Kansas Geological Survey

Assessment of the Impact of Stormwater Recharge from Unlined Earthen Pits on Ground-Water Quality in the Wichita Area

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Donald O. Whittemore, Lawrence R. Hathaway, Lawrence H. Skelton, Thomas J. McClain, Michael T. Dealy, Brian G. Fisher, and Robert W. Buddemeier

A Cooperative Investigation by the Kansas Geological Survey, Equus Beds Groundwater Management District No. 2, and Wichita-Sedgwick County Department of Community Health

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Contents

Executive Summary

A study was conducted by the Kansas Geological Survey, the Equus Beds Groundwater Management District No. 2, and the Wichita-Sedgwick County Department of Community Health to assess the impact on ground-water quality in the Equus Beds aquifer of stormwater recharge from unlined earthen pits. Two sites were examined, both of which are located at or near the north boundary of Wichita and south of Valley Center. One site, Fox Meadows, drains a new residential area, and the other, Miles Sand, drains a more urban area that includes heavily traveled Meridian Street. The investigation provides background data against which to compare future effects of infiltrating storm runoff in the developing area.

Surface waters in the stormwater retention pits and a drainage ditch to the Miles Sand pit and ground waters underlying the pit areas did not contain volatile organic compounds, triazine herbicides, or heavy metals in concentrations of concern to water supplies. One of the drainage ditch samples contained detectable insecticide chemicals. Agricultural activities occurring before the new housing development in Fox Meadows appear to have caused nitrate contamination of the Equus Beds aquifer there (about 4-8 mg/L nitrate-nitrogen), although the values are less than the drinking-water standard. Nitrate concentrations in all the other surface and ground waters sampled were relatively low (0.3 to less than 3 mg/L nitrate-nitrogen).

The main water-quality problem is saline water (490-580 mg/L chloride concentration) in the pond and ground waters of Miles Sand. Hydrogeochemical data suggest that most but not all of the salinity is natural. An appreciable portion of the salinity is probably saline water from the Arkansas River and adjacent alluvial aquifer that has flowed in the subsurface toward the Little Arkansas River. Upward movement of saltwater from the Permian Wellington aquifer underlying the study area could possibly contribute to the salinity. Contamination by oil-field brine does not appear to be a significant chloride source. Street runoff containing dissolved road salt applied to streets in the watershed would be the most likely anthropogenic salinity source. The lack of samples collected from the drainage ditch near the pit during the winter makes it difficult to assess whether street runoff is a major source of the salinity.

Introduction

In 1988 several water users contacted the Equus Beds Groundwater Management District No. 2 (GMD2) regarding a stormwater retention pond being constructed in a proposed housing addition north of Wichita. Their concerns included the potential adverse impact of stormwater infiltration on ground-water quality. To address the concerns, the GMD2 worked with the Kansas Geological Survey (KGS) and the Wichita-Sedgwick County Department of Community Health (WSCDCH) to develop a memorandum of understanding to determine what effect disposing untreated urban stormwater runoff in unlined earthen pits has on the water quality of the Equus Beds aquifer. Accordingly, the KGS, GMD2, and WSCDCH conducted a study involving sampling and analysis of surface and ground waters collected from 1991 to 1992. Two sites were examined, both of which are located at or near the north boundary of Wichita and south of Valley Center between the Arkansas and Little Arkansas rivers. Both sites contain ponds that receive untreated stormwater runoff that either infiltrates to the subsurface or evaporates.

The stormwater retention pond that initiated the ground-water quality concerns is located in a housing development known as Fox Meadows. The housing addition is located in the northern half of NE sec. 13, T. 26 S., R. 1 W. (Figure 1). The area of the housing addition is approximately 60 acres and is subdivided into 60 lots of about 0.5 acre each. Each home requires a domestic well and a septic system.

A stormwater retention pond was constructed in the Fox Meadows development to receive drainage by means of grassed channels and ditches from only the area of the housing development. The retention pond contains a variable amount of water, depending on preceding precipitation, and can be dry after extended periods without substantial precipitation. The retention area is located near the center of the south half of the development and is shown in Figure 1. The pond is about 14 ft (4.3 m) deep and provides about 36 acre-ft of water storage. Sands of the aquifer underlie the soils that were excavated during pond construction, facilitating infiltration of retention water to the underlying aquifer. Water levels measured by the GMD2

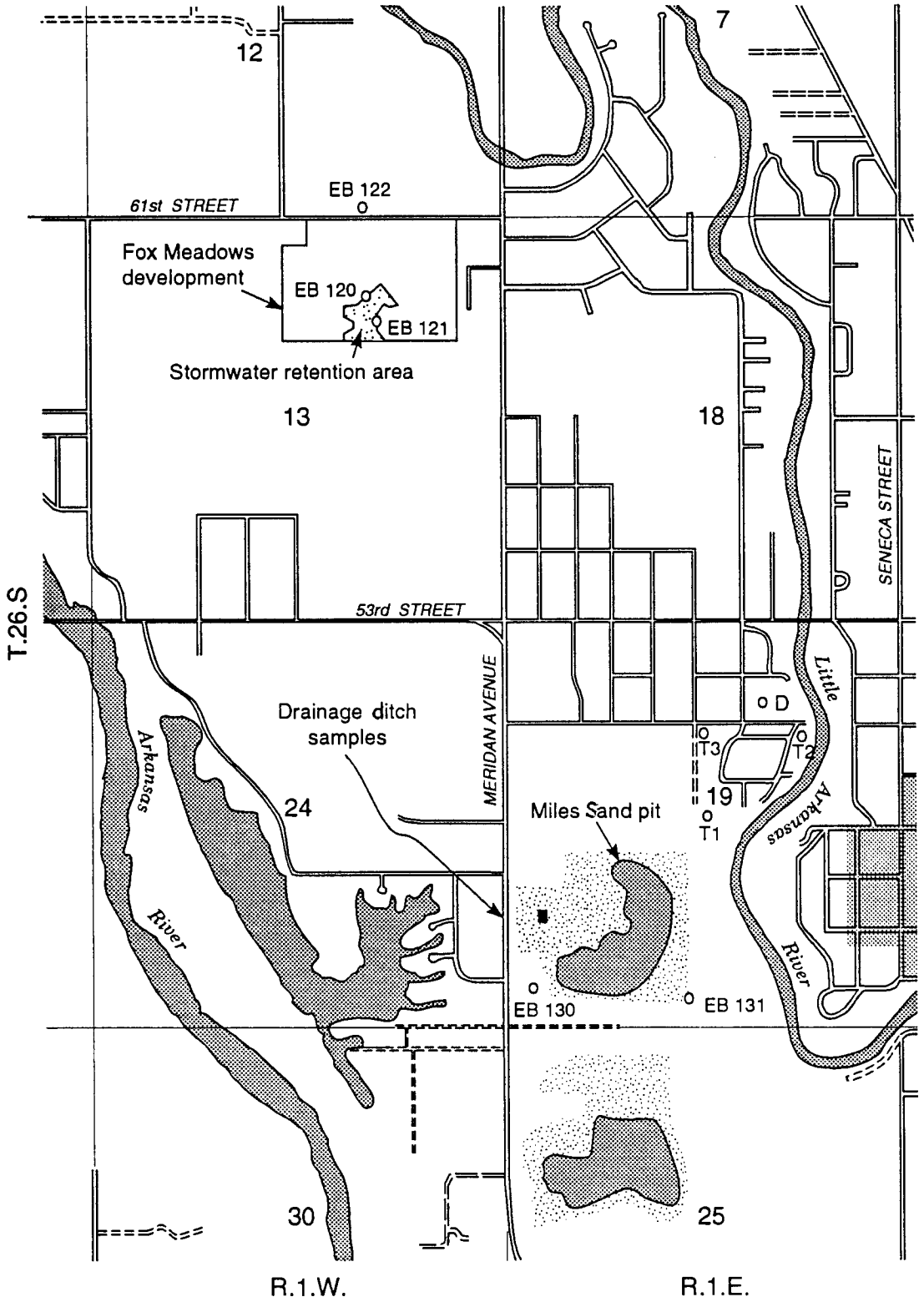

Figure 1. Map of the study area with locations of stormwater retention pits, monitoring and test wells and the drainage ditch sampling point. Small circles indicate monitoring wells (EB), test holes (T), or domestic well (D).

indicate that the depth to the water table ranges from 14 to 20 ft (4.3-6.1 m). The retention pond is about 0.5 mi (0.8 km) to the southwest of a bend in the Little Arkansas River and approximately 1 mi (1.6 km) northeast of the Arkansas River. Two irrigation wells and an estimated 20 domestic wells exist within a 0.5-mi radius and downgradient of the retention pond. Only a few houses had been built at the start of the study, and development was continuing at the time of this report.

The other site is a pond at Miles Sand Co. in the SW sec. 19, T. 26 S., R. 1 W. (Figure 1), where a pit produced from sand and gravel mining receives untreated stormwater runoff from a much larger area than that of Fox Meadows. The sand pit was excavated by suction-pump mining to the bottom of the alluvial sand and gravel [about 49 ft (15 m) as indicated by the shale depth in the EB 130C well log; see Appendix B]. The watershed draining to the Miles Sand pit encompasses a more urbanized area than the Fox Meadows basin and thus receives runoff from more heavily traveled streets. The level of water in the pit about 15 ft (4.6 m) below land surface indicates the shallow depth to the water table. The pit is about 1.5 mi (2.4 km) to the south-southeast of the Fox Meadows pond, 0.2 mi (0.3 km) west of the Little Arkansas River, and 0.8 mi (1.3 km) northeast of the Arkansas River.

In cooperation with the City of Wichita Water Department, the GMD2 installed three monitoring wells in the Equus Beds aquifer around each of the two stormwater disposal pits (Figure 1). All observation wells were augered and constructed using appropriate quality control procedures and materials to prevent contamination or corruption of water samples from well construction or materials. Two of the wells, EB 120C and EB 121A, in the Fox Meadows area are at two sides of the retention pond, and the other well, EB 122A, is to the north across 61st Street from the housing addition. The three wells near the Miles Sand pit are at two sites, EB 130 and EB 131, to the southwest and the southeast of the sand pit, respectively. Two of the wells at each site are shallow, with depths of 28.5-30 ft (8.7-9.1 m) and are labeled "A" after the well site number. The other well at each site is deeper [49.5 ft (15.1 m)] and is labeled "C". The screened interval in the wells is 5 ft (1.5 m) at the bottom of the borehole. The well casing and

continuous-slot screen are PVC. Bentonite was used to grout the well above a gravel pack. Surveyed location and elevation for the wells are listed in Appendix A, and well log and construction information is listed in Appendix B.

Water samples were collected by the WSCDCH according to EPA sampling protocol and sent to the KGS for measurement of dissolved inorganic constituents and to GTEL Environmental Laboratories Inc. in Wichita for determination of volatile organic compounds and selected herbicides. The sampling sites included the six observation wells, the two stormwater recharge pits, a road ditch routing drainage to the Miles Sand pit, and snow melt in a roadside puddle. The road ditch is along the west side of Meridian Avenue and drains through a culvert under the street to the Miles Sand pit. The period of sampling was from August 8, 1991, to July 7, 1992. Sample collection information is summarized in Table 1 and is from sampling logs on file at the WSCDCH and KGS.

Results and Discussion

Water collected from the Fox Meadows retention pond was fresh throughout the study, although the major constituent concentrations were much higher in the initial sample collected in August 1991 compared with four later samples (Table 2). The stormwater retention area was constructed to include drainage only from the new housing development and to exclude drainage from other areas. The higher concentration of total dissolved solids (TDS) in the first sample could represent either readily soluble minerals in the soils exposed during construction of the pond and the housing area or remnants of a source from the previously larger drainage area. Water collected from the drainage ditch near the Miles Sand pit on the same day as the first sample from the Fox Meadows pond contained a much lower TDS concentration.

The ground water in the vicinity of the Fox Meadows drainage pond was fresh throughout the study period (Table 2). The range of values for specific conductance and sulfate and chloride concentrations were relatively narrow for all well samples (728-800 uS/cm, 61-72 mg/L, and 68-86 mg/L, respectively) except for the last sample from well EB 121A, which contained somewhat fresher water.

Table 1. Sample Collection Information

Sample site	Sample date	Sample time[a]	Air temp. (°C)	Weather[b]	Chemical analyses[c]
Site 1, Fox Meadows area, surface waters					
Stormwater pond	07/24/91	17:00	na[d]	na	O,P
	08/28/91	8:00-8:20	na	r/w	I,O
	11/06/91	7:15-7:45	14	r/w	I
	05/14/92	6:40-7:30	19	l	I,O,P[e]
	06/19/92	19:30-20:00	na	r/w	I,O,P
	06/20/92	11:30-12:00	na	na	I
Site 1, Fox Meadows area, ground waters					
EB 120C	08/09/91	14:15-15:00	27	o	I
	09/12/91	16:00-16:56	33	w	I
	11/19/91	14:45	10	o/w	I
	04/23/92	13:55	12	o/w	I
	05/29/92	11:00	na	w	I
	07/07/92	9:36-10:40	32	c/w	I
EB 121A	08/09/91	13:30	27	o/w	O,P
	09/12/91	7:05-8:15	31	l	O,P
	11/19/91	13:47-14:45	na	o/w	I
	05/29/92	9:23-11:00	na	l	I,O,P
	07/07/92	11:10	34	w	I,O,P
EB 122A	08/08/91	7:00-9:00	27	o/w	O,P
	09/13/91	8:30	24	o/l	I,O,P
	11/19/91	15:30	na	o/w	I
	05/29/92	13:00-14.00	25	o	I,O,P
	07/07/92	14:15-14:45	na	w	I,O,P
Site 2, Miles Sand pit area, surface waters					
Roadsite puddle	11/06/91	18:30-19:00	14	r/w	I
Drainage ditch	08/28/91	19:00-20:00	24	r/w	I,O
	05/14/92	17:45-18:30	19	l	I,O,P[e]
	06/19/92	18:30-19:30	na	w/r	I,O,P
	06/20/92	11:00-11:30	na	na	I
Sand pit pond	07/24/91	16:30	na	na	O,P
	08/12/91	16:50-16:05	27	o/w	I
	11/19/91	13:22-13:45	10	o/w	I
	05/29/92	na	20	na	I
	07/06/92	16:50-16:00	na	na	I

Table 1. (Continued)

Sample site	Sample date	Sample time[a]	Air temp. deg. C	Weather[b]	Chemical analyses[c]
Site 2, Miles Sand pit area, ground waters					
EB 130A	08/08/91	12:00-17:00	39	w	I,O,P[e]
	09/13/91	10:00	25	o/w	I,O,P
	11/19/91	10:35	10	o/w	I
	04/23/92	9:30-10:45	18	o/w	I
	05/28/92	11:30-13:00	12	o	I,O,P
	07/06/92	10:30-11:15	38	e/w	I,O,P
EB 130C	08/09/91	10:00	na	o	I
	09/13/91	10:45-11:15	30	o/w	I
	11/19/91	11:45	10	o/w	I
	04/23/92	10:45	18	o/w	I
	05/28/92	13:30	12	e	I
	07/06/92	11:40-12:00	na	w	I
EB 131A	08/09/91	12:00-12:34	27	o	O,P
	09/13/91	11:30-12:15	30	o	I,O,P
	04/23/92	10:45-11:30	14	o/w	I
	05/28/92	15:00-16:00	18	l	I,O,P
	07/06/92	16:00-17:00	na	e	I,O,P

a. Time in 24 hour clock; range in time refers to start time to finish time.
b. o = cloudy, w = windy, l = calm, r = rain, e = clear.
c. I = inorganic, O = volatile organic, P = pesticide.
d. Data not available.
e. Chain of custody date for organic and pesticide determinations is one day later than recorded on sample log sheet.

