n.m.	149.50	n.m.	172.60	6.43	56.50	6.67	147.40	6.33	94.60	7.80	93.60
15C-Y	n.m.	31.30	n.m.	28.90	5.45	24.60	5.75	27.10	5.75	27.80	7.81	28.30
18C-R	n.m.	122.80	n.m.	125.30	5.92	48.20	6.19	40.10	6.30	34.40	7.84	33.30
19D-R	n.m.	67.20	n.m.	249.00	5.76	143.20	4.63	57.60	5.93	86.20	7.70	66.20
19D-Y	n.m.	24.90	n.m.	21.70	5.17	23.30	4.69	24.30	5.61	30.30	7.68	26.60
31F-R	n.m.	87.40	n.m.	70.10	5.94	91.30	5.66	65.10	6.24	57.30	7.67	64.50
31F-Y	n.m.	18.39	n.m.	21.40	5.32	25.30	4.93	21.90	5.55	21.40	7.67	21.90
33F-R	n.m.	80.10	n.m.	102.60	6.26	416.00	6.15	31.30	6.39	216.00	7.77	85.80
33F-Y	n.m.	119.10	n.m.	138.60	6.52	105.30	6.32	81.70	3.00	64.30	7.81	100.60
33F-G	n.m.	21.40	n.m.	29.70	5.14	26.30	4.80	25.20	5.61	25.90	7.87	24.60

n.m.- not measured

Figure 4

Figure 5

Figure 6

Figure 7

Figure 8

Figure 9

Figure 10

Figure 11

Appendix 1

FIELD GEOLOGIC LOG

PROJECT <u>Groundwater / Surface Water Project</u>		DATE <u>11/3/98</u>	SHEET <u>1</u> OF <u>1</u>
		DRILLING SUBCONTRACTOR <u>EMTC</u>	
WELL NUMBER <u>GSD03C</u>	LOCATION <u>Foumle Branch</u>	DRILLER <u>Steve Reese</u>	
LOGS PREPARED BY <u>KL Dixon</u>	COMPANY <u>WSRC</u>	DRILLING METHOD <u>Hand Auger</u>	

RUN NUMBER	DEPTH BELOW GROUND SURFACE (FEET)	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS/REMARKS
	0			0-1' Organic clay - Brown	0-1'
	1			1-3' Clay - gray	1-3'
	2				
	3			3-3.5' - Sandy clay ^{medium} to fine grained sand with pebbles - gray	3-3.5'
	4			3.5-5.0' - Sandy clay - fine grained sand densely packed - gray	3.5-5.0'
	5			5.0-7.0' - Sandy clay - Medium grained sand - gray	5.0-7.0'
	6				
	7			7.0-8.0' - Sandy clay - Medium grained sand poorly sorted with many pebbles. Increasing sand content across interval	7.0-8.0'
	8				
	9			8-10.5' Silty sand - Sand fraction poorly sorted predominantly medium grained with many small pebbles	8-10.5'
	10				
	11			10.5-16' - Silty clay with very fine sand. White with yellow mottles.	10.5-16'
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				

FIELD GEOLOGIC LOG

PROJECT <u>Groundwater / Surface Water Project</u>		DATE <u>1/13/98</u>	SHEET <u>1 OF 1</u>
WELL NUMBER <u>GSWD15C</u>		DRILLING SUBCONTRACTOR <u>EMTC</u>	
LOCATION <u>Fourmile Branch</u>		DRILLER <u>Steve Reese</u>	
LOGS PREPARED BY <u>L.L. Dixon</u>		COMPANY <u>WSRC</u>	
		DRILLING METHOD <u>Hand Auger</u>	

