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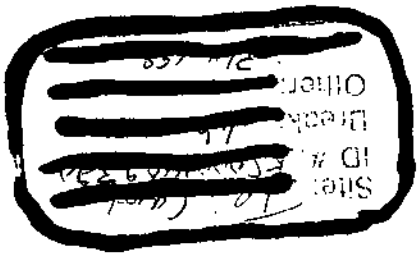

CORRECTIVE ACTION STUDY
Whole House Treatment Systems for Private Water Wells
Latimer, Kansas

BE&K/Terranext Project Number 17101978

Prepared For:

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1.0 Introduction

This report summarizes the equipment and installation of six, whole-house, water treatment systems at the Mitchell Peck, Werner Monnich, Richard Monnich, Robin Harlow, Dyas Farres, and Bernice Diekmann residences in Latimer, Kansas. The systems were completed as described in BE&K/Terranext's Corrective Action Study Work Plan dated June 1, 1998.

BE&K/Terranext developed a Corrective Action Study Work Plan for installing whole-house water treatment systems at the six residences, based on the Kansas Department of Health and Environment (KDHE) letter dated May 12, 1998. Following KDHE approval of the Corrective Action Study Work Plan, BE&K/Terranext purchased and installed the equipment. The whole-house treatment systems were designed by BE&K/Terranext to remove volatile organic compounds (VOCs) present in the Latimer private water wells to Safe Drinking Water Standard Maximum Contaminant Levels (MCLs). The whole-house treatment systems are an interim solution until a permanent drinking water solution can be implemented.

1.1 Site Background

Trichloroethylene (TCE), carbon tetrachloride (CCL_4), and ethylene dibromide (EDB) were detected above the MCLs in private water wells in and near Latimer during a Preliminary Removal Evaluation (PRE) sampling event conducted by KDHE on October 6 and October 7, 1997. The PRE indicated two discrete source areas for the VOC contamination:

- the Tri-County Airport/former Herington Army Air Field (HAAF), where TCE was used as a parts degreaser, and
- the grain storage bins at the former Latimer Grain/Latimer Agri-Services facility, where CCL_4 and EDB were used as grain fumigants.

In response to the detection of these compounds, KDHE, under direction of the KDHE/State Water Plan Contamination Remediation Program, contracted BE&K/Terranext to complete the following tasks: supply emergency bottled water to the six impacted households, design and install whole house treatment systems at the six impacted residences, and investigate permanent alternative water supplies. The first two tasks have been documented in this report and the alternative water supply study has been submitted under separate document.

1.2 Emergency Bottled Water Supply

BE&K/Terranext contracted Culligan Water of Salina (658 E. North St., Salina, KS 67101, 785-825-4912), to provide drinking water coolers and bottled water to the six impacted residences in October 1997. In addition to the water coolers at each residence, a water cooler is located at the Werner Monnich's work shop. BE&K/Terranext continued to provide bottled water to the six homes until analytical testing confirmed that carbon treatment systems were removing the TCE, CCl_4, and EDB to levels below their respective MCLs in each of the six private wells. The coolers and unused bottled water were removed from the Latimer residences in January, 1999.

2.0 Treatment System

BE&K/Terranext obtained cost proposals from two GAC system vendors to supply and install the equipment. A cost analysis comparing the equipment and costs was submitted to KDHE. A vendor was selected by KDHE based on the information presented in the cost analysis.

2.1 Treatment System Design

The whole house treatment systems consist of a sediment filter, two 1.5 ft^3 (cubic foot) carbon vessels in a series configuration, a UV sterilizer, and a flow meter to record the amount of flow through each system in total gallons.

2.1.1 Primary Treatment

A GAC system adsorbs TCE, CCl_4, EDB, and other organic chemicals which may be present in the well water passing through the system and onto the carbon. Adsorption is the process of collecting soluble substances that are in solution on a suitable interface. In a GAC system, water is pushed through the carbon vessels by the water pressure developed by the well pump. As the impacted water moves through the carbon vessels, contaminants adsorb to the carbon until the mass transfer zone within the vessel is exhausted and breakthrough occurs. TCE and CCl_4 adsorb onto carbon faster than EDB. EDB generally requires a longer contact time to be removed. The vessels were designed to maximize the empty bed contact time (EBCT) for each vessel to allow for the removal of EDB.

The sediment filter precedes the system to remove any sediment which potentially could clog the GAC vessel. For monitoring purposes, a sample port is located ahead of, in between, and after each carbon vessel. The location of these sample ports allows BE&K/Terranext to monitor the influent, in between, and effluent contaminant concentrations. The sample port in

between the carbon vessels was installed by BE&K/Terranext to determine the breakthrough period for the carbon in the lead vessel.

2.1.2 Secondary Treatment

The UV sterilizer was installed following the carbon exchange vessels to ensure that drinking water is bacteriologically acceptable, as bacteria could potentially accumulate in the carbon vessels.

2.2 Treatment System Installation

An initial site visit was conducted by BE&K/Terranext and Hague Quality Water, BE&K/Terranext's treatment system and installation subcontractor, on July 6, 1998 to determine the installation location of the treatment systems in each of the six residences. During the site visit, BE&K/Terranext discussed the placement of the treatment systems with each homeowner to determine a suitable location. BE&K/Terranext inquired of each homeowner about the plumbing in their home to ensure all points of consumptive use would be treated.

The installation of the whole-house treatment systems took place on August 6, 7, and 10, 1998. The following equipment was installed at each residence:

- Two, Hague Quality Water Inc. Model HIL 52 carbon exchange vessels,
- One, Applied Membrane Inc. Model UV20-1 ultraviolet sterilization unit,
- One, Applied Membrane Inc. Model UV20-2s sediment prefilter, and
- One, Badger Meter Inc., RCDL Model 25 flow meter.