Table 2. Chemical Properties and Inorganic Constituent Concentrations

Sample site	Sample date	Sp.C. µS/cm[a]	Lab pH[b]	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Sr mg/L	HCO_3 mg/L	SO_4 mg/L	Cl mg/L	F mg/L	NO_3-N mg/L	PO_4-P mg/L	As mg/L	Cu mg/L	Mn mg/L	Pb mg/L
Site 1, Fox Meadows area, surface waters																		
Stormwater pond	08/28/91	1140	7.10	75.7	16.3	114	29.8	0.48	55	219	183							
	11/06/91	76	7.00	7.7	1.2	2.7	4.5	0.04	34	3.7	2.4	0.12	0.8					
	05/14/92	214								7.1	21.2		0.8		0.0010	0.027	0.0003	0.0042
	06/19/92	75	6.80	9.3	1.0	1.0	4.9	0.04	35	1.7	2.7	0.12	0.4	0.147	0.0020	0.020	0.0022	0.0080
	06/20/92	94	6.65	9.3	1.0	4.0	5.4	0.04	33	2.2	7.9	0.12	0.4	0.147	0.0006	0.0070	0.0010	0.0105
Site 1, Fox Meadows area, ground waters																		
EB 120C	08/09/91	778	7.45	63.7	12.1	74.5	2.3	0.58	240	67.6	70.9		5.2					
	09/12/91	785	7.45	68.5	12.5	77.1	3.8	0.57	242	71.7	74.4	0.47	5.2	0.033	0.0026	0.018	<0.0010	0.013
	11/19/91	774	7.40	68.0	12.2	75.6	3.4	0.19	239	67.9	73.4	0.48	5.4	0.033	0.0083	0.0034	0.0011	0.011
	04/23/92	790								67.8	77.2		5.2		0.0010	<0.0001	0.0017	0.0030
	05/29/92	775								69.5	75.7		5.4		0.0018	0.0005	0.0011	0.0048
	07/07/92	785	7.60	66.5	12.1	77.1	3.6	0.57	236	70.9	77.0	0.51	5.9	0.029	0.0018	0.012	0.0005	0.0090
EB 121A	11/19/91	730	7.20	73.7	12.8	58.8	3.4	0.20	227	63.0	67.7	0.70	5.2	0.042	0.0082	0.0111	0.0024	0.0082
	05/29/92	800								62.7	72.3		8.1		0.0013	0.018	0.0004	0.0098
	07/07/92	583	7.55	61.6	10.9	41.1	3.4	0.49	231	35.2	41.2	0.74	3.6	0.033	0.0009	0.0135	0.0023	0.0040
EB 122A	09/13/91	728	7.20	71.8	13.0	57.3	3.5	0.55	208	63.9	75.4	0.46	5.4	0.020	0.0046	0.0100	0.0310	0.013
	11/19/91	732	7.25	74.2	13.3	56.6	2.7	0.19	212	62.4	74.2	0.48	5.9	0.026	0.0071	0.0024	0.0018	0.0048
	05/29/92	760								64.3	85.5		5.4		0.0019	0.0016	0.0019	0.012
	07/07/92	750	7.25	72.9	13.3	57.0	5.2	0.58	210	61.1	83.1	0.50	5.4	0.023	0.0023	0.0175	0.0022	0.0014
Site 2, Miles Sand pit area, surface waters																		
Roadside puddle	11/06/91	408	7.60	27.6	2.3	45.6	8.0	0.12	100	14.6	62.6	0.13	2.7					
Drainage ditch	08/28/91	138	7.50	10.4	1.4	16.1	4.9	0.05	59	6.5	8.0							
	05/14/92	150								3.2	3.9		1.2		0.0025	0.015	0.0024	0.0065
	06/19/92	86	6.40	3.3	0.6	4.5	12.2	0.02	22	1.9	9.4	<0.10	0.4	0.179	0.0034	0.029	0.0015	0.0077
	06/20/92	93	6.80	6.5	1.2	2.8	11.4	0.04	36	1.7	6.1	0.13	0.5	0.46	0.0030	0.0067	0.0004	0.0075

Table 2. (Continued)

Sample site	Sample date	Sp.C. µS/cm[a]	Lab pH[b]	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	Sr mg/L	HCO_3 mg/L	SO_4 mg/L	Cl mg/L	F mg/L	NO_3-N mg/L	PO_4-P mg/L	As mg/L	Cu mg/L	Mn mg/L	Pb mg/L
Site 2, Miles Sand pit area, surface waters (continued)																		
Sand pit pond	08/12/91	2220	8.35	61.2	22.2	347.0	5.4	0.79	155	180	506							
	11/19/91	2210	8.10	74.9	22.9	352.0	5.9	0.27	173	177	512	0.61	0.3	0.003	0.0110	0.0106	0.0430	0.0073
	05/29/92	2210								172	512		0.9		0.0034	0.0210	0.0340	0.0063
	07/06/92	2120	8.00	67.3	21.8	335.0	7.9	0.76	150	166	495	0.49	0.3	<0.003	0.0027	0.0100	0.0022	0.0058
Site 2, Miles Sand pit area, ground waters																		
EB 130A	08/08/91	2320	8.00	67.5	22.7	360.0	5.7	0.90	170	178	536		0.1					
	09/13/91	2350	7.65	77.4	24.6	373.0	7.2	0.91	174	177	553	0.56	0.5	0.039	0.0032	0.0250	0.0230	0.0088
	11/19/91	2360	7.70	79.7	25.1	371.0	7.7	0.32	177	176	560	0.54	0.3	0.029	0.0092	0.0093	0.0299	0.0038
	04/23/92	2390								158	579		0.3		0.0007	0.0028	0.0220	0.0037
	05/28/92	2400								167	582		0.5		0.0047	0.0075	0.0190	0.0055
	07/06/92	2400	7.75	72.1	23.8	391.0	8.0	0.86	171	170	581	0.60	1.3	0.039	0.0025	0.0210	0.0330	0.0052
EB 130C	08/09/91	2340	7.80	75.3	23.3	354.0	5.4	0.87	175	180	536		0.1					
	09/13/91	2345	7.60	82.5	24.3	360.0	6.8	0.86	175	180	546	0.54	0.3	0.029	0.0048	<0.010	0.0240	0.0084
	11/19/91	2350	7.60	83.5	24.3	361.0	6.9	0.30	181	177	553	0.52	0.2	0.026	0.0115	0.0029	0.0314	0.0027
	04/23/92	2360								166	567		0.1		0.0022	0.0006	0.0170	0.0050
	05/28/92	2380								164	568		0.1		0.0026	0.0012	0.0150	0.0088
	07/06/92	2390	7.75	80.0	23.7	377.0	4.1	0.86	173	169	576	0.56	0.3	0.020	0.0035	0.0080	0.0205	0.0036
EB 131A	09/13/91	2150	7.90	68.1	20.7	340.0	11.4	0.73	156	172	493	0.81	0.2	0.049	0.0054	<0.010	0.0010	0.0068
	04/23/92	2200								175	512		0.2		0.0020	0.0035	0.0002	0.0057
	05/28/92	2210								173	509		0.3		0.0030	0.0034	0.0002	0.0065
	07/06/92	2205	8.00	72.8	24.2	346.0	5.2	0.81	175	176	511	0.62	0.2	0.033	0.0033	0.0070	0.0004	0.0004

a. Specific conductance in microSiemen/cm at 25 °C.

b. Recorded to nearest 0.5 unit.

Br concentrations in samples collected from EB 130A and EB 130C wells on 11/19/91 are 1.30 mg/L and 0.90 mg/L, respectively.

The nitrate and phosphate concentrations of the study waters were determined to assess nutrient inputs from such sources as fertilizers and septic systems. The maximum contaminant level for nitrate in drinking water is 10 mg/L for nitrate expressed as nitrogen (NO_3-N) or 45 mg/L if expressed as nitrate (NO_3). Nitrate concentrations in the Fox Meadows pond were relatively low [0.4-0.8 mg/L as NO_3-N (1.6-3.6 mg/L as NO_3)], and were lower during the latter part of the study. In contrast, the nitrate concentrations of the ground water were much higher, [3.6-8.1 mg/L NO_3-N (16-36 mg/L NO_3)], although still below the drinking-water standard. The nitrate values remained nearly constant in waters from wells EB 120C and EB 122A [5.2-5.9 mg/L NO_3-N (23-26 mg/L NO_3)] but fluctuated between 3.6 and 8.1 mg/L NO_3-N (16 and 36 mg/L NO_3) in well EB 121A. Although the housing development is outside the city limits and uses septic tanks and lateral lines for domestic wastewater disposal, the recent and continuing construction of the development and the relatively constant nitrate in the ground water for two wells suggests that most of the nitrate is from past agricultural sources. The area was farmed previous to development.

Phosphate concentrations in all the samples from the Fox Meadows and Mile Sand pit areas were low, less than 0.5 mg/L as phosphate-phosphorus (PO_4-P). Surface waters in the Fox Meadows retention pond and the Miles Sand drainage ditch contained greater phosphate concentrations (0.15-0.46 mg/L PO_4-P) than the Miles Sand pit and all ground waters (0.001-0.049 mg/L PO_4-P), suggesting removal by adsorption on sediment.

Water in the Miles Sand pit was slightly saline during the study, with a relatively constant chloride concentration ranging from 495 to 512 mg/L (Table 2). At least part of the salinity could be derived from street runoff containing dissolved road salt. The stormwater drainage area includes mainly urban but also rural land use. The drainage ditch is along a heavily traveled street on which road salt is spread when conditions warrant. The pit is just to the east of the street. Water collected in the late spring and summer from the drainage ditch routing water to the pit contained dissolved chloride concentrations in the range of only 1.7-6.5 mg/L. In comparison, snowmelt at the beginning of winter (November 6, 1991) collected from a roadside

puddle contained 63 mg/L dissolved chloride, whereas snowmelt collected on the same day from the Fox Meadows drainage pond had only 2.4 mg/L chloride. No ditch samples were collected during the middle or at the end of the winter when runoff dissolving road salt would be expected to be the most saline. However, examination of snowmelt was not included in the original study purpose and funding.

The ground water in the vicinity of the pit was also saline with a total range of chloride concentration of 493-582 mg/L for the three monitoring wells near the pit (Table 2). The chloride concentrations showed a slight increasing trend during the study, and sulfate concentrations either remained nearly constant or decreased slightly.

To examine possible salinity sources by geochemical identification, we also determined the bromide concentration in samples collected from wells EB 130A and 130C on November 11, 1991. The bromide and chloride composition of the waters were compared to plots of bromide/chloride ratio versus chloride concentration for the mixing of freshwaters and various salinity sources. Other possible saltwater sources besides road salt that were considered in the study region are natural salt dissolution in the Permian rocks underlying the alluvial aquifer, saline Arkansas River water (which also receives its salinity from Permian salt dissolution), and oil-field brines (Whittemore, 1982, 1984, 1990). The bromide/chloride mass ratios for the two well waters (0.00232 for EB 130A and 0.00163 for EB 130C) are higher than expected for only Permian salt dissolution (a ratio range of 0.0002-0.0010 at a chloride concentration of 550 mg/L) and lower than expected for oil brine as the primary chloride source (a ratio above 0.003). The ratios might fit a mixture of natural salt dissolution and oil brine as the chloride source. Another possibility is a mixture of salinity from natural salt dissolution and road salt with elevated bromide from combustion products of gasoline additives.

The ground waters in the study region appear to be more saline in locations closer to the Arkansas River and fresher in locations closer to the Little Arkansas River based on data in this report, Lane and Miller (1965), Bevans (1989), and analyses of waters from several test wells drilled to the base of the alluvial aquifer in 1986 (R. Vincent, personal communication, 1993).

Water collected in 1985 from a 25-ft-deep (7.6-m-deep) domestic well labeled "D" in Figure 1 had chloride and sulfate concentrations of 220 mg/L and 150 mg/L, respectively (Bevans, 1989). Ground waters from three test wells in SW NE sec. 19, T. 26 S., R. 1 E. were slightly saline based on field determinations of chloride concentration (R. Vincent, personal communication, 1993). The locations of the three test wells are shown as T1, T2, and T3 on Figure 1. The chloride contents of waters from test holes T2 [28-38 ft (8.5-11.6 m) depth] and T3 [35-45 ft (10.7-13.7 m) depth] were very similar, 272 and 282 mg/L, respectively. The chloride concentration of water from test hole T1 was more saline, 508 mg/L at a depth of 28-38 ft (8.5-11.6 m) and 460 at a depth of 38-48 ft (11.6-14.6). In 1989 chloride and sulfate concentrations ranged from 355 mg/L and 210 mg/L, respectively, for water from the shallow well to 477 mg/L and 213 mg/L, respectively, for the deep well at site EB 221 in NE NW SW sec. 14, T. 26 S., R. 1 W., 0.2 mi (0.3 km) south of the Arkansas River and about 2.5 mi (4.0 km) to the northwest of Miles Sand pit (Whittemore, 1990). Water collected in 1985 from a 40-ft-deep (12-m-deep) domestic well in NW NW NW sec. 15, T. 26 S., R. 1 W., 0.4 mi (0.6 km) southwest of the Arkansas River and about 4 mi (6 km) to the northwest of Miles Sand pit, had chloride and sulfate contents of 630 mg/L and 250 mg/L, respectively (Bevans, 1989). In contrast, ground waters from four test holes drilled about 0.1 mi (0.16 km) east of the Little Arkansas River in the NE NE sec. 29, T. 26 S. R. 1 E. and at a depth of 38-45 ft (11.6-13.7 m) contained 98-115 mg/L chloride and 174-229 mg/L sulfate (R. Vincent, personal communication, 1993).

Thus ground waters about a mile to the southeast of the Miles Sand pit on the east side of the Little Arkansas River are fresh, whereas ground waters near Miles Sand pit on the west side of the Little Arkansas River and near the Arkansas River are saline. The higher chloride concentration at the shallower depth in test hole T1 and the slightly, but consistently higher chloride in water from shallow well EB 130A than in samples from deep well EB 130C suggest that the main salinity source near Miles Sand pit is not derived from below the alluvial aquifer. The major salinity source must also fit the pattern of increasing chloride concentration toward the south, as indicated by waters from the Fox Meadows monitoring wells, a 30 ft deep well in

SW sec. 18, T. 26 S., R. 1 E. yielding water with a chloride concentration of 61 mg/L (B.G. Fisher residence), well D, test holes T1 to T3, and the monitoring wells near Miles Sand pit.

Much of the ground-water and sand-pit salinity could be derived from saline water in the alluvium of the Arkansas River valley that has flowed in the subsurface as a result of local water-level differences. The Miles Sand pit is situated between two rivers, although it is closer to the Little Arkansas River than to the Arkansas River as indicated by Figure 1. The two river channels approach each other near Miles Sand pit and approximately parallel one another until joining about 5 mi (8 km) to the south in the center of Wichita. Once the channels are within 1.5 mi (2.4 km) of one another, as apparent in sections 24 and 19 in Figure 1, the separation distance ranges from 0.5 mi to less than 1.5 mi (0.8-2.4 km) before the confluence. The channel of the Arkansas River appears to be at a higher level than that of the Little Arkansas River in the study area. The relative elevations for the two river levels were estimated using the U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles for Maize and Valley Center. Elevation contours for both quadrangles are based on 1939 planetable surveys revised in 1960 for Maize and 1961 for Valley Center. Features on both maps, including the river channels, were both photorevised in 1982. The river conditions for both maps appear to be lower flows. The elevation contour for 1,325 ft crosses the Arkansas River in SW sec. 24 west of the Miles Sand pit, whereas the estimated elevation is 1,312 ft for the water level in the Little Arkansas River just east of the sand pit in SE sec. 19. In addition, the channel of the Arkansas River is broader and generally shallower than that of the Little Arkansas River. Therefore an average gradient of about 13 ft (4 m) exists between the two rivers, which could cause ground-water to flow through the alluvium from the Arkansas River to the Little Arkansas River. The Little Arkansas River appears to act as a drain relative to the Arkansas River in north Wichita and could induce the flow of saline river water to the Miles Sand pit area. This observation is supported by a modeling study of the Arkansas River valley from Hutchinson to Wichita (Myers et al., 1993).

The source of the natural salinity in the Arkansas River alluvium to the west of the Miles Sand pit is probably derived both from discharge of underlying Permian saltwater to the alluvium

and infiltration of saline Arkansas River water (Whittemore, 1990; Myers et al., 1993). Chloride concentrations in the Arkansas River during lower flows at Maize are in the range of several hundred milligrams per liter, as indicated by values of 140-1,000 mg/L during 1988-1991 (Myers et al., 1993). The sulfate and chloride contents of Arkansas River water collected at Maize in December 1989 were 161 mg/L and 582 mg/L, respectively (Whittemore, 1990). Thus the river-water sulfate concentration appears to be in a similar concentration range for that in ground waters near the Miles Sand pit, given similar chloride. As indicated earlier, ground waters in Arkansas River alluvium near Maize are also slightly saline and contain higher dissolved solids at deeper depths. The salinity of low Arkansas River flow and alluvial ground waters near the river appears to be sufficiently high to account for most of the chloride content observed in the Miles Sand pit area.

Another possible source of natural saline water could be flow of Permian saltwater from the Permian Wellington aquifer, which underlies the Miles Sand pit according to a map by Gogel (1981). The probability of this source would be greater if a deep unplugged or poorly plugged borehole exists in the vicinity and penetrates the shale underlying the alluvial aquifer. Flow from the underlying Permian would be expected to be greatest when local ground-water levels in the alluvial aquifer were lowest during periods of low river stage and high consumptive use of ground water.

Chloride contents in the Little Arkansas River at Valley Center are lower than those in the Arkansas River near Wichita and are less than 200 mg/L during lower flow (U.S. Geological Survey water data). Chloride concentrations were higher in the Little Arkansas River in the past because surface disposal of oil-field brines contaminated tributaries (Leonard and Kleinschmidt, 1976). Thus part of the salinity in the Miles Sand pit area might be hypothesized as the past infiltration of Little Arkansas River water if the river level was high enough relative to the local ground-water and Arkansas River levels to allow flow into the subsurface and if the salinity of the water was great enough during the higher flows. Such infiltration of oil-brine contaminated waters from the Little Arkansas River could explain the elevated bromide content in the EB 130

samples. However, the combination of conditions needed and the chloride concentration of other ground waters near the river indicate that this is probably not a significant salinity source. Consumptive use of ground water from wells and evaporation from the sand pit pond during the summer might cause local depressions in the ground-water table relative to the river, but they would also induce additional flow from the Arkansas River. Sustained high flows in the Little Arkansas River with lower flows in the Arkansas River would be necessary for substantial infiltration of Little Arkansas River water. The first flush of surface or near-surface oil brine by a rainstorm in the Little Arkansas River watershed could bring in saline water, but continued high flows would be much too dilute to add appreciable salinity to the alluvial aquifer near Miles Sand pit. As indicated earlier, ground waters are fresh close to the eastern side of the Little Arkansas River southeast of the Miles Sand pit. Infiltration of any oil brine from the river would also be expected to affect this location. If oil brine has contributed to the salinity, the source is not expected to be local because the Miles Sand pit is not near an oil field. In comparison, the Fox Meadows drainage area is relatively near an oil field (the Valley Center Field to the north) but the ground waters in that area are not high in chloride.

The additional bromide in the two ground-water samples above that attributable to natural salt dissolution could also be derived from the bromine-containing additive used in leaded gasoline. Bromide/chloride ratios at given chloride concentrations are generally higher in street runoff from urban areas than for rural areas (Davis and Whittemore, unpublished paper, 1993). The shallower EB 130A well has a higher bromide/chloride ratio, possibly suggesting a greater contribution to the total salinity from urban runoff affected by road salt and gasoline additives, than the ground water from the deeper well EB 130C. Unlike the bromide concentrations, the chloride concentrations at the two depths of site EB 130 are similar, and the slight variations in chloride concentration generally occur in concert. Any explanation based on two or more salinity sources must fit the dissimilar change in bromide and chloride concentrations with depth and the similarity in chloride concentration variations.