RUN NUMBER	DEPTH BELOW GROUND SURFACE (FEET)	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS/REMARKS
	0			0-2' Dark Organic Muck with some medium sand. Many roots	0-2'
	1				
	2			2'-4' Clay - Gray	2-4'
	3				
	4			4'-6' - Sandy Clay - Medium grained sand. Gray	4-6'
	5				
	6			6-7' Clay - Gray	6-7'
	7				
	8			7-9.5' Silty sand. Sand fraction medium grained. Some small pebbles	7-9.5'
	9				
	10			9.5'-10.5' Clay - Gray with some small pebbles.	9.5'-10.5'
	11			10.5'-12' Sandy Clay - Sand fraction medium grained. yellow mottling.	10.5'-12'
	12				
	13			12-14' Clay - Gray	12-14'
	14				
	15				
	16				
	17				
	18				
	19				
	20

FIELD GEOLOGIC LOG

PROJECT <u>Groundwater / Surface Water Interface</u>		DATE <u>1/13/98</u>	SHEET <u>1</u> OF <u>1</u>
		DRILLING SUBCONTRACTOR <u>EMTC</u>	
WELL NUMBER <u>GSW018C</u>	LOCATION <u>Fourmile Branch</u>	DRILLER <u>Steve Reese</u>	
LOGS PREPARED BY <u>LD Dixon</u>	COMPANY <u>EM WSRL</u>	DRILLING METHOD <u>Hand Auger</u>	

RUN NUMBER	DEPTH BELOW GROUND SURFACE (FEET)	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS/REMARKS
	0			0-0.5'	
	1			Sand - Medium Grained. Black organic with abundant fine roots	0-0.5'
	2			0.5'-4.5'	0.5-4.5'
	3			Sandy-clay - Medium sand - poorly sorted gray-yellow.	
	4				
	5			4.5'-5.0'	4.5'-5.0'
	6			Clay - dark yellow. Some medium sand	
	7			5.0'-6.0'	5.0'-6.0'
	8			Silty sand - loosely packed, poorly sorted. Sand is fine grained. Increasing clay over interval.	
	9			6.0'-9.0'	6.0'-9.0'
	10			Clay - gray with some medium sand densely packed.	
	11			9.0'-12.0'	9.0'-12'
	12			Sandy-clay - Medium sand. gray.	
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				

FIELD GEOLOGIC LOG

PROJECT <u>Groundwater / Surface water Project</u>		DATE <u>1/13/98</u>	SHEET <u>1 of 1</u>
		DRILLING SUBCONTRACTOR <u>EMTC</u>	
WELL NUMBER <u>GSW019D</u>	LOCATION <u>Fourmile Branch</u>	DRILLER <u>Steve Reese</u>	
LOGS PREPARED BY <u>K.L. Dixon</u>	COMPANY <u>WSRC</u>	DRILLING METHOD <u>Hand Auger</u>	

RUN NUMBER	DEPTH BELOW GROUND SURFACE (FEET)	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS/REMARKS
	0			0-3' Medium sand with Brown	0-3'
	1			Drainage. Abundant fine roots some	
	2			large.	
	3			3-5' Sandy clay. Sand fraction	3-5'
	4			medium grained - gray	
	5			5-7' Clay - gray Some medium sand.	5-7'
	6				
	7			7-8' Silty clay - gray	7-8'
	8			8-11' Coarse sand, poorly sorted	8-11'
	9			with many pebbles (River rocks)	
	10				
	11			11-17' Clay - gray with yellow	11-17'
	12			mottling. Densely packed. yellow	
	13			mottling more predominate in lower	
	14			part of interval. Increasing sand over	
	15			lower part of interval. Not large	
	16			portion of grain size distribution.	
	17				
	18				
	19				
	20				

FIELD GEOLOGIC LOG

PROJECT <u>Groundwater / Surface Water Project</u>		DATE <u>1/13/98</u>	SHEET <u>1</u> OF <u>1</u>
		DRILLING SUBCONTRACTOR <u>EMTC</u>	
WELL NUMBER <u>GSW031F</u>	LOCATION <u>Fourmile Branch</u>	DRILLER <u>Steve Reese</u>	
LOGS PREPARED BY <u>KL Dixon</u>	COMPANY <u>WSRC</u>	DRILLING METHOD <u>Hand Auger</u>	