The systems were installed in the basement/crawl spaces of the Werner Monnich, Richard Monnich, and Robin Harlow residences between the water well and the first use of water. The

Dyas Farres, Bernice Diekmann, and Mitchell Peck residences do not have basements, therefore the treatment systems were installed outside the residences, between the water well and the first use of water. The Dyas Farres and Mitchell Peck treatment systems were installed in existing well houses. The Mitchell Peck residence well house did not have sufficient space to accommodate the treatment system, therefore additions to the pump house were made by BE&K/Terranext during the system installation. The Bernice Diekmann treatment system was installed in an existing detached garage, and a wooden enclosure was built around the vessels. Electrical power for the treatment systems was obtained from each home's electrical system. Table 1 summarizes the treatment system locations and weatherproofing, and Appendix 1 contains photographs of the system installations.

Table 1
Treatment System Specifications

Residence	System Location	Backwash Discharge	Heater	Insulated Enclosure
M.Peck	Well House	Ground	Yes	Yes
D.Farres	Well House	Ground	Yes	Yes
R.Harlow	Basement	Floor Drain	NA	NA
R.Monnich	Basement	Floor Drain	NA	NA
W.Monnich	Basement	Floor Drain	NA	NA
Diekmann	Garage	Ground	Yes	Yes

After the treatment systems were installed at the Dyas Farres, Bernice Diekmann, and Mitchell Peck residences, BE&K/Terranext weatherproofed the system enclosures to minimize the chances of freezing the carbon vessels during the winter months. BE&K/Terranext insulated each enclosure using Styrofoam insulation with an R11 value. BE&K/Terranext also installed a thermostatically controlled ceramic heater in each enclosure.

2.3 Treatment System Startup

BE&K/Terranext finished the installation and started the six treatment systems on August 11, 1998. After the systems were started, each system was allowed to run until the effluent water was clear and free of carbon dust. To evaluate the performance of each system, BE&K/Terranext collected startup influent and effluent samples from each system on August 11, 1998. Analytical results are presented in Table 2.

Table 2
Treatment System Sample Results
Whole House Treatment Systems
Latimer, Kansas

Residence Sample Date	Influent			Effluent		
	EDB	TCE	CCl4	EDB	TCE	CCl4
MCL	0.05 µg/l	5 µg/l	5 µg/l	0:05 µg/l	5 µg/l	5 µg/l
M.Peck 8/11/98	**0.36**	**18**	**17**	ND	0.71	0.74
D.Farres 8/11/98 9/25/98	**0.11** **0.19**	ND **24**	ND 2.6	ND ND	**20** 2.8	2.8 ND
R.Harlow 8/11/98	**0.11**	**17**	3.6	ND	ND	ND
R.Monnich 8/11/98 9/25/98	ND NA	**11** **18**	2.6 3.4	ND ND	0.99 ND	ND ND
W.Monnich 8/11/98 9/25/98	ND NA	**16** **19**	0.73 2.3	ND **0.16**	ND ND	ND ND
Diekmann 8/11/98 10/09/98	**0.26** **0.74**	**15** **20**	**12** **8.8**	**0.25** ND	**16** ND	**13** ND

Note: sample results in µg/l
ND= Not Detected above laboratory detection limits
NA = Not Analyzed
0.26 =**(Bold)** Indicates detection above the MCL

Analytical results from the initial sampling event at the Dyas Farres and Bernice Diekmann residences indicated effluent concentrations of TCE, CCl_4, and EDB above the MCL. Samples from the Mitchell Peck and Richard Monnich residences indicated effluent concentrations above the laboratory detection limit, but below the MCLs. The samples collected from the Mitchell Peck, Dyas Farres, and Bernice Diekmann residences were collected shortly after the installation of the treatment systems. BE&K/Terranext believes the elevated concentrations at the Richard Monnich, Dyas Farres, and Mitchell Peck residences were due to insufficient flow through the household plumbing lines prior to the sampling event. Apparently, insufficient flow through the plumbing lines did not allow residual contaminated water to be completely flushed from the lines. Based on the analytical results, it is also possible that the influent and effluent Dyas Farres samples were switched either in the field or in the laboratory.

The results of the influent sample and the effluent sample collected from the kitchen sink at the Bernice Diekmann residence were nearly identical, indicating that water may be by-passing the treatment system. BE&K/Terranext consulted with the homeowner about the household plumbing prior to the installation of this treatment system since construction of the home did not allow BE&K/Terranext to visually verify the plumbing. To determine if water was bypassing the treatment system, BE&K/Terranext shut off the flow through the system and turned on each faucet in the house. The kitchen sink was the only faucet to flow, which indicated that the underground plumbing at this residence was different than described by the homeowner and that water supplied to the kitchen sink was fed from the well supply line prior to the treatment system. A plumber from Hague Quality Water visited the Diekmann residence on September 30, 1998 to re-plumb the kitchen supply line ensuring treatment of water that goes to the kitchen sink.

On September 25, 1998, BE&K/Terranext collected a set of confirmation samples from two of the four residences where VOCs were detected in the initial round of effluent samples;

D. Farres and R. Monnich. BE&K/Terranext also collected a sample from the W. Monnich residence during the confirmation sampling event to further evaluate the effectiveness of the treatment systems. Results from this sampling event are summarized in Table 2. The effluent samples collected during this event were reported below the laboratory detection limit for all samples except the D. Farres effluent sample (2.8 μg/l TCE), and the W. Monnich effluent sample (0.16 μg/l EDB). EDB was not detected in either the W. Monnich influent or effluent startup samples collected on August 11, 1998. BE&K/Terranext believes this increase in the effluent concentration of EDB