Chloride concentrations in samples from well EB 130A were somewhat lower but

consistently less than those in water from well EB 131A. However, well EB 130A is closer to the Arkansas River than well EB 131A. If the main salinity source is from Arkansas River alluvium to the west, variations in local recharge could be the explanation. The Maize topographic quadrangle shows a large, elongated pond in sec. 24 (also drawn in Figure 1) that parallels but is not connected to the Arkansas River during lower river flow. This pond would receive direct atmospheric precipitation and surface drainage in the immediate area during storms. The freshwater could dilute the saline shallow ground water near the pond. Well site EB 130 is only 0.2 mi (0.3 km) east of the easternmost fingers of the pond area known as the Moorings.

Nitrate concentrations in the Miles Sand pit waters were relatively low, 0.3-0.9 mg/L as NO_3-N (1.2-4.1 mg/L as NO_3), a range similar to that for the Fox Meadows pond waters. Water in the roadside puddle and drainage ditch samples contained a somewhat greater range in nitrate, [0.4-2.7 mg/L NO_3-N (1.8-12 mg/L NO_3)]. Nitrate contents in the ground waters from the three wells in the pit area [0.1-1.3 mg/L NO_3-N (0.5-5.7 mg/L NO_3)] were also in the same general range as for the pit waters but were much lower than in the Fox Meadows ground water.

The dissolved concentrations of the metals arsenic, copper, lead, and manganese were all below current values for maximum contaminant levels in drinking waters in all surface waters and ground waters sampled at both the Fox Meadows and Miles Sand pit areas (Table 2). There is no apparent pattern in the metals concentrations from surface- or ground-water collection sites or with time.

The water samples from both sites were analyzed for the volatile organic compounds included in modified method 8240 of the U.S. Environmental Protection Agency (Appendix C). The volatile organic compounds include mainly chlorinated hydrocarbons and simple aromatic hydrocarbons that are of concern for drinking waters. Analyses were not made for saturated petroleum hydrocarbons composing the major part of gasoline and oil. No concentrations of the volatile organic compounds determined were found above the practical quantification limits (listed with the analyses in Appendix C) for the analytical methods used to determine the

compounds. Traces of a few volatile organic compounds were detected in a few samples. However, the chemicals are also used in the analytical laboratory and might possibly represent contamination by vapors during processing and analysis.

No detectable concentrations of the triazine herbicides atrazine, propazine, simazine, and prometon were found in any of the surface- and ground-water samples (Appendix D). The analytical laboratories determining the herbicides improved their ability to detect lower limits of the compounds during the study period. Detection limits for the four herbicides were 1 µg/L for the later samples. Traces of the insecticides malathion and chloropyrifos were found in a sample from the drainage ditch of the Miles Sand pit collected on June 19, 1992. The two compounds were identified in the laboratory using two different analytical columns and conditions and thus appear to be real detections.

Conclusions

The study indicates that ground-water quality in the Equus Beds aquifer underlying the stormwater retention pits has not been significantly affected by volatile organic compounds, triazine herbicides, and heavy metals. Surface waters in the stormwater retention pits and drainage ditch and ground waters underlying the pit areas did not contain concentrations of these substances at levels of concern to water supplies during the study period. One of the drainage ditch samples contained detectable insecticides. Agricultural activities occurring before the new housing development in Fox Meadows appear to have caused moderate nitrate contamination of the Equus Beds aquifer, although the concentrations are less than the drinking-water standard. Nitrate concentrations in all the other surface and ground waters sampled were relatively low. The investigation provides good background data against which to compare future effects of infiltrating stormwater runoff in the developing Fox Meadows addition.

The main water-quality problem observed is saline water in the Miles Sand pit and ground waters near the pit. Hydrogeochemical data suggest that most but not all of the salinity is natural. An appreciable portion of the chloride concentration is probably from saline water in the Arkansas River and alluvial aquifer next to the river that has flowed in the subsurface toward the

Little Arkansas River. The Miles Sand pit area lies along the ground-water flow path between the two rivers. Upward movement of saltwater from the Permian Wellington aquifer underlying the study area could be another possible natural salinity source. Contamination by oil-field brine does not appear to be a significant chloride source. Street runoff containing dissolved road salt applied to heavily traveled Meridian Street and other streets near the pit would be the most likely anthropogenic contribution to the salinity. The exclusion of drainage from Meridian Street to the Fox Meadows pond might be responsible for the decrease in the salinity of waters in the stormwater retention pond in that area. The lack of samples collected from the drainage ditch near the Miles Sand pit during the middle or end of winter makes it difficult to assess whether street runoff can contain a high enough chloride concentration to be a major source of the salinity in the Miles Sand pond and ground waters. A definitive geochemical identification of the main chloride source(s) based on bromide and chloride relationships for only two ground-water samples was not possible because of the variety of potential salinity sources.

Recommendations for Further Study

The major unknown revealed by the study is the contribution of winter street runoff to water salinity. Determination of this source would involve sample collection mainly during the winter from the drainage ditch, pond, and wells of the Miles Sand pit and determination of specific conductance, and chloride, sulfate, and bromide concentrations. Some samples from the Fox Meadows area should be included for direct comparison of an area without major street runoff during the same time span. The sampling should focus on drainage ditch waters during periods of snow and ice melt following applications of appreciable amounts of road salt. Geochemical interpretation of the results will provide a much better assessment of the impact of urban runoff on ground- and surface-water salinity. A few samples could also be analyzed for petroleum hydrocarbons that comprise oil and gasoline used in vehicles, and for volatile organic compounds and pesticides. Determination of petroleum hydrocarbons in the samples will allow assessment of the impact of vehicular organic compounds in street runoff compared with runoff

in a residential area.

The Fox Meadows housing addition was in the process of early development during this study. Any effects on runoff of domestic fertilizer and pesticide use would be expected to increase as development continues toward completion of the 60 housing units. The data presented in this report provide a database against which to compare chemical data from long-term sampling as the drainage areas for both stormwater retention pits continue to develop. Such continued sampling could include major, minor, and trace inorganic constituents, hydrocarbons and volatile organic compounds, and pesticides. Additional trace metals, such as cadmium, chromium, mercury, and selenium, should be included in the analyses of selected samples. Sampling once every two years from the two unlined pits and the six monitoring wells should be sufficient, based on the low impact of trace metals and organic compounds found in the study. Sample collection for tracking salinity effects may need to be more frequent, based on the suggested winter study of street runoff. A continued investigation should be designed to distinguish the ground-water quality effects of below-ground disposal, such as septic systems and infiltration of surface runoff into the stormwater retention ponds. Sampling of runoff at the beginning and end of a few storms after dry periods would provide information on the chemical composition of flush waters in which surface-derived contaminants might be expected to be greatest.

Any future investigations should consider the potential for other sources of ground-water contamination in the area and the direction of ground-water flow. For example, water well records show that seven monitoring wells were drilled in August 1993 in the northeast corner of the section in which the Miles Sand pit is located. The wells are part of a remediation investigation of the Kansas Department of Health and Environment. Records for test wells drilled earlier in the same general area indicate the presence of a gas station, a potential source of hydrocarbons.

Acknowledgments

The information provided by Robert Vincent of Ground Water Associates Inc. on test holes in the study area was valuable for interpreting salinity sources. In addition, the following individuals are acknowledged for their contributions to the study: Trolona Burgir, Don Koci, Jonathan Fisher, Mary Fisher, Shannon Fisher, Kevin Howard, Don Rider, Adrianne Smith, and Marshall Staughter (water sample collection), Karmie Galle and Truman Waugh (determination of inorganic constituents in water samples), S. Ravikumar (data entry for tables), Mark Schoeneweis (production of figure graphics), Mimi Braverman (editing of the final report), Anna Kraxner (production of report copies), Harley Miles (Fox Meadows site access), and George Pearson (Miles Sand Co. site access).

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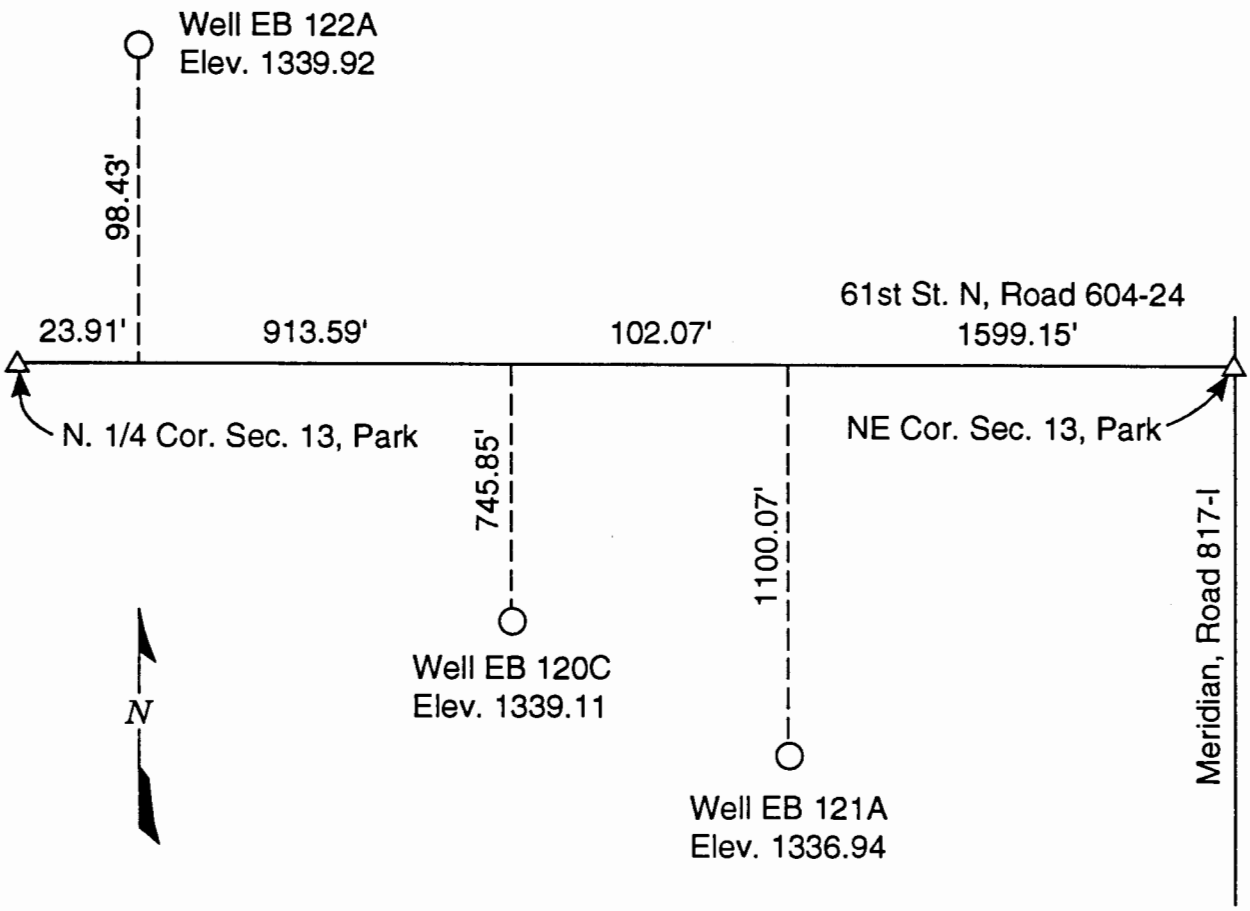
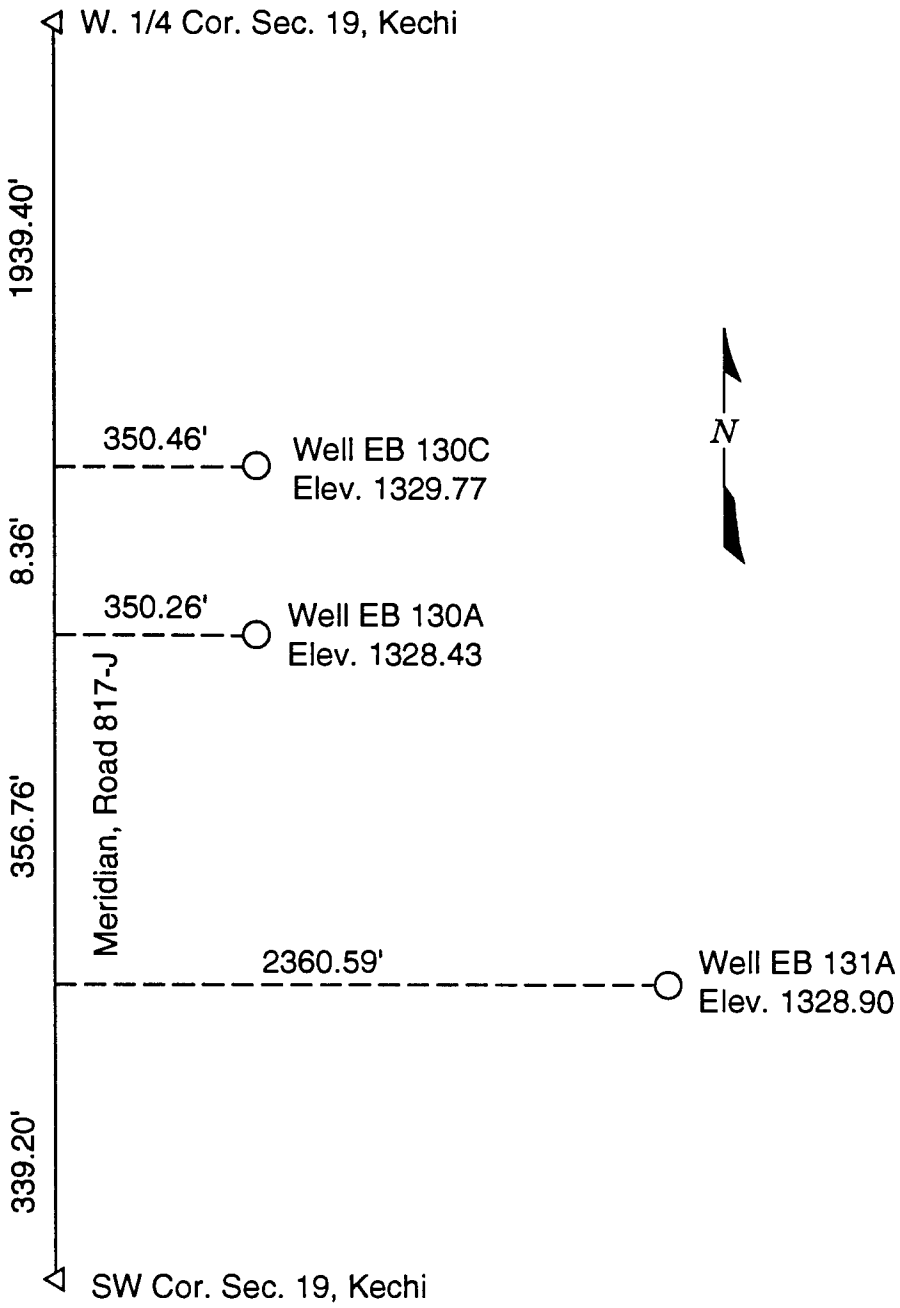
Appendix A: Measured Locations and Elevations of Monitoring Wells



Fox Meadows area
NE 1/4 Sec. 13, T. 26 S., R. 1 W.
Park Twp. Sedgwick Co., KS
Well elevations at top of well casing inside box.
Survey by Sedgwick County Bureau of Public Services.



Miles Sand pit area
SW 1/4 Sec. 13, T. 26 S., R. 1 E.
Kechi Twp. Sedgwick Co., KS
Well elevations at top of well casing inside box.
Survey by Sedgwick County Bureau of Public Services.

Appendix B: Monitoring Well Log and Construction Information

MW #EB-120C

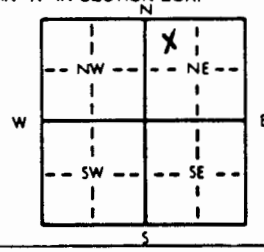
WATER WELL RECORD Form WWC-5 KSA 82a-1212

1 LOCATION OF WATER WELL: County: SEDGWICK | Fraction: C ¼ NW ¼ NE ¼ | Section Number: 13 | Township Number: T 26 S | Range Number: R 1 W E/W

Distance and direction from nearest town or city street address of well if located within city?
From Meridian & 53rd No., approx. 1980' West, west side of road. Wichita, KS.