RUN NUMBER	DEPTH BELOW GROUND SURFACE (FEET)	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS/REMARKS
	0				
	1				
	2				
	3				
	4				
	5				
	6				
	7				
	8				
	9				
	10				
	11				
	12				
	13				
	14				
	15				
	16				
	17				
	18				
	19				
	20				

FIELD GEOLOGIC LOG

PROJECT <u>Groundwater / Surface Water Project</u>		DATE <u>1/13/98</u>	SHEET <u>1 OF 1</u>
WELL NUMBER <u>GSW033F</u>		DRILLING SUBCONTRACTOR <u>EMTC</u>	
LOCATION <u>Fourmile Branch</u>		DRILLER <u>Steve Reese</u>	
LOGS PREPARED BY <u>KLD Dixon</u>		COMPANY <u>WSRC</u>	
		DRILLING METHOD <u>Hand Auger</u>	

RUN NUMBER	DEPTH BELOW GROUND SURFACE (FEET)	LITHOLOGY	PERCENT RECOVERY	SAMPLE DESCRIPTION	DRILLING COMMENTS/REMARKS
	0			0-3' Dark organic Muck with medium sand. (poorly sorted). Many roots	0-3'
	1				
	2				
	3			3-3.5 - Sandy Clay - medium sand poorly sorted.	3-3.5'
	4			3.5-4.5 Clay - Gray - some fine sand tightly packed.	3.5-4.5'
	5			4.5-6.0 Silty Sand - medium sand loosely packed.	4.5-6.0'
	6			6.0-6.4 Sandy Clay - yellow with some gray. medium sand.	6.0-6.4'
	7			6.4-6.5 Silty Sand - fine to medium sand - yellow.	6.4-6.5'
	8			6.5-6.7 Silty Sand - fine to medium sand - yellow - loosely packed with pebbles.	6.5-6.7'
	9			6.7-7.0 Sandy Clay - medium sand tightly packed yellow	6.7-7.0'
	10			7.0-8.3 Clay - some fine sand - densely packed - gray.	7.0-8.3'
	11			8.3-9.0 Silty Sand - medium sand - yellow	8.3-9.0'
	12			9.0-9.5 Silty coarse sand with pebbles poorly sorted.	9.0-9.5'
	13			9.5-12.0 - silty medium sand - well sorted. Some rocks at 11.5 ft.	9.5-12.0'
	14			12-14 - Sandy Clay - medium sand	12-14'
	15			Increasing clay content over interval	
	16				
	17				
	18				
	19				
	20				

Appendix 2

Well Construction Diagram

Well Number: GSW013C	Date of Installation: 9/29/97	Horizontal Scale: 1:3
		Vertical Scale: 1:3
SRS North: 64703.63	SRS East: 64324.10	Ground Elevation: 247.8 FT

Well Construction Diagram

Well Number: GSW015C	Date of Installation: 9/30/97	Horizontal Scale: 1:2
		Vertical Scale: 1:2
SRS North: 64683.37	SRS East: 64322.21	Ground Elevation: 246.9 FT

Well Construction Diagram

Well Number: GSW018C	Date of Installation: 10/7/97	Horizontal Scale: 1:2
		Vertical Scale: 1:2
SRS North: 64651.72	SRS East: 64379.27	Ground Elevation: 248.8 FT

Well Construction Diagram

Well Number: GSW019D	Date of Installation: 9/24/97	Horizontal Scale: 1 : 3
		Vertical Scale: 1 : 3
SRS North: 64703.70	SRS East: 64314.62	Ground Elevation: 247.6 FT

Well Construction Diagram

Well Number: GSW031F	Date of Installation: 10/1/97	Horizontal Scale: -
		Vertical Scale: -
SRS North: 64705.41	SRS East: 64294.70	Ground Elevation: 247.4 FT

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Well Construction Diagram

Well Number: GSW033F	Date of Installation: 9/30/97	Horizontal Scale: 1:3
		Vertical Scale: 1:3
SRS North: 64686.98	SRS East: 64319.27	Ground Elevation: 247.8 FT