2 WATER WELL OWNER: Ground Water Management District II
RR#, St. Address, Box # : 313 Spruce, Halstead, KS. 67056
City, State, ZIP Code :
Board of Agriculture, Division of Water Resources Application Number:

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL: 49½ ft. ELEVATION:
Depth(s) Groundwater Encountered 1. ft. 2. ft. 3. ft.
WELL'S STATIC WATER LEVEL 18 ft. below land surface measured on mo/day/yr 6-21-91
Pump test data: Well water was ft. after hours pumping gpm
Est. Yield gpm: Well water was ft. after hours pumping gpm
Bore Hole Diameter 4½ in. to ft., and in. to ft.
WELL WATER TO BE USED AS: 1 Domestic 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Lawn and garden only 8 Air conditioning 9 Dewatering 10 Monitoring well 11 Injection well 12 Other (Specify below)
Was a chemical/bacteriological sample submitted to Department? Yes No X; If yes, mo/day/yr sample was submitted
Water Well Disinfected? Yes No X

5 TYPE OF BLANK CASING USED: 1 Steel 2 PVC sch 40 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below)
CASING JOINTS: Glued Clamped Welded Threaded Flush Joint
Blank casing diameter 2 in. to 44½ ft., Dia in. to ft., Dia in. to ft.
Casing height above land surface 30 in., weight .703 lbs./ft. Wall thickness or gauge No. .154
TYPE OF SCREEN OR PERFORATION MATERIAL: 7 PVC sch 40 (8 RMP (SR)) 10 Asbestos-cement
1 Steel 3 Stainless steel 5 Fiberglass 11 Other (specify)
2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS 12 None used (open hole)
SCREEN OR PERFORATION OPENINGS ARE: 1 Continuous slot 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut 8 Saw cut 20 slot 9 Drilled holes 10 Other (specify) 11 None (open hole)
SCREEN-PERFORATED INTERVALS: From 44½ ft. to 49½ ft., From ft. to ft.
From ft. to ft., From ft. to ft.
GRAVEL PACK INTERVALS: From 39 ft. to 49½ ft., From ft. to ft.
From ft. to ft., From ft. to ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite HOLE PLUG Other
Grout Intervals: From 0 ft. to 39 ft., From ft. to ft., From ft. to ft.
What is the nearest source of possible contamination:
1 Septic tank 2 Sewer lines 3 Watertight sewer lines 4 Lateral lines 5 Cess pool 6 Seepage pit 7 Pit privy 8 Sewage lagoon 9 Feedyard 10 Livestock pens 11 Fuel storage 12 Fertilizer storage 13 Insecticide storage 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below) Storm water disposal
Direction from well? WEST How many feet? 10 pond/sand pit pond

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	3	Topsoil			
3	5	Fine Sand			
5	10	Coarse Sand			
10	19	Coarse to Very Coarse Sand			
19	15	Fine to Medium Sand			
25	30	Fine Sand			
30	49½	Coarse SAnd			
49½	55	Shale			

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 6-21-91 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 236 This Water Well Record was completed on (mo/day/yr) 7-1-91
under the business name of Harp Well & Pump Service, Inc. by (signature) Mary Arnold

INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-7320. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

OFFICE USE ONLY T R E/W SEC. ¼ ¼ ¼

WELL # EB-121A

WATER WELL RECORD

Form WWC-5 KSA 82a-1212

1 LOCATION OF WATER WELL:	Fraction	Section Number	Township Number	Range Number
County: SEDGWICK	C E/2 ¼ SW ¼ NE ¼	13	T 26 S	R 1 W E/W

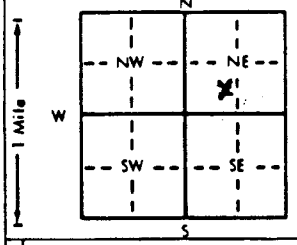
Distance and direction from nearest town or city street address of well if located within city? 2 mi. So. of Valley Center on Meridian, West on 61st St. No. approx. .25 mi., So. on dirt residential st. into Fox Meadows Subdivision,

2 WATER WELL OWNER: E. side ofpond at So. end of sub. div.

RR#, St. Address, Box # : Ground Water Management District II Board of Agriculture, Division of Water Resources

City, State, ZIP Code : 313 Spruce, Halstead, KS. 67056 Application Number:

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL 29.5 ft. ELEVATION:

Depth(s) Groundwater Encountered 1. ..... ft. 2. ..... ft. 3. ..... ft.

WELL'S STATIC WATER LEVEL 17 ft. below land surface measured on mo/day/yr 6-20-91

Pump test data: Well water was ..... ft. after ..... hours pumping ..... gpm

Est. Yield ..... gpm: Well water was ..... ft. after ..... hours pumping ..... gpm

Bore Hole Diameter 9" O.Do. 4½" HOLLOW STEM AUGER in. to ..... ft.

WELL WATER TO BE USED AS: 1 Domestic 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Lawn and garden only 8 Air conditioning 9 Dewatering 10 Monitoring well 11 Injection well 12 Other (Specify below)

Was a chemical/bacteriological sample submitted to Department? Yes ..... No X ; If yes, mo/day/yr sample was submitted ..... Water Well Disinfected? Yes ..... No X

5 TYPE OF BLANK CASING USED: 1 Steel 2 PVC sch 40 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below)

CASING JOINTS: Glued ..... Clamped ..... Welded ..... Threaded Flush Joint

Blank casing diameter 2 in. to 24.5 ft., Dia ..... in. to ..... ft., Dia ..... in. to ..... ft.

Casing height above land surface 30 in., weight .703 lbs./ft. Wall thickness or gauge No. .154

TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile 7 PVC sch 40 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) 12 None used (open hole)

SCREEN OR PERFORATION OPENINGS ARE: 1 Continuous slot 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut 8 Saw cut 20 slot 9 Drilled holes 10 Other (specify) 11 None (open hole)

SCREEN-PERFORATED INTERVALS: From 24.5 ft. to 29.5 ft., From ..... ft. to ..... ft.

From ..... ft. to ..... ft., From ..... ft. to ..... ft.

GRAVEL PACK INTERVALS: From 19 ft. to 29.5 ft., From ..... ft. to ..... ft.

From ..... ft. to ..... ft., From ..... ft. to ..... ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite HOLEPLUG

Grout Intervals: From 0 ft. to 19 ft., From ..... ft. to ..... ft., From ..... ft. to ..... ft.

What is the nearest source of possible contamination: 1 Septic tank 2 Sewer lines 3 Watertight sewer lines 4 Lateral lines 5 Cess pool 6 Seepage pit 7 Pit privy 8 Sewage lagoon 9 Feedyard 10 Livestock pens 11 Fuel storage 12 Fertilizer storage 13 Insecticide storage 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below) storm water disposal pit

Direction from well? WEST How many feet? 25

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
		SEE ATTACHED SCHEDULE			

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 6-20-91 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 236 This Water Well Record was completed on (mo/day/yr) 7-1-91 under the business name of HARP WELL & PUMP SERVICE, INC. by (signature) Mary Arnold

INSTRUCTIONS: Use typewriter or ball point pen. *PLEASE PRESS FIRMLY* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-7320. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

OFFICE USE ONLY T R E/W SEC. ¼ ¼ ¼

EQUUS BEDS GROUNDWATER MANAGEMENT DISTRICT NO. 2

DRILLER'S LOG AND WELL RECORD FIELD SHEET

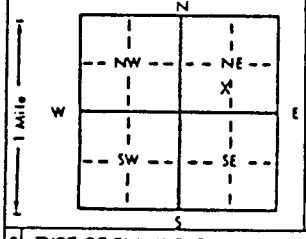
Well No. EB121A

1 LOCATION OF WATER WELL: County: Sedgwick | Fraction: C E/2 SW ¼ NE ¼ | Section Number: 13 | Township Number: T 26 S | Range Number: R 1W W

Distance and direction from nearest town or city street address of well if located within city? Two mi. S. of Valley Center on Meridian, west on 61st St. No. approx. 0.25 mi., south on dirt residential st. into Fox Meadows Subdivision, East side of pond at south end of sub div.

2 WATER WELL OWNER: Ground Water Management District II
RR#, St. Address, Box # : 313 Spruce, Halstead, Kansas 67056
City, State, ZIP Code :
Board of Agriculture, Division of Water Resources Application Number: N/A

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL... 29.5 ft. ELEVATION: approx. 1325
Depth(s) Groundwater Encountered 1. ..... ft. 2. ..... ft. 3. ..... ft.
WELL'S STATIC WATER LEVEL ..... ft. below land surface measured on mo/day/yr .....
Pump test data: Well water was ..... ft. after ..... hours pumping ..... gpm
Est. Yield ..... gpm: Well water was ..... ft. after ..... hours pumping ..... gpm
Bore Hole Diameter ..... in. to ..... ft., and ..... in. to ..... ft.
WELL WATER TO BE USED AS: 1 Domestic 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Lawn and garden only 8 Air conditioning 9 Dewatering (10 Observation well) 11 Injection well 12 Other (Specify below) .....
Was a chemical/bacteriological sample submitted to Department? Yes ..... No ✓ ; If yes, mo/day/yr sample was submitted ..... Water Well Disinfected? Yes ..... No

5 TYPE OF BLANK CASING USED: 1 Steel (2 PVC) 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below) .....
CASING JOINTS: Glued ..... Clamped ..... Welded ..... (Threaded) .....
Blank casing diameter 2 in. to 0.23 ft., Dia ..... in. to ..... ft., Dia ..... in. to ..... ft.
Casing height above land surface 30 in., weight ..... lbs./ft. Wall thickness or gauge No. .....
TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile (7 PVC) 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) ..... 12 None used (open hole)
SCREEN OR PERFORATION OPENINGS ARE: (1 Continuous slot) 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut 8 Saw cut 9 Drilled holes 10 Other (specify) ..... 11 None (open hole)
SCREEN-PERFORATED INTERVALS: From 29.5 ft. to 24.5 ft., From ..... ft. to ..... ft.
From ..... ft. to ..... ft., From ..... ft. to ..... ft.
GRAVEL PACK INTERVALS: From 29.5 ft. to 19 ft., From ..... ft. to ..... ft.
Colorado Silica Sand From ..... ft. to ..... ft., From ..... ft. to ..... ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout (3 Bentonite) 4 Other .....
Grout Intervals: From 10.9 ft. to surface ft., From ..... ft. to ..... ft., From ..... ft. to ..... ft.
What is the nearest source of possible contamination:
(1) Septic tanks 4 Lateral lines 7 Pit privy 10 Livestock pens 14 Abandoned water well
2 Sewer lines 5 Cess pool 8 Sewage lagoon 11 Fuel storage 15 Oil well/Gas well
3 Watertight sewer lines 6 Seepage pit 9 Feedyard 12 Fertilizer storage 16 Other (specify below) Storm water disp. pit.
13 Insecticide storage
Direction from well? West How many feet? 25 ft.

FROM	TO	LITHOLOGIC LOG	FROM	TO	LITHOLOGIC LOG
0	3	Unconsol. silt to V. fine to fine sand, non-calc., chestnut brown containing scattered qtz. sand grains to 0.5 mm diam.	13	18	Qtz sand, non-calc., well sorted, rounded to angular. More than one-half is 0.5 mm to 1 mm. Infrequent qtz and chert pebbles to 1 cm. Blk stained frags. No mica seen.
3	8	Well sorted, angular to sub-rd. clean quartz sand, grains + 0.25 to 0.5 mm, less than 1% mica not exceeding 1 mm, scattered qtz frags to 2 mm, Scattered unident. dark-colored to blk frags...poss. Fe_2O_3 or organic. Light-brown sand, Sl calcareous.	18	23	Brown, ± 10% chert particles 0.5 to 1.0 mm in diam. Sandy, clayey, quartz & chert pebbles, rounded, smoothed up to 2 cm diam, but usually + 1 cm. Non-calc.
8	13	Same as 3-8 ft. Incr number of larger quartz frags to 2 mm, less mica, scattered rounded chert frags to 2.0 mm. Light-brown. Dark particles are Fe or Mn stained. Less than 1% chert grains yel to orange. Qtz grains incr. in size, few to 4 mm.	23	28	Predom. qtz/chert pebbles ranging from 0.5 mm to 2.0 cm. Red, brown, white, in clay/sand mix. Sand is quartz - to 0.5 mm.
			28	29.5	Coarse quartz sand, sub-rd to sub-ang., grains to 2 mm diam. Chert & granite pebbles to 18 X 9 mm to 15 X 12 mm.

7 COMPLETION:

Date Well Completed: 20 / 6 / 1991
Site Geologist... Lawrence H. Skelton
Signature ...

AR-86-2 .....USE BACK OF SHEET FOR ADDITIONAL REMARKS.....

WELL # EB-122A

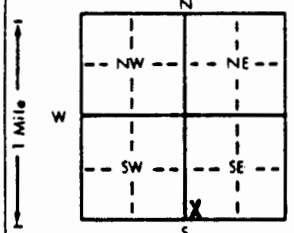
WATER WELL RECORD Form WWC-5 KSA 82a-1212

1 LOCATION OF WATER WELL: County: SEDGWICK | Fraction: SW ¼ SW ¼ SE ¼ | Section Number: 12 | Township Number: T 26 S | Range Number: R 1 W E/W

Distance and direction from nearest town or city street address of well if located within city? 2 mi. So., of Valley Center on Meridian & .5 mi. W. on 61st St. No., About 5 ft. W. of fence & 30 ft. No. of 61st St.

2 WATER WELL OWNER: Ground Water Management District II
RR#, St. Address, Box # : 313 Spruce, Halstead, KS. 67056
City, State, ZIP Code :
Board of Agriculture, Division of Water Resources Application Number:

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL 30.0 ft. ELEVATION:
Depth(s) Groundwater Encountered 1. ft. 2. ft. 3. ft.
WELL'S STATIC WATER LEVEL 17 ft. below land surface measured on mo/day/yr 6-20-91
Pump test data: Well water was ft. after hours pumping gpm
Est. Yield gpm: Well water was ft. after hours pumping gpm
Bore Hole Diameter 9" O.D. to 4½" HOLLOW STEM AUGER in. to ft.
WELL WATER TO BE USED AS: 1 Domestic 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Lawn and garden only 8 Air conditioning 9 Dewatering 10 Monitoring well 11 Injection well 12 Other (Specify below)
Was a chemical/bacteriological sample submitted to Department? Yes No X; If yes, mo/day/yr sample was submitted Water Well Disinfected? Yes No X

5 TYPE OF BLANK CASING USED: 1 Steel 2 PVC sch 40 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below)
CASING JOINTS: Glued Clamped Welded Threaded
Blank casing diameter 2 in. to 25 ft., Dia in. to ft., Dia in. to ft.
Casing height above land surface 30 in., weight .703 lbs./ft. Wall thickness or gauge No. .154
TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile 7 PVC sch 40 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) 12 None used (open hole)
SCREEN OR PERFORATION OPENINGS ARE: 1 Continuous slot 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut 8 Saw cut 20 slot 9 Drilled holes 10 Other (specify) 11 None (open hole)
SCREEN-PERFORATED INTERVALS: From 25 ft. to 30 ft., From ft. to ft.
From ft. to ft., From ft. to ft.
GRAVEL PACK INTERVALS: From 19 ft. to 30 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite HOLE PLUG Other
Grout Intervals: From 0 ft. to 19 ft., From ft. to ft., From ft. to ft.
What is the nearest source of possible contamination: 1 Septic tank 2 Sewer lines 3 Watertight sewer lines 4 Lateral lines 5 Cess pool 6 Seepage pit 7 Pit privy 8 Sewage lagoon 9 Feedyard 10 Livestock pens 11 Fuel storage 12 Fertilizer storage 13 Insecticide storage 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below) tilled field 6' east
Direction from well? NW &NNW How many feet? ½ 1 mile dirt road 10' West

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
		SEE ATTACHED SCHEDULE			

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 6-20-91 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 236 This Water Well Record was completed on (mo/day/yr) 7-1-91 under the business name of HARP WELL & PUMP SERVICE, INC. by (signature) Mary Arnold

INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-7320. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

OFFICE USE ONLY T R E/W SEC. ¼ ¼ ¼

EQUUS BEDS GROUNDWATER MANAGEMENT DISTRICT NO. 2

DRILLER'S LOG AND WELL RECORD FIELD SHEET

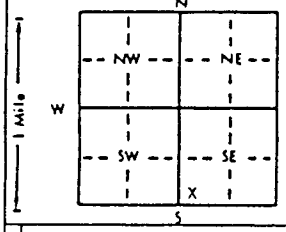
Well No. EB-122A

1 LOCATION OF WATER WELL: County: Sedgwick | Fraction: SW ¼ SW ¼ SE ¼ | Section Number: 12 | Township Number: T 26 S | Range Number: R 1W W

Distance and direction from nearest town or city street address of well if located within city?
2 mi.S. of Valley Center on Meridian & 0.5 mi. W. on 61st St. North. About 5 ft W. of fence & 30 ft. N. of 61st St.

2 WATER WELL OWNER: Ground WaterManagement District II
RR#, St. Address, Box # : 313 Spruce, Halstead, Ks. 67056
City, State, ZIP Code :
Board of Agriculture, Division of Water Resources Application Number: N/A

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL....30.0..... ft. ELEVATION: .....1338.....
Depth(s) Groundwater Encountered 1.....ft. 2.....ft. 3.....ft.
WELL'S STATIC WATER LEVEL ..... ft. below land surface measured on mo/day/yr .....
Pump test data: Well water was ..... ft. after ..... hours pumping ..... gpm
Est. Yield ..... gpm: Well water was ..... ft. after ..... hours pumping ..... gpm
Bore Hole Diameter.....in. to .....ft., and.....in. to .....ft.
WELL WATER TO BE USED AS: 1 Domestic 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Lawn and garden only 8 Air conditioning 9 Dewatering (10 Observation well) 11 Injection well 12 Other (Specify below) .....
Was a chemical/bacteriological sample submitted to Department? Yes.....No....X....; If yes, mo/day/yr sample was submitted
Water Well Disinfected? Yes No

5 TYPE OF BLANK CASING USED: (2 PVC)
1 Steel 2 PVC 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below) .....
CASING JOINTS: Glued .....Clamped .....
Welded .....
(Threaded) .....
Blank casing diameter .....in. to .....ft., Dia .....in. to .....ft., Dia .....in. to .....ft.
Casing height above land surface....30.....in., weight .....lbs./ft. Wall thickness or gauge No. .....

TYPE OF SCREEN OR PERFORATION MATERIAL: (7 PVC)
1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile 7 PVC 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) ..... 12 None used (open hole)

SCREEN OR PERFORATION OPENINGS ARE: (1 Continuous slot)
1 Continuous slot 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut 8 Saw cut 9 Drilled holes 10 Other (specify) ..... 11 None (open hole)

SCREEN-PERFORATED INTERVALS: From....30.....ft. to....25.....ft., From.....ft. to.....ft.
From.....ft. to.....ft., From.....ft. to.....ft.
GRAVEL PACK INTERVALS: From....30.....ft. to....19.....ft., From.....ft. to.....ft.
Colorado Silica Sand. From.....ft. to.....ft., From.....ft. to.....ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite 4 Other .....
Grout Intervals: From....19.....ft. to surface ft., From.....ft. to.....ft., From.....ft. to.....ft.

What is the nearest source of possible contamination:
1 Septic tank 2 Sewer lines 3 Watertight sewer lines 4 Lateral lines 5 Cess pool 6 Seepage pit 7 Pit privy 8 Sewage lagoon 9 Feedyard 10 Livestock pens 11 Fuel storage 12 Fertilizer storage 13 Insecticide storage 14 Abandoned water well (15) Oil well/Gas well 16 Other (specify below) tilled field-6 ft. east dirt road-10 ft. west
Direction from well? NW & NNW How many feet? 1 mile

FROM	TO	LITHOLOGIC LOG
0	3	Loamy, sandy, silty, angular to sub-rd, qtz grains 90% are less than 0.25 mm diam. A few, less than 1%, grains to 1 mm. Organic debris, dark-chestnut brown, non-calc.
3	8	Fine qtz sand ranging from 0.125 to 1 mm diam; angular to sub-rd. 1 to 2% rounded, water-worn quartz and igneous rk pebbles to 10 mm; some black-stained grains poss Mn stain. Non-calc.
8	13	Same as 3-8, a few more larger pieces to 13 mm. Vol. of smaller grains (0.125 to .25 mm) lessening, sand becoming bigger. Non-calc.
13	18	Same as 8-13--grain size holding. Same
18	23	Quartz sand. 90% 0.5 mm to 1.00 mm. Perhaps 5% are larger, rounded, water-worn qtz pebbles to 14 mm long axis. Some chert pebbles to 5-10 mm. About one-half iron stained. Overall, coarser than above. Angular to sub-rd. Non-calc.
23	28	Same as 18-23. Chert & ig rock pebbles to 18 mm X 12 mm. Avg. sand 0.5 to 1.0 mm diam Ferromagnesian xl incl in qtz pebbles. Non-calc.
28	33	Poss. 20% of sand grains to 2.0 mm, rounded to subangular. Some feldspar & granitic

7 COMPLETION: (Over)

Date Well Completed: 20.../...6./.1991
Site Geologist.....
Signature.....
Lawrence H. Skelton

AR-86-2 .....USE BACK OF SHEET FOR ADDITIONAL REMARKS.....

grains. Larger pebbles to 10-15 mm, sub-ang. to sub-rd. Non-calc.

MW #EB-130C

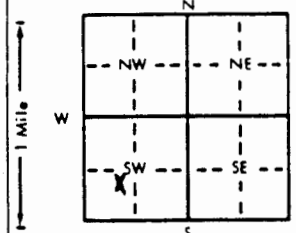
WATER WELL RECORD Form WWC-5 KSA 82a-1212

1 LOCATION OF WATER WELL: County: SEDGWICK | Fraction: NE ¼ SW ¼ SW ¼ | Section Number: 19 | Township Number: T 26 S | Range Number: R 1 E E/W

Distance and direction from nearest town or city street address of well if located within city? Fox Meadow/s
From Meridian and 53rd St. No., 4620' So, approx. 660' E, East side of Road Wichita, KS.

2 WATER WELL OWNER: Ground Water Management District II
RR#, St. Address, Box # : 313 Spruce, Halstead, KS. 67056
City, State, ZIP Code : Board of Agriculture, Division of Water Resources Application Number:

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL: 49½ ft. ELEVATION:
Depth(s) Groundwater Encountered 1. ft. 2. ft. 3. 6-21-91 ft.
WELL'S STATIC WATER LEVEL 18 ft. below land surface measured on mo/day/yr
Pump test data: Well water was ft. after hours pumping gpm
Est. Yield gpm: Well water was ft. after hours pumping gpm
Bore Hole Diameter 4½ in. to ft., and in. to ft.
WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well; 1 Domestic 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below); 2 Irrigation 4 Industrial 7 Lawn and garden only 10 Monitoring well
Was a chemical/bacteriological sample submitted to Department? Yes No X; If yes, mo/day/yr sample was submitted Water Well Disinfected? Yes No X

5 TYPE OF BLANK CASING USED: 1 Steel 3 RMP (SR) 5 Wrought iron 8 Concrete tile; 2 PVC sch 40 4 ABS 6 Asbestos-Cement 9 Other (specify below) 7 Fiberglass
CASING JOINTS: Glued Clamped Welded Threaded Flush Joint
Blank casing diameter 2 in. to 44½ ft., Dia in. to ft., Dia in. to ft.
Casing height above land surface 30 in., weight .703 lbs./ft. Wall thickness or gauge No. .154
TYPE OF SCREEN OR PERFORATION MATERIAL: 7 PVC sch 40
1 Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 10 Asbestos-cement
2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS 11 Other (specify) 12 None used (open hole)
SCREEN OR PERFORATION OPENINGS ARE: 8 Saw cut 20 slot
1 Continuous slot 3 Mill slot 5 Gauzed wrapped 6 Wire wrapped 9 Drilled holes 11 None (open hole)
2 Louvered shutter 4 Key punched 7 Torch cut 10 Other (specify)
SCREEN-PERFORATED INTERVALS: From 39 ft. to 44 ft., From ft. to ft.
From ft. to ft., From ft. to ft.
GRAVEL PACK INTERVALS: From 34 ft. to 44 ft., From ft. to ft.
From ft. to ft., From ft. to ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite HOLE PLUG
Grout Intervals: From 0 ft. to 34 ft., From ft. to ft., From ft. to ft.
What is the nearest source of possible contamination:
1 Septic tank 4 Lateral lines 7 Pit privy 10 Livestock pens 14 Abandoned water well
2 Sewer lines 5 Cess pool 8 Sewage lagoon 11 Fuel storage 15 Oil well/Gas well
3 Watertight sewer lines 6 Seepage pit 9 Feedyard 12 Fertilizer storage 16 Other (specify below)
13 Insecticide storage Storm water disposal pond/sand pit pond
Direction from well? West How many feet? 20

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	4	Topsoil			
4	10	Fine Sand			
10	20	Coa/rse Sand			
20	30	Medium to Coarse Sand			
30	40	Medium Sand			
40	44	Very Coarse Sand and Gravel			
44	49	Gray Shale			

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 6-21-91 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 236 This Water Well Record was completed on (mo/day/yr) 7-1-91
under the business name of Harp Well & Pump Service, Inc. by (signature) Mary Arnold

INSTRUCTIONS: Use typewriter or ball point pen. *PLEASE PRESS FIRMLY* and *PRINT* clearly. Please fill in blanks, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66620-7320. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

OFFICE USE ONLY T R E/W SEC. ¼ ¼ ¼

well # EB-131A

WATER WELL RECORD

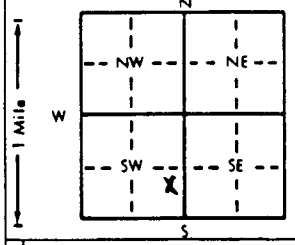
Form WWC-5 KSA 82a-1212

1 LOCATION OF WATER WELL:	Fraction	Section Number	Township Number	Range Number
County: Sedgwick	NEc ¼ SE ¼ SW ¼	19	T 26 S	R 1 E E/W

Distance and direction from nearest town or city street address of well if located within city? Miles Sand Co., 4852 No. Meridian, Wichita, ~~KS. 67204, approx. .75 mi So, of 53rd St. No. & .5 mi. E. of Meridian on E side of lake.~~

2 WATER WELL OWNER: Ground Water Management District II
RR#, St. Address, Box # : 313 Spruce, Halstead, KS. 67056
City, State, ZIP Code :
Board of Agriculture, Division of Water Resources Application Number:

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL 28.5 ft. ELEVATION: APPROX. 1328
Depth(s) Groundwater Encountered 1. ..... ft. 2. ..... ft. 3. ..... ft.
WELL'S STATIC WATER LEVEL 17 ft. below land surface measured on mo/day/yr 6-20-91
Pump test data: Well water was ..... ft. after ..... hours pumping ..... gpm
Est. Yield ..... gpm: Well water was ..... ft. after ..... hours pumping ..... gpm
Bore Hole Diameter 9" O.D. in ~~4½"~~ HOLLOW STEM AUGER ..... in. to ..... ft.
WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well
1 Domestic 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below)
2 Irrigation 4 Industrial 7 Lawn and garden only 10 Monitoring well .....
Was a chemical/bacteriological sample submitted to Department? Yes ..... No X ; If yes, mo/day/yr sample was submitted ..... Water Well Disinfected? Yes ..... No X

5 TYPE OF BLANK CASING USED: 5 Wrought iron 8 Concrete tile CASING JOINTS: Glued ..... Clamped .....
1 Steel 3 RMP (SR) 6 Asbestos-Cement 9 Other (specify below) ..... Welded .....
2 PVC sch 40 4 ABS 7 Fiberglass ..... Threaded Flush Joint
Blank casing diameter 2 in. to 23.5 ft., Dia ..... in. to ..... ft., Dia ..... in. to ..... ft.
Casing height above land surface 36 in., weight .703 lbs./ft. Wall thickness or gauge No. .154
TYPE OF SCREEN OR PERFORATION MATERIAL: 7 PVC sch 40 10 Asbestos-cement
1 Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 11 Other (specify) .....
2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS 12 None used (open hole)
SCREEN OR PERFORATION OPENINGS ARE: 5 Gauzed wrapped 8 Saw cut 20 slot 11 None (open hole)
1 Continuous slot 3 Mill slot 6 Wire wrapped 9 Drilled holes
2 Louvered shutter 4 Key punched 7 Torch cut 10 Other (specify) .....
SCREEN-PERFORATED INTERVALS: From 23.5 ft. to 28.5 ft., From ..... ft. to ..... ft.
From ..... ft. to ..... ft., From ..... ft. to ..... ft.
GRAVEL PACK INTERVALS: From 15. ft. to 28.5 ft., From ..... ft. to ..... ft.
From ..... ft. to ..... ft., From ..... ft. to ..... ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite HOLE PLUG .....
Grout Intervals: From 0 ft. to 12.3 ft., From ..... ft. to ..... ft., From ..... ft. to ..... ft.
What is the nearest source of possible contamination:
1 Septic tank 4 Lateral lines 7 Pit privy 10 Livestock pens 14 Abandoned water well
2 Sewer lines 5 Cess pool 8 Sewage lagoon 11 Fuel storage 15 Oil well/Gas well
3 Watertight sewer lines 6 Seepage pit 9 Feedyard 12 Fertilizer storage 16 Other (specify below)
13 Insecticide storage SAND PIT POND
Direction from well? WEST How many feet? 30

FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
		SEE SCHEDULE ATTACHED 1			

7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 6-20-91 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 236 This Water Well Record was completed on (mo/day/yr) 7-1-91
under the business name of Harp Well & Pump Service, Inc. by (signature) Mary Arnold

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OFFICE USE ONLY T R E/W SEC. ¼ ¼ ¼

EQUUS BEDS GROUNDWATER MANAGEMENT DISTRICT NO. 2

DRILLER'S LOG AND WELL RECORD FIELD SHEET

Well No. EB-131A

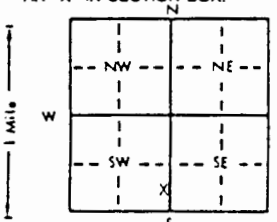
1 LOCATION OF WATER WELL: County: Sedgwick | Fraction: NEc SE ¼ SW ¼ | Section Number: 19 | Township Number: T 26 S | Range Number: R 1E E

Distance and direction from nearest town or city street address of well if located within city? Miles Sand Co., 4852 North Meridian, Wichita 67204

Approx. 0.75 mi. S. of 53rd St. North and 0.5 mi. E. of Meridian on E side of lake.

2 WATER WELL OWNER:
RR#, St. Address, Box # : Ground Water Management District II
City, State, ZIP Code : 313 Spruce, Halstead, Kansas 67056
Board of Agriculture, Division of Water Resources Application Number: N/A

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:



4 DEPTH OF COMPLETED WELL 28.5 ft. ELEVATION: Approx. 1328

Depth(s) Groundwater Encountered 1. ..... ft. 2. ..... ft. 3. ..... ft.

WELL'S STATIC WATER LEVEL ..... ft. below land surface measured on mo/day/yr .....

Pump test data: Well water was ..... ft. after ..... hours pumping ..... gpm

Est. Yield ..... gpm: Well water was ..... ft. after ..... hours pumping ..... gpm

Bore Hole Diameter ..... in. to ..... ft., and ..... in. to ..... ft.

WELL WATER TO BE USED AS: 1 Domestic 2 Irrigation 3 Feedlot 4 Industrial 5 Public water supply 6 Oil field water supply 7 Lawn and garden only 8 Air conditioning 9 Dewatering (10 Observation well) 11 Injection well 12 Other (Specify below) .....

Was a chemical/bacteriological sample submitted to Department? Yes ..... No ...X... If yes, mo/day/yr sample was submitted ..... Water Well Disinfected? Yes ..... No .....

5 TYPE OF BLANK CASING USED: 1 Steel (2 PVC) 3 RMP (SR) 4 ABS 5 Wrought iron 6 Asbestos-Cement 7 Fiberglass 8 Concrete tile 9 Other (specify below) .....

CASING JOINTS: Glued ..... Clamped ..... Welded ..... (Threaded) .....

Blank casing diameter ..... in. to ..... ft., Dia ..... in. to ..... ft., Dia ..... in. to ..... ft.

Casing height above land surface 36 in., weight ..... lbs./ft. Wall thickness or gauge No. .....

TYPE OF SCREEN OR PERFORATION MATERIAL: (7 PVC) 1 Steel 2 Brass 3 Stainless steel 4 Galvanized steel 5 Fiberglass 6 Concrete tile 8 RMP (SR) 9 ABS 10 Asbestos-cement 11 Other (specify) ..... 12 None used (open hole)

SCREEN OR PERFORATION OPENINGS ARE: (1 Continuous slot) 2 Louvered shutter 3 Mill slot 4 Key punched 5 Gauzed wrapped 6 Wire wrapped 7 Torch cut 8 Saw cut 9 Drilled holes 10 Other (specify) ..... 11 None (open hole)

SCREEN-PERFORATED INTERVALS: From 28.5 ft. to 23.5 ft., From ..... ft. to ..... ft.

From ..... ft. to ..... ft., From ..... ft. to ..... ft.

GRAVEL PACK INTERVALS: From 28.5 ft. to 15.0 ft., From ..... ft. to ..... ft.

Colorado Silica Sand From ..... ft. to ..... ft., From ..... ft. to ..... ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout (3 Bentonite) 4 Other .....

Grout Intervals: From 12.3 ft. to surface ft., From ..... ft. to ..... ft., From ..... ft. to ..... ft.

What is the nearest source of possible contamination:
1 Septic tank 2 Sewer lines 3 Watertight sewer lines 4 Lateral lines 5 Cess pool 6 Seepage pit 7 Pit privy 8 Sewage lagoon 9 Feedyard 10 Livestock pens 11 Fuel storage 12 Fertilizer storage 13 Insecticide storage 14 Abandoned water well 15 Oil well/Gas well 16 Other (specify below) Sand pit pond

Direction from well? West How many feet? 30 ft.

FROM	TO	LITHOLOGIC LOG
0	3	Dark-brn, sandy, silt. Qtz grains range from 0.1 & smaller to 0.2 mm. Lightly stained with Fe_2O_3. Grains angular to rounded. Non-calc. Less than 0.5% mica. Color lightens below 18 inches. There are a few ± 1%, qtz grains up to 3 mm diam.
3	8	Yellow to tan, poorly sorted sand/pebble mixture. Predominately qtz, less 1% ea. mica and feldspar. Smaller grains angular to subangular. Larger round to sub-rd & frosted. Pebbles are qtz, few granite & sandstone. Avg size range of sand 0.1 to 0.5 mm, pebbles from 5 to 10-15 mm. Contains unmeasured amount of silt-size silica particles.
8	13	Tan qtz sand ranging from approx 0.5 to 2.0 mm diam. Angular to sub-rd, frosted to transparant, pebbles to 18 mm, comp. of granite, qtz, ss. Pebbles rounded, smooth, comprise perhaps 15-20% by vol. of sample, Non-calc. Some mica.
13	18	Tan qtz sand predom, 0.25 to 1.5 mm diam. Cherty qtz pebbles to 14 mm constitute less than 5% by vol. One mm size qtz grain shows etched XL faces, poss. authigenic qtz. Less than 1% ang. black-coated grains, either Mn or Fe stain. Some sand-size feldspar, lg, & meta rock grains.
18	23	Similar to 13-18

(Over)

7 COMPLETION:

Date Well Completed: 20 ... 5 ... 1991

Site Geologist ..... Signature .....

Lawrence H. Shelton

AR-86-2 ..... USE BACK OF SHEET FOR ADDITIONAL REMARKS .....

23	28	Similar to 18-23. Fewer pebbles, sand-size fraction increasing.
28	33	Well-sorted, light-tan , angular to rounded quartz sand, avg. 0.25 to 1.0 mm diam. Fewer pebbles. A few 0.2 mm diam mica flakes

Appendix C: Analytical Data for Volatile Organic Compounds in Water Samples

Project Number: EQB01.EQB01
Storm Water Disposal Study
Work Order Number: X1-07-948
Date Reported: 08-09-91

Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02		
Client Identification		Fox Meadows #1	Miles Sand #2		
Date Sampled		07-24-91	07-24-91		
Date Analyzed		08-01-91	08-01-91		
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
Chloromethane	10	<10	<10		
Bromomethane	10	<10	<10		
Vinyl Chloride	10	<10	<10		
Chloroethane	10	<10	<10		
Methylene Chloride	5	<5	<5		
Acetone	100	<100	<100		
Carbon Disulfide	5	<5	<5		
1,1-Dichloroethene	5	<5	<5		
1,1-Dichloroethane	5	<5	<5		
1,2-Dichloroethene (total)	5	<5	<5		
Chloroform	5	<5	<5		
1,2-Dichloroethane	5	<5	<5		
2-Butanone	100	<100	<100		
1,1,1-Trichloroethane	5	<5	<5		
Carbon Tetrachloride	5	<5	<5		
Vinyl Acetate	50	<50	<50		
Bromodichloromethane	5	<5	<5		
1,2-Dichloropropane	5	<5	<5		
cis-1,3-Dichloropropene	5	<5	<5		
Trichloroethene	5	<5	<5		
Dibromochloromethane	5	<5	<5		

Table 1 continued on next page, footnotes at end of table

Table 1 (continued)

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02		
Client Identification		Fox Meadows #1	Miles Sand #2		
Date Sampled		07-24-91	07-24-91		
Date Analyzed		08-01-91	08-01-91		
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
1,1,2-Trichloroethane	5	<5	<5		
Benzene	5	<5	<5		
2-Chloroethylvinyl Ether	10	<10	<10		
trans-1,3-Dichloropropene	5	<5	<5		
Bromoform	5	<5	<5		
4-Methyl-2-Pentanone	50	<50	<50		
2-Hexanone	50	<50	<50		
Tetrachloroethene	5	<5	<5		
1,1,2,2-Tetrachloroethane	5	<5	<5		
Toluene	5	<5	**1 J**		
Chlorobenzene	5	<5	<5		
Ethylbenzene	5	<5	<5		
Styrene	5	<5	<5		
Xylenes (total)	5	<5	<5		
1,2-Dichlorobenzene	5	<5	<5		
1,3-Dichlorobenzene	5	<5	<5		
1,4-Dichlorobenzene	5	<5	<5		
PQL Multiplier[e]		1	1		

Table 1 continued on next page, footnotes at end of table

Footnotes to Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
EPA Method 8240[a]

a Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, Table 2, US EPA November 1986; sample preparation per EPA Method 5030.

b Practical quantitation limit.

c Data Flag Definitions

J Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the quantitation limit, but greater than zero, or when reporting an estimated concentration for a tentatively identified compound.

B Indicates that the analyte was found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

e Indicates the adjustments made for sample dilution.

Project Number: EQB01.EQB01
Storm Water Disposal
Pond Study
Work Order Number: X1-08-409
Date Reported: 08-19-91

Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02		
Client Identification		EB121-A	EB131-A		
Date Sampled		08-09-91	08-09-91		
Date Analyzed		08-14-91	08-14-91		
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
Chloromethane	10	<10	<10		
Bromomethane	10	<10	<10		
Vinyl Chloride	10	<10	<10		
Chloroethane	10	<10	<10		
Methylene Chloride	5	<5	<5		
Acetone	100	<100	<100		
Carbon Disulfide	5	<5	<5		
1,1-Dichloroethene	5	<5	<5		
1,1-Dichloroethane	5	<5	<5		
1,2-Dichloroethene (total)	5	<5	<5		
Chloroform	5	<5	<5		
1,2-Dichloroethane	5	<5	<5		
2-Butanone	100	<100	<100		
1,1,1-Trichloroethane	5	<5	<5		
Carbon Tetrachloride	5	<5	<5		
Vinyl Acetate	50	<50	<50		
Bromodichloromethane	5	<5	<5		
1,2-Dichloropropane	5	<5	<5		
cis-1,3-Dichloropropene	5	<5	<5		
Trichloroethene	5	<5	<5		
Dibromochloromethane	5	<5	<5		

Table 1 continued on next page, footnotes at end of table

Project Number: EQB01.EQB01
Storm Water Disposal
Pond Study
Work Order Number: X1-08-409
Date Reported: 08-19-91

Table 1 (continued)

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02		
Client Identification		EB121-A	EB131-A		
Date Sampled		08-09-91	08-09-91		
Date Analyzed		08-14-91	08-14-91		
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
1,1,2-Trichloroethane	5	<5	<5		
Benzene	5	<5	<5		
2-Chloroethylvinyl Ether	10	<10	<10		
trans-1,3-Dichloropropene	5	<5	<5		
Bromoform	5	<5	<5		
4-Methyl-2-Pentanone	50	<50	<50		
2-Hexanone	50	<50	<50		
Tetrachloroethene	5	<5	<5		
1,1,2,2-Tetrachloroethane	5	<5	<5		
Toluene	5	<5	<5		
Chlorobenzene	5	<5	<5		
Ethylbenzene	5	<5	<5		
Styrene	5	<5	<5		
Xylenes (total)	5	<5	<5		
1,2-Dichlorobenzene	5	<5	<5		
1,3-Dichlorobenzene	5	<5	<5		
1,4-Dichlorobenzene	5	<5	<5		
PQL Multiplier[e]		1	1		

Table 1 continued on next page, footnotes at end of table

Footnotes to Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
EPA Method 8240[a]

a Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, Table 2, US EPA November 1986; sample preparation per EPA Method 5030.

b Practical quantitation limit.

c Data Flag Definitions

J Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the quantitation limit, but greater than zero, or when reporting an estimated concentration for a tentatively identified compound.

B Indicates that the analyte was found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

e Indicates the adjustments made for sample dilution.

Project Number: EQB01.EQB01
Storm Water Disposal
Pond Study
Work Order Number: X1-08-274
Date Reported: 08-19-91

Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01			
Client Identification		EB122A			
Date Sampled		08-08-91			
Date Analyzed		08-15-91			
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
Chloromethane	10	<10			
Bromomethane	10	<10			
Vinyl Chloride	10	<10			
Chloroethane	10	<10			
Methylene Chloride	5	<5			
Acetone	100	<100			
Carbon Disulfide	5	<5			
1,1-Dichloroethene	5	<5			
1,1-Dichloroethane	5	<5			
1,2-Dichloroethene (total)	5	<5			
Chloroform	5	<5			
1,2-Dichloroethane	5	<5			
2-Butanone	100	<100			
1,1,1-Trichloroethane	5	<5			
Carbon Tetrachloride	5	<5			
Vinyl Acetate	50	<50			
Bromodichloromethane	5	<5			
1,2-Dichloropropane	5	<5			
cis-1,3-Dichloropropene	5	<5			
Trichloroethene	5	<5			
Dibromochloromethane	5	<5			

Table 1 continued on next page, footnotes at end of table

Project Number: EQB01.EQB01
Storm Water Disposal
Pond Study
Work Order Number: X1-08-274
Date Reported: 08-19-91

Table 1 (continued)

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01			
Client Identification		EB122A			
Date Sampled		08-08-91			
Date Analyzed		08-15-91			
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
1,1,2-Trichloroethane	5	<5			
Benzene	5	<5			
2-Chloroethylvinyl Ether	10	<10			
trans-1,3-Dichloropropene	5	<5			
Bromoform	5	<5			
4-Methyl-2-Pentanone	50	<50			
2-Hexanone	50	<50			
Tetrachloroethene	5	<5			
1,1,2,2-Tetrachloroethane	5	<5			
Toluene	5	<5			
Chlorobenzene	5	<5			
Ethylbenzene	5	<5			
Styrene	5	<5			
Xylenes (total)	5	<5			
1,2-Dichlorobenzene	5	<5			
1,3-Dichlorobenzene	5	<5			
1,4-Dichlorobenzene	5	<5			
PQL Multiplier[e]		1			

Table 1 continued on next page, footnotes at end of table

Footnotes to Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
EPA Method 8240[a]

a Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, Table 2, US EPA November 1986; sample preparation per EPA Method 5030.

b Practical quantitation limit.

c Data Flag Definitions

J Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the quantitation limit, but greater than zero, or when reporting an estimated concentration for a tentatively identified compound.

B Indicates that the analyte was found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

e Indicates the adjustments made for sample dilution.

Project Number: EQB01.EQB01
Storm Water Disposal
Pond Study
Work Order Number: X1-08-276
Date Reported: 08-19-91

Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01			
Client Identification		EB130A			
Date Sampled		08-09-91			
Date Analyzed		08-15-91			
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
Chloromethane	10	<10			
Bromomethane	10	<10			
Vinyl Chloride	10	<10			
Chloroethane	10	<10			
Methylene Chloride	5	<5			
Acetone	100	<100			
Carbon Disulfide	5	<5			
1,1-Dichloroethene	5	<5			
1,1-Dichloroethane	5	<5			
1,2-Dichloroethene (total)	5	<5			
Chloroform	5	<5			
1,2-Dichloroethane	5	<5			
2-Butanone	100	<100			
1,1,1-Trichloroethane	5	<5			
Carbon Tetrachloride	5	<5			
Vinyl Acetate	50	<50			
Bromodichloromethane	5	<5			
1,2-Dichloropropane	5	<5			
cis-1,3-Dichloropropene	5	<5			
Trichloroethene	5	<5			
Dibromochloromethane	5	<5			

Table 1 continued on next page, footnotes at end of table

Project Number: EQB01.EQB01
Storm Water Disposal
Pond Study
Work Order Number: X1-08-276
Date Reported: 08-19-91
Date Reissued: 08-30-91

Table 1 (continued)

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01			
Client Identification		EB130A			
Date Sampled		08-09-91			
Date Analyzed		08-15-91			
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
1,1,2-Trichloroethane	5	<5			
Benzene	5	<5			
2-Chloroethylvinyl Ether	10	<10			
trans-1,3-Dichloropropene	5	<5			
Bromoform	5	<5			
4-Methyl-2-Pentanone	50	<50			
2-Hexanone	50	<50			
Tetrachloroethene	5	<5			
1,1,2,2-Tetrachloroethane	5	<5			
Toluene	5	<5			
Chlorobenzene	5	<5			
Ethylbenzene	5	<5			
Styrene	5	<5			
Xylenes (total)	5	<5			
1,2-Dichlorobenzene	5	<5			
1,3-Dichlorobenzene	5	<5			
1,4-Dichlorobenzene	5	<5			
PQL Multiplier[e]		1			

Table 1 continued on next page, footnotes at end of table

Project Number: EQB01.EQB01
Storm Water Disposal
Pond Study
Work Order Number: X1-08-276
Date Reported: 08-19-91

Footnotes to Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
EPA Method 8240[a]

a Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, Table 2, US EPA November 1986; sample preparation per EPA Method 5030.

b Practical quantitation limit.

c Data Flag Definitions

J Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the quantitation limit, but greater than zero, or when reporting an estimated concentration for a tentatively identified compound.

B Indicates that the analyte was found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

e Indicates the adjustments made for sample dilution.

Project Number: EQB01.EQB01
Storm Water Disposal
Pond Study
Work Order Number: X1-08-A05
Date Reported: 09-18-91

Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02		
Client Identification		Fox Meadows #1	Miles Ditch #1		
Date Sampled		08-28-91	08-28-91		
Date Analyzed		09-10-91	09-10-91		
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
Chloromethane	10	<10	<10		
Bromomethane	10	<10	<10		
Vinyl Chloride	10	<10	<10		
Chloroethane	10	<10	<10		
Methylene Chloride	5	<5	<5		
Acetone	100	<100	<100		
Carbon Disulfide	5	<5	<5		
1,1-Dichloroethene	5	<5	<5		
1,1-Dichloroethane	5	<5	<5		
1,2-Dichloroethene (total)	5	<5	<5		
Chloroform	5	<5	<5		
1,2-Dichloroethane	5	<5	<5		
2-Butanone	100	<100	<100		
1,1,1-Trichloroethane	5	<5	<5		
Carbon Tetrachloride	5	<5	<5		
Vinyl Acetate	50	<50	<50		
Bromodichloromethane	5	<5	<5		
1,2-Dichloropropane	5	<5	<5		
cis-1,3-Dichloropropene	5	<5	<5		
Trichloroethene	5	<5	<5		
Dibromochloromethane	5	<5	<5		

Table 1 continued on next page, footnotes at end of table

Project Number: EQB01.EQB01
Storm Water Disposal
Pond Study
Work Order Number: X1-08-A05
Date Reported: 09-18-91

Table 1 (continued)

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02		
Client Identification		Fox Meadows #1	Miles Ditch #1		
Date Sampled		08-28-91	08-28-91		
Date Analyzed		09-10-91	09-10-91		
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
1,1,2-Trichloroethane	5	<5	<5		
Benzene	5	<5	<5		
2-Chloroethylvinyl Ether	10	<10	<10		
trans-1,3-Dichloropropene	5	<5	<5		
Bromoform	5	<5	<5		
4-Methyl-2-Pentanone	50	<50	<50		
2-Hexanone	50	<50	<50		
Tetrachloroethene	5	<5	<5		
1,1,2,2-Tetrachloroethane	5	<5	<5		
Toluene	5	<5	<5		
Chlorobenzene	5	<5	<5		
Ethylbenzene	5	<5	<5		
Styrene	5	<5	<5		
Xylenes (total)	5	<5	<5		
1,2-Dichlorobenzene	5	<5	<5		
1,3-Dichlorobenzene	5	<5	<5		
1,4-Dichlorobenzene	5	<5	<5		
PQL Multiplier[e]		1	1		

Table 1 continued on next page, footnotes at end of table

Footnotes to Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
EPA Method 8240[a]

a Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, Table 2, US EPA November 1986; sample preparation per EPA Method 5030.

b Practical quantitation limit.

c Data Flag Definitions

J Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the quantitation limit, but greater than zero, or when reporting an estimated concentration for a tentatively identified compound.

B Indicates that the analyte was found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

e Indicates the adjustments made for sample dilution.

Project Number: EQB01.EQB01
Storm Water Disposal Pond Study
Work Order Number: X1-09-406
Date Reported: 09-26-91

Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02	03	04
Client Identification		EB 131-A	EB 130-A	EB 122-A	EB 121-A
Date Sampled		09-13-91	09-13-91	09-13-91	09-12-91
Date Analyzed		09-18-91	09-18-91	09-18-91	09-19-91
Analyte	PQL, ug/L[b]	Concentration, ug/L[c]			
Chloromethane	10	<10	<10	<10	<10
Bromomethane	10	<10	<10	<10	<10
Vinyl Chloride	10	<10	<10	<10	<10
Chloroethane	10	<10	<10	<10	<10
Methylene Chloride	5	**4 JX**	<5	<5	<5
Acetone	100	<100	<100	<100	<100
Carbon Disulfide	5	<5	<5	<5	<5
1 ,1-Dichloroethene	5	<5	<5	<5	<5
1,1-Dichloroethane	5	<5	<5	<5	<5
1,2-Dichloroethene (total)	5	<5	<5	<5	<5
Chloroform	5	<5	<5	<5	<5
1,2-Dichloroethane	5	<5	<5	<5	<5
2-Butanone	100	<100	<100	<100	<100
1,1,1-Trichloroethane	5	<5	<5	<5	<5
Carbon Tetrachloride	5	<5	<5	<5	<5
Vinyl Acetate	50	<50	<50	<50	<50
Bromodichloromethane	5	<5	<5	<5	<5
1,2-Dichloropropane	5	<5	<5	<5	<5
cis-1,3-Dichloropropene	5	<5	<5	<5	<5
Trichloroethene	5	<5	<5	<5	<5
Dibromochloromethane	5	<5	<5	<5	<5

Table 1 continued on next page, footnotes at end of table

Project Number: EQB01.EQB01
Storm Water Disposal Pond Study
Work Order Number: X1-09-406
Date Reported: 09-26-91

Table 1 (continued)

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02	03	04
Client Identification		EB 131-A	EB 130-A	EB 122-A	EB 121-A
Date Sampled		09-13-91	09-13-91	09-13-91	09-12-91
Date Analyzed		09-18-91	09-18-91	09-18-91	09-19-91
Analyte	PQL ug/L[b]	Concentration, ug/L[c]			
1,1,2-Trichloroethane	5	<5	<5	<5	<5
Benzene	5	<5	<5	<5	<5
2-Chloroethylvinyl Ether	10	<10	<10	<10	<10
trans-1,3-Dichloropropene	5	<5	<5	<5	<5
Bromoform	5	<5	<5	<5	<5
4-Methyl-2-Pentanone	50	<50	<50	<50	<50
2-Hexanone	50	<50	<50	<50	<50
Tetrachloroethene	5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	5	<5	<5	<5	<5
Toluene	5	<5	<5	<5	<5
Chlorobenzene	5	<5	<5	<5	<5
Ethylbenzene	5	<5	<5	<5	<5
Styrene	5	<5	<5	<5	<5
Xylenes (total)	5	<5	<5	<5	<5
1,2-Dichlorobenzene	5	<5	<5	<5	<5
1,3-Dichlorobenzene	5	<5	<5	<5	<5
1,4-Dichlorobenzene	5	<5	<5	<5	<5
PQL Multiplier[e]		1	1	1	1

Table 1 continued on next page, footnotes at end of table

Footnotes to Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
EPA Method 8240[a]

a Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, Table 2, US EPA November 1986; sample preparation per EPA Method 5030.

b Practical quantitation limit.

c Data Flag Definitions

- J Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the quantitation limit, but greater than zero, or when reporting an estimated concentration for a tentatively identified compound.
- B Indicates that the analyte was found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.
- X Indicates compound was not found in the blank, but it is a common laboratory contaminant and warns the data user to take appropriate action.

e Indicates the adjustments made for sample dilution.

Project Number: EQB01.EQB01
Storm Water Pond
Disposal Study
Work Order Number: X2-05-726
Date Reported: 06-02-92

Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02		
Client Identification		Miles Sandpit Drainage Ditch	Fox Meadow Drainage Pond		
Date Sampled		05-15-92	05-15-92		
Date Analyzed		05-27-92	05-27-92		
Analyte	PQL ug/L[b]	Concentration, ug/L[c]			
Chloromethane	10	<10	<10		
Bromomethane	10	<10	<10		
Vinyl Chloride	10	<10	<10		
Chloroethane	10	<10	<10		
Methylene Chloride	5	<5	<5		
Acetone	100	**10 J**	**6 J**		
Carbon Disulfide	5	<5	<5		
1,1-Dichloroethene	5	<5	<5		
1,1-Dichloroethane	5	<5	<5		
1,2-Dichloroethene (total)	5	<5	<5		
Chloroform	5	<5	<5		
1,2-Dichloroethane	5	<5	<5		
2-Butanone	100	<100	<100		
1,1,1-Trichloroethane	5	<5	<5		
Carbon Tetrachloride	5	<5	<5		
Vinyl Acetate	50	<50	<50		
Bromodichloromethane	5	<5	<5		
1,2-Dichloropropane	5	<5	<5		
cis-1,3-Dichloropropene	5	<5	<5		
Trichloroethene	5	<5	<5		
Dibromochloromethane	5	<5	<5		

Table 1 continued on next page, footnotes at end of table

Project Number: EQB01.EQB01
Storm Water Pond
Disposal Study
Work Order Number: X2-05-726
Date Reported: 06-02-92

Table 1 (continued)

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02		
Client Identification		Miles Sandpit Drainage Ditch	Fox Meadow Drainage Pond		
Date Sampled		05-15-92	05-15-92		
Date Analyzed		05-27-92	05-27-92		
Analyte	PQL ug/L[b]	Concentration, ug/L[c]			
1,1,2-Trichloroethane	5	<5	<5		
Benzene	5	<5	<5		
2-Chloroethylvinyl Ether	10	<10	<10		
trans-1,3-Dichloropropene	5	<5	<5		
Bromoform	5	<5	<5		
4-Methyl-2-Pentanone	50	<50	<50		
2-Hexanone	50	<50	<50		
Tetrachloroethene	5	<5	<5		
1,1,2,2-Tetrachloroethane	5	<5	<5		
Toluene	5	<5	<5		
Chlorobenzene	5	<5	<5		
Ethylbenzene	5	<5	<5		
Styrene	5	<5	<5		
Xylenes (total)	5	<5	<5		
1,2-Dichlorobenzene	5	<5	<5		
1,3-Dichlorobenzene	5	<5	<5		
1,4-Dichlorobenzene	5	<5	<5		
PQL Multiplier[e]		1	1		

Table 1 continued on next page, footnotes at end of table

Footnotes to Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
EPA Method 8240[a]

a Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, Table 2, US EPA November 1986; sample preparation per EPA Method 5030.

b Practical quantitation limit.

c Data Flag Definitions

J Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the quantitation limit, but greater than zero, or when reporting an estimated concentration for a tentatively identified compound.

B Indicates that the analyte was found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

e Indicates the adjustments made for sample dilution.

NOTE: Sample temperature when received at the laboratory was 5 °C.

Project Number: EQB01.EQB01
Storm Water Disposal Study
Work Order Number: X2-05-C97
Date Reported: 06-04-92

Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02	03	04
Client Identification		EB-130-A	EB-131-A	EB-121-A	EB-122-A
Date Sampled		05-28-92	05-28-92	05-29-92	05-29-92
Date Analyzed		06-02-92	06-02-92	06-02-92	06-02-92
Analyte	PQL ug/L[b]	Concentration, ug/L[c]			
Chloromethane	10	<10	<10	<10	<10
Bromomethane	10	<10	<10	<10	<10
Vinyl Chloride	10	<10	<10	<10	<10
Chloroethane	10	<10	<10	<10	<10
Methylene Chloride	5	<5	<5	<5	<5
Acetone	100	<100	<100	<100	<100
Carbon Disulfide	5	<5	<5	<5	<5
1,1-Dichloroethene	5	<5	<5	<5	<5
1,1-Dichloroethane	5	<5	<5	<5	<5
1,2-Dichloroethene (total)	5	<5	<5	<5	<5
Chloroform	5	<5	<5	<5	<5
1,2-Dichloroethane	5	<5	<5	<5	<5
2-Butanone	100	<100	<100	<100	<100
1,1,1-Trichloroethane	5	<5	<5	<5	<5
Carbon Tetrachloride	5	<5	<5	<5	<5
Vinyl Acetate	50	<50	<50	<50	<50
Bromodichloromethane	5	<5	<5	<5	<5
1,2-Dichloropropane	5	<5	<5	<5	<5
cis-1,3-Dichloropropene	5	<5	<5	<5	<5
Trichloroethene	5	<5	<5	<5	<5
Dibromochloromethane	5	<5	<5	<5	<5

Table 1 continued on next page, footnotes at end of table

Project Number: EQB01.EQB01
Storm Water Disposal Study
Work Order Number: X2-05-C97
Date Reported: 06-04-92

Table 1 (continued)

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02	03	04
Client Identification		EB-130-A	EB-131-A	EB-121-A	EB-122-A
Date Sampled		05-28-92	05-28-92	05-29-92	05-29-92
Date Analyzed		06-02-92	06-02-92	06-02-92	06-02-92
Analyte	PQL ug/L[b]	Concentration, ug/L[c]			
1,1,2-Trichloroethane	5	<5	<5	<5	<5
Benzene	5	<5	<5	<5	<5
2-Chloroethylvinyl Ether	10	<10	<10	<10	<10
trans-1,3-Dichloropropene	5	<5	<5	<5	<5
Bromoform	5	<5	<5	<5	<5
4-Methyl-2-Pentanone	50	<50	<50	<50	<50
2-Hexanone	50	<50	<50	<50	<50
Tetrachloroethene	5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	5	<5	<5	<5	<5
Toluene	5	<5	<5	<5	<5
Chlorobenzene	5	<5	<5	<5	<5
Ethylbenzene	5	<5	<5	<5	<5
Styrene	5	<5	<5	<5	<5
Xylenes (total)	5	<5	<5	<5	<5
1,2-Dichlorobenzene	5	<5	<5	<5	<5
1,3-Dichlorobenzene	5	<5	<5	<5	<5
1,4-Dichlorobenzene	5	<5	<5	<5	<5
PQL Multiplier[e]		1	1	1	1

Table 1 continued on next page, footnotes at end of table

Footnotes to Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
EPA Method 8240[a]

a Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, Table 2, US EPA November 1986; sample preparation per EPA Method 5030.

b Practical quantitation limit.

c Data Flag Definitions

J Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the quantitation limit, but greater than zero, or when reporting an estimated concentration for a tentatively identified compound.

B Indicates that the analyte was found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

e Indicates the adjustments made for sample dilution.

NOTE: Sample temperature when received at the laboratory was 10 ^{o}C.

Project Number: EQB01.EQB01
Storm Water
Pond Disposal
Study
Work Order Number: X2-06-439
Date Reported: 07-06-92

Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02		
Client Identification		Miles Sand Pit	Fox Meadows Drain Pond		
Date Sampled		06-19-92	06-19-92		
Date Analyzed		06-26-92	06-26-92		
Analyte	PQL ug/L[b]	Concentration, ug/L[c]			
Chloromethane	10	<10	<10		
Bromomethane	10	<10	<10		
Vinyl Chloride	10	<10	<10		
Chloroethane	10	<10	<10		
Methylene Chloride	5	<5	<5		
Acetone	100	<100	<100		
Carbon Disulfide	5	<5	<5		
1,1-Dichloroethene	5	<5	<5		
1,1-Dichloroethane	5	<5	<5		
1,2-Dichloroethene (total)	5	<5	<5		
Chloroform	5	<5	<5		
1,2-Dichloroethane	5	<5	<5		
2-Butanone	100	<100	<100		
1,1,1-Trichloroethane	5	<5	<5		
Carbon Tetrachloride	5	<5	<5		
Vinyl Acetate	50	<50	<50		
Bromodichloromethane	5	<5	<5		
1,2-Dichloropropane	5	<5	<5		
cis-1,3-Dichloropropene	5	<5	<5		
Trichloroethene	5	<5	<5		
Dibromochloromethane	5	<5	<5		

Table 1 continued on next page, footnotes at end of table

Project Number: EQB01.EQB01
Storm Water
Pond Disposal
Study
Work Order Number: X2-06-439
Date Reported: 07-06-92

Table 1 (continued)

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02		
Client Identification		Miles Sand Pit	Fox Meadows Drain Pond		
Date Sampled		06-19-92	06-19-92		
Date Analyzed		06-26-92	06-26-92		
Analyte	PQL ug/L[b]	Concentration, ug/L[c]			
1,1,2-Trichloroethane	5	<5	<5		
Benzene	5	<5	<5		
2-Chloroethylvinyl Ether	10	<10	<10		
trans-1,3-Dichloropropene	5	<5	<5		
Bromoform	5	<5	<5		
4-Methyl-2-Pentanone	50	<50	<50		
2-Hexanone	50	<50	<50		
Tetrachloroethene	5	<5	<5		
1,1,2,2-Tetrachloroethane	5	<5	<5		
Toluene	5	<5	<5		
Chlorobenzene	5	<5	<5		
Ethylbenzene	5	<5	<5		
Styrene	5	<5	<5		
Xylenes (total)	5	<5	<5		
1,2-Dichlorobenzene	5	<5	<5		
1,3-Dichlorobenzene	5	<5	<5		
1,4-Dichlorobenzene	5	<5	<5		
PQL Multiplier[e]		1	1		

Table 1 continued on next page, footnotes at end of table

Footnotes to Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
EPA Method 8240[a]

a Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, Table 2, US EPA November 1986; sample preparation per EPA Method 5030.

b Practical quantitation limit.

c Data Flag Definitions

- J Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the quantitation limit, but greater than zero, or when reporting an estimated concentration for a tentatively identified compound.
- B Indicates that the analyte was found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

e Indicates the adjustments made for sample dilution.

NOTE: Sample temperature when received at the laboratory was 4 °C.

Project Number: EQB01.EQB01
Work Order Number: X2-07-103
Date Reported: 07-17-92

Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02	03	04
Client Identification		EB-130A	EB-131A	EB-121A	EB-122A
Date Sampled		07-06-92	07-06-92	07-07-92	07-07-92
Date Analyzed		07-08-92	07-08-92	07-08-92	07-08-92
Analyte	PQL ug/L[b]	Concentration, ug/L[c]			
Chloromethane	10	<10	<10	<10	<10
Bromomethane	10	<10	<10	<10	<10
Vinyl Chloride	10	<10	<10	<10	<10
Chloroethane	10	<10	<10	<10	<10
Methylene Chloride	5	<5	<5	<5	<5
Acetone	100	<100	<100	<100	<100
Carbon Disulfide	5	<5	<5	<5	<5
1,1-Dichloroethene	5	<5	<5	<5	<5
1,1-Dichloroethane	5	<5	<5	<5	<5
1,2-Dichloroethene (total)	5	<5	<5	<5	<5
Chloroform	5	<5	<5	<5	<5
1,2-Dichloroethane	5	<5	<5	<5	<5
2-Butanone	100	<100	<100	<100	<100
1,1,1-Trichloroethane	5	<5	<5	<5	<5
Carbon Tetrachloride	5	<5	<5	<5	<5
Vinyl Acetate	50	<50	<50	<50	<50
Bromodichloromethane	5	<5	<5	<5	<5
1,2-Dichloropropane	5	<5	<5	<5	<5
cis-1,3-Dichloropropene	5	<5	<5	<5	<5
Trichloroethene	5	<5	<5	<5	<5
Dibromochloromethane	5	<5	<5	<5	<5

Table 1 continued on next page, footnotes at end of table

Table 1 (continued)

ANALYTICAL RESULTS

Volatile Organics in Water
Modified EPA Method 8240[a]

GTEL Sample Number		01	02	03	04
Client Identification		EB-130A	EB-131A	EB-121A	EB-122A
Date Sampled		07-06-92	07-06-92	07-07-92	07-07-92
Date Analyzed		07-08-92	07-08-92	07-08-92	07-08-92
Analyte	PQL ug/L[b]	Concentration, ug/L[c]			
1,1,2-Trichloroethane	5	<5	<5	<5	<5
Benzene	5	<5	<5	<5	<5
2-Chloroethylvinyl Ether	10	<10	<10	<10	<10
trans-1,3-Dichloropropene	5	<5	<5	<5	<5
Bromoform	5	<5	<5	<5	<5
4-Methyl-2-Pentanone	50	<50	<50	<50	<50
2-Hexanone	50	<50	<50	<50	<50
Tetrachloroethene	5	<5	<5	<5	<5
1,1,2,2-Tetrachloroethane	5	<5	<5	<5	<5
Toluene	5	<5	<5	<5	<5
Chlorobenzene	5	<5	<5	<5	<5
Ethylbenzene	5	<5	<5	<5	<5
Styrene	5	<5	<5	<5	<5
Xylenes (total)	5	<5	<5	<5	<5
1,2-Dichlorobenzene	5	<5	<5	<5	<5
1,3-Dichlorobenzene	5	<5	<5	<5	<5
1,4-Dichlorobenzene	5	<5	<5	<5	<5
PQL Multiplier[e]		1	1	1	1

Table 1 continued on next page, footnotes at end of table

Footnotes to Table 1

ANALYTICAL RESULTS

Volatile Organics in Water
EPA Method 8240[a]

a Test Methods for Evaluating Solid Waste, SW-846, Third Edition, Revision 0, Table 2, US EPA November 1986; sample preparation per EPA Method 5030.

b Practical quantitation limit.

c Data Flag Definitions

J Indicates an estimated value. This flag is used when the mass spectral data indicates the presence of a compound that meets the identification criteria but the result is less than the quantitation limit, but greater than zero, or when reporting an estimated concentration for a tentatively identified compound.

B Indicates that the analyte was found in the blank as well as a sample. It indicates possible/probable blank contamination and warns the data user to take appropriate action.

e Indicates the adjustments made for sample dilution.

NOTE: Sample temperature when received at the laboratory was 8 ^{o}C.

Appendix D: Analytical Data for Pesticides in Water Samples

Project Number: EQB01.EQB01
Storm Water
Disposal Pond Study
Work Order Number: X1-08-275
Date Reported: 08-27-91

Table 1

ANALYTICAL RESULTS
Triazine Herbicides in Water
EPA Method 507[a]

GTEL Sample Number		01			
Client Identification		EB122A			
Date Sampled		08-08-91			
Date Received		08-09-91			
Date Extracted		08-16-91			
Date Analyzed		08-18-91			
Analyte	QL* ug/L	Concentration, ug/L			
Propazine	5.0	<5.0			
Simazine	5.0	<5.0			
Atrazine	5.0	<5.0			
*QL Multiplier		1			

a EPA-600/4-88/039 Methods for the Determination of Organic Compounds in Drinking Water, EMSLORD, US EPA, Dec., 1988.
* QL = Quantitation Limit.

GTEL ENVIRONMENTAL LABORATORIES, INC.

Project Number: EQB01.EQB01
Storm Water Disposal
Pond Study
Work Order Number: X1-08-943
Date Reported: 08-28-91

Table 1

ANALYTICAL RESULTS
Triazine Herbicides in Water
EPA Method 507[a]

GTEL Sample Number		01	02		
Client Identification		EB121-A	EB131-A		
Date Sampled		08-09-91	08-09-91		
Date Received		08-09-91	08-09-91		
Date Analyzed		08-18-91	08-18-91		
Analyte	QL* ug/L	Concentration, ug/L			
Propazine	5.0	<5.0	<5.0		
Simazine	5.0	<5.0	<5.0		
Atrazine	5.0	<5.0	<5.0		
*QL Multiplier		1	1		

a EPA-600/4-88/039 Methods for the Determination of Organic Compounds in Drinking Water, EMSLORD, US EPA, Dec., 1988.
* QL = Quantitation Limit.

GTEL ENVIRONMENTAL LABORATORIES, INC.

Project Number: EQB01.EQB01
Storm Water
Disposal Pond Study
Work Order Number: X1-08-277
Date Reported: 08-26-91

Table 1

ANALYTICAL RESULTS
Triazine Herbicides in Water
EPA Method 507[a]

GTEL Sample Number		01			
Client Identification		EB130A			
Date Sampled		08-09-91			
Date Received		08-09-91			
Date Extracted		08-16-91			
Date Analyzed		08-18-91			
Analyte	QL* ug/L	Concentration, ug/L			
Propazine	5.0	<5.0			
Simazine	5.0	<5.0			
Atrazine	5.0	<5.0			
*QL Multiplier		1			

a EPA-600/4-88/039 Methods for the Determination of Organic Compounds in Drinking Water, EMSLORD, US EPA, Dec., 1988.

* QL = Quantitation Limit.

GTEL ENVIRONMENTAL LABORATORIES, INC.

Project Number: EQB01.EQB01
Storm Water
Disposal Study
Work Order Number: X1-07-926
Date Reported: 08-21-91

Table 1

ANALYTICAL RESULTS
Triazine Herbicides in Water
EPA Method 507[a]

GTEL Sample Number		01	02		
Client Identification		Fox Meadows #1	Miles Sand #2		
Date Sampled		07-24-91	07-24-91		
Date Received		07-26-91	07-26-91		
Date Analyzed		08-05-91	08-05-91		
Analyte	QL* ug/L	Concentration, ug/L			
Propazine	20	<20	<20		
Simazine	20	<20	<20		
Atrazine	20	<20	<20		
*QL Multiplier		1	1		

a EPA-600/4-88/039 Methods for the Determination of Organic Compounds in Drinking Water, EMSLORD, US EPA, Dec., 1988.
* QL = Quantitation Limit.

GTEL ENVIRONMENTAL LABORATORIES, INC.

Project Number: EQB01.EQB01
Storm Water
Disposal Pond Study
Work Order Number: X1-09-407
Date Reported: 10-17-91

Table 1

ANALYTICAL RESULTS
Triazine Herbicides in Water
EPA Method 507[a]

GTEL Sample Number		01	02	03	04
Client Identification		EB 131-A	EB 130-A	EB 122-A	EB121-A
Date Sampled		09-13-91	09-13-91	09-13-91	09-12-91
Date Analyzed		09-24-91	09-24-91	09-24-91	09-24-91
Analyte	QL* ug/L	Concentration, ug/L			
Propazine	5.0	<5.0	<5.0	<5.0	<5.0
Simazine	5.0	<5.0	<5.0	<5.0	<5.0
Atrazine	5.0	<5.0	<5.0	<5.0	<5.0
*QL Multiplier		1	1	1	1

a EPA-600/4-88/039 Methods for the Determination of Organic Compounds in Drinking Water, EMSLORD, US EPA, Dec., 1988.
* QL = Quantitation Limit.

GTEL ENVIRONMENTAL LABORATORIES, INC.

pace INCORPORATED
THE ASSURANCE OF QUALITY

REPORT OF LABORATORY ANALYSIS

GTEL Environmental Laboratories, Inc.
4211 May Ave.
Wichita, KS 67209

June 02, 1992
PACE Project Number: 520520508
GTEL Work Order Number: X2-05-72

Attn: Ms. Kathleen Kremer

Client Reference: Storm Water Pond Disposal Study

PACE Sample Number:			60 0067287	
Date Collected:			05/15/92	
Date Received:			05/20/92	
Client Sample ID:			Miles Sand Pit	
Parameter	Units	MDL		DATE ANALYZED
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	05/27/92
Propazine	ug/L	1.0	ND	05/27/92
Simazine	ug/L	1.0	ND	05/27/92
Prometon	ug/L	1.0	ND	05/27/92
Triphenyl phosphate (Surrogate)	%		28	05/27/92
Organophosphorus Pesticide Prep - Waters			05/21/92	

MDL Method Detection Limit
ND Not detected at or above the MDL.

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REPORT OF LABORATORY ANALYSIS

Ms. Kathleen Kremer
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June 02, 1992
PACE Project Number: 520520508
GTEL Work Order Number: X2-05-72

Client Reference: Storm Water Pond Disposal Study

PACE Sample Number:			60 0067295	
Date Collected:			05/15/92	
Date Received:			05/20/92	
Client Sample ID:			Fox Meadows	
Parameter	Units	MDL	Pond	DATE ANALYZED
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	05/27/92
Propazine	ug/L	1.0	ND	05/27/92
Simazine	ug/L	1.0	ND	05/27/92
Prometon	ug/L	1.0	ND	05/27/92
Triphenyl phosphate (Surrogate)	%		22	05/27/92
Organophosphorus Pesticide Prep - Waters			05/21/92	

MDL Method Detection Limit
ND Not detected at or above the MDL.

These data have been reviewed and are approved for release.

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Ms. Kathleen Kremer
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QUALITY CONTROL DATA

June 02, 1992
PACE Project Number: 520520508
GTEL Work Order Number: X2-05-7

Client Reference: Storm Water Pond Disposal Study

METHOD 8140 PLUS
Batch: 60 13822
Samples: 60 0067287, 60 0067295

METHOD BLANK:

Parameter	Units	MDL	Method Blank
Atrazine	ug/L	1.0	ND
Propazine	ug/L	1.0	ND
Simazine	ug/L	1.0	ND
Prometon	ug/L	1.0	ND
Triphenyl phosphate (Surrogate)	%		38

LABORATORY CONTROL SAMPLE AND CONTROL SAMPLE DUPLICATE:

Parameter	Units	MDL	Reference Value	Recv	Dupl Recv	RPD
Malathion	ug/L	1.0	4.06	92%	88%	4%
Parathion-ethyl	ug/L	1.0	4.10	115%	112%	2%

MDL Method Detection Limit
RPD Relative Percent Difference

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REPORT OF LABORATORY ANALYSIS

GTEL Environmental Laboratories, Inc.
Midwest Region
4211 May Ave.
Wichita, KS 67209

June 17, 1992
PACE Project Number: 52060250l
GTEL Wichita Work Order #X2-05-C

Attn: Ms. Nancy Kerchen

Client Reference: Fox Meadows + Rules Pit

Parameter	Units	MDL		DATE ANALYZED
PACE Sample Number:			60 0073767	
Date Collected:			05/28/92	
Date Received:			06/02/92	
Client Sample ID:			EB-130A	
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	06/15/92
Propazine	ug/L	1.0	ND	06/15/92
Simazine	ug/L	1.0	ND	06/15/92
Prometon	ug/L	1.0	ND	06/15/92
Triphenyl phosphate (Surrogate)	%		76	06/15/92
Organophosphorus Pesticide Prep - Waters			06/03/92	

Parameter	Units	MDL		DATE ANALYZED
PACE Sample Number:			60 0073775	
Date Collected:			05/28/92	
Date Received:			06/02/92	
Client Sample ID:			EB-131A	
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	06/16/92
Propazine	ug/L	1.0	ND	06/16/92
Simazine	ug/L	1.0	ND	06/16/92
Prometon	ug/L	1.0	ND	06/16/92
Triphenyl phosphate (Surrogate)	%		73	06/16/92
Organophosphorus Pesticide Prep - Waters			06/03/92	

MDL Method Detection Limit
ND Not detected at or above the MDL.

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Ms. Nancy Kerchen
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June 17, 1992
PACE Project Number: 520602501

Client Reference: Fox Meadows + Rules Pit

GTEL Wichita Work Order #X2-05-C9[illegible]

PACE Sample Number:			60 0073783	
Date Collected:			05/29/92	
Date Received:			06/02/92	
Client Sample ID:			EB-121A	
Parameter	Units	MDL		DATE ANALYZED
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	06/16/92
Propazine	ug/L	1.0	ND	06/16/92
Simazine	ug/L	1.0	ND	06/16/92
Prometon	ug/L	1.0	ND	06/16/92
Triphenyl phosphate (Surrogate)	%		57	06/16/92
Organophosphorus Pesticide Prep - Waters			06/03/92	

PACE Sample Number:			60 0073791	
Date Collected:			05/29/92	
Date Received:			06/02/92	
Client Sample ID:			EB-122A	
Parameter	Units	MDL		DATE ANALYZED
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	06/16/92
Propazine	ug/L	1.0	ND	06/16/92
Simazine	ug/L	1.0	ND	06/16/92
Prometon	ug/L	1.0	ND	06/16/92
Triphenyl phosphate (Surrogate)	%		70	06/16/92
Organophosphorus Pesticide Prep - Waters			06/03/92	

MDL Method Detection Limit
ND Not detected at or above the MDL.

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Ms. Nancy Kerchen
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June 17, 1992
PACE Project Number: 520602501

Client Reference: Fox Meadows + Rules Pit

GTEL Wichita Work Order #K2-05-C98

These data have been reviewed and are approved for release.

Neal R. Hudson
Manager, Organic Chemistry

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Ms. Nancy Kerchen
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QUALITY CONTROL DATA

June 17, 1992
PACE Project Number: 520602501
GTEL Wichita Work Order #X2-05-C9

Client Reference: Fox Meadows + Rules Pit

TRIAZINES IN WATERS
Batch: 60 14172
Samples: 60 0073767, 60 0073775, 60 0073783, 60 0073791

METHOD BLANK:

Parameter	Units	MDL	Method Blank
Atrazine	ug/L	1.0	ND
Propazine	ug/L	1.0	ND
Simazine	ug/L	1.0	ND
Prometon	ug/L	1.0	ND
Triphenyl phosphate (Surrogate)	%		102

SPIKE AND SPIKE DUPLICATE:

Parameter	Units	MDL	60 0073767 EB-130A		Spike	Spike Recv	Spike Dupl Recv	RPD
Atrazine	ug/L	1.0	ND	D	7.0	96%	66%	37%

LABORATORY CONTROL SAMPLE:

Parameter	Units	MDL	Reference Value	Recv
Atrazine	ug/L	1.0	7.0	85%

MDL Method Detection Limit
D Concentration found on diluted sample.
RPD Relative Percent Difference

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REPORT OF LABORATORY ANALYSIS

GTEL Environmental Laboratories, Inc.
4211 May Ave.
Wichita, KS 67209

June 30, 1992
PACE Project Number: 520623505
GTEL Wichita Work Order #X2-06-4

Attn: Ms. Kathleen Kremer

Client Reference: Fox Meadows & Miles

PACE Sample Number:			60 0085129	
Date Collected:			06/19/92	
Date Received:			06/23/92	
Client Sample ID:			Miles Sand Pit Drain Ditch	
Parameter	Units	MDL		DATE ANALYZED
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	06/26/92
Propazine	ug/L	1.0	ND	06/26/92
Simazine	ug/L	1.0	ND	06/26/92
Prometon	ug/L	1.0	ND	06/26/92
Triphenyl phosphate (Surrogate)	%		116	06/26/92
Decachlorobiphenyl Surrogate	%		42	06/26/92
Tetrachloro-meta-xylene Surrogate	%		65	06/26/92
Organophosphorus Pesticide Prep - Waters			06/25/92	

MDL Method Detection Limit
ND Not detected at or above the MDL.

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Ms. Kathleen Kremer
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June 30, 1992
PACE Project Number: 520623505
GTEL Wichita Work Order #X2-06-4

Client Reference: Fox Meadows & Miles

PACE Sample Number:			60 0085137	
Date Collected:			06/19/92	
Date Received:			06/23/92	
Client Sample ID:			Fox Meadow Drainage Pond	
Parameter	Units	MDL		DATE ANALYZED
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	06/26/92
Propazine	ug/L	1.0	ND	06/26/92
Simazine	ug/L	1.0	ND	06/26/92
Prometon	ug/L	1.0	ND	06/26/92
Triphenyl phosphate (Surrogate)	%		109	06/26/92
Decachlorobiphenyl Surrogate	%		57	06/26/92
Tetrachloro-meta-xylene Surrogate	%		69	06/26/92
Organophosphorus Pesticide Prep - Waters			06/25/92	

MDL Method Detection Limit
ND Not detected at or above the MDL.

These data have been reviewed and are approved for release.

Charles E Bigm for
Neal R. Hudson
Manager, Organic Chemistry

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Ms. Kathleen Kremer
Page 3

QUALITY CONTROL DATA

June 30, 1992
PACE Project Number: 520623505

GTEL Wichita Work Order #X2-06-43

Client Reference: Fox Meadows & Miles

TRIAZINES IN WATERS
Batch: 60 14409
Samples: 60 0085129, 60 0085137

METHOD BLANK:

Parameter	Units	MDL	Method Blank
Atrazine	ug/L	1.0	ND
Propazine	ug/L	1.0	ND
Simazine	ug/L	1.0	ND
Prometon	ug/L	1.0	ND
Triphenyl phosphate (Surrogate)	%		150
Decachlorobiphenyl Surrogate	%		89
Tetrachloro-meta-xylene Surrogate	%		84

SPIKE AND SPIKE DUPLICATE:

Parameter	Units	MDL	60 0073767	Spike	Spike Recv	Spike Dupl Recv	RPD
Atrazine	ug/L	1.0	ND	7.0	96%	66%	37%

LABORATORY CONTROL SAMPLE:

Parameter	Units	MDL	Reference Value	Recv
Atrazine	ug/L	1.0	7.0	85%

MDL Method Detection Limit
RPD Relative Percent Difference

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REPORT OF LABORATORY ANALYSIS

GTEL Environmental Laboratories Inc.
PACE Project No. 520623505
Client Reference: Fox Meadows & Miles
GTEL Wichita Work Order #X2-06-439

Project Narrative

Fraction: Triazine Herbicides (507)

Sample 60 008512.9 (Miles Sandpit Drain Ditch) contained traces of Malathion and Chlorpyrifos less than 10 ug/L. These compounds were identified utilizing two different analytical columns and conditions.

Charles E. Girgin
GC Semivolatiles Supervisor
June 30, 1992

KLG3/kcz

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REPORT OF LABORATORY ANALYSIS

GTEL Environmental Laboratories, Inc.
4211 May Ave.
Wichita, KS 67209

July 22, 1992
PACE Project Number: 520708506
GTEL Wichita Work Order #X2-07-1

Attn: Ms. Kathleen Kremer

Client Reference: Fox Meadows & Miles Sand Pit

PACE Sample Number:			60 0092508	
Date Collected:			07/06/92	
Date Received:			07/08/92	
			EB 130A	
Parameter	Units	MDL		DATE ANALYZED
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	07/21/92
Propazine	ug/L	1.0	ND	07/21/92
Simazine	ug/L	1.0	ND	07/21/92
Prometon	ug/L	1.0	ND	07/21/92
Triphenyl phosphate (Surrogate)	%		72	07/21/92
Decachlorobiphenyl Surrogate	%		95	07/21/92
Tetrachloro-meta-xylene Surrogate	%		103	07/21/92
Organophosphorus Pesticide Prep - Waters			07/10/92	

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Ms. Kathleen Kremer
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July 22, 1992
PACE Project Number: 520708506
GTEL Wichita Work Order #X2-07-1C

Client Reference: Fox Meadows & Miles Sand Pit

PACE Sample Number:			60 0092516	
Date Collected:			07/06/92	
Date Received:			07/08/92	
Client Sample ID:			EB 131A	
Parameter	Units	MDL		DATE ANALYZED
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	07/21/92
Propazine	ug/L	1.0	ND	07/21/92
Simazine	ug/L	1.0	ND	07/21/92
Prometon	ug/L	1.0	ND	07/21/92
Triphenyl phosphate (Surrogate)	%		60	07/21/92
Decachlorobiphenyl Surrogate	%		86	07/21/92
Tetrachloro-meta-xylene Surrogate	%		103	07/21/92
Organophosphorus Pesticide Prep - Waters			07/10/92	

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Ms. Kathleen Kremer
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July 22, 1992
PACE Project Number: 520708506
GTEL Wichita Work Order #X2-07-10

Client Reference: Fox Meadows & Miles Sand Pit

PACE Sample Number:			60 0092524	
Date Collected:			07/07/92	
Date Received:			07/08/92	
Client Sample ID:			EB 121A	
Parameter	Units	MDL		DATE ANALYZED
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	07/21/92
Propazine	ug/L	1.0	ND	07/21/92
Simazine	ug/L	1.0	ND	07/21/92
Prometon	ug/L	1.0	ND	07/21/92
Triphenyl phosphate (Surrogate)	%		41	07/21/92
Decachlorobiphenyl Surrogate	%		32	07/21/92
Tetrachloro-meta-xylene Surrogate	%		125	07/21/92
Organophosphorus Pesticide Prep - Waters			07/10/92	

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Ms. Kathleen Kremer
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July 22, 1992
PACE Project Number: 520708506
GTEL Wichita Work Order #X2-07-103

Client Reference: Fox Meadows & Miles Sand Pit

PACE Sample Number:			60 0092532	
Date Collected:			07/07/92	
Date Received:			07/08/92	
Client Sample ID:			EB 122A	
Parameter	Units	MDL		DATE ANALYZED
ORGANIC ANALYSIS				
TRIAZINES IN WATERS				
Atrazine	ug/L	1.0	ND	07/21/92
Propazine	ug/L	1.0	ND	07/21/92
Simazine	ug/L	1.0	ND	07/21/92
Prometon	ug/L	1.0	ND	07/21/92
Triphenyl phosphate (Surrogate)	%		109	07/21/92
Decachlorobiphenyl Surrogate	%		68	07/21/92
Tetrachloro-meta-xylene Surrogate	%		97	07/21/92
Organophosphorus Pesticide Prep - Waters			07/10/92	

These data have been reviewed and are approved for release.

Neal R. Hudson
Manager, Organic Chemistry

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FOOTNOTES
for pages 1 through 4

July 22, 1992
PACE Project Number: 520708506
GTEL Wichita Work Order #X2-07-103

Client Reference: Fox Meadows & Miles Sand Pit

MDL Method Detection Limit
ND Not detected at or above the MDL.

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Ms. Kathleen Kremer
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QUALITY CONTROL DATA

July 22, 1992
PACE Project Number: 520708506
GTEL Wichita Work Order #X2-07-10

Client Reference: Fox Meadows & Miles Sand Pit

TRIAZINES IN WATERS
Batch: 60 14907
Samples: 60 0092508, 60 0092516, 60 0092524, 60 0092532

METHOD BLANK:

Parameter	Units	MDL	Method Blank
Atrazine	ug/L	1.0	ND
Propazine	ug/L	1.0	ND
Simazine	ug/L	1.0	ND
Prometon	ug/L	1.0	ND
Triphenyl phosphate (Surrogate)	%		184
Decachlorobiphenyl Surrogate	%		107
Tetrachloro-meta-xylene Surrogate	%		107

SPIKE AND SPIKE DUPLICATE:

Parameter	Units	MDL	600092532 EB 122A	Spike	Spike Recv	Spike Dupl Recv	RPD
Atrazine	ug/L	1.0	ND	10.0	88%	119%	29%

LABORATORY CONTROL SAMPLE:

Parameter	Units	MDL	Reference Value	Recv
Atrazine	ug/L	1.0	5.0	95%

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REPORT OF LABORATORY ANALYSIS

FOOTNOTES
for page 6

July 22, 1992
PACE Project Number: 520708506
GTEL Wichita Work Order #X2-07-103

Client Reference: Fox Meadows & Miles Sand Pit

DS	Concentration found on diluted sample.
MDL	Method Detection Limit
ND	Not detected at or above the MDL.
RPD	Relative Percent Difference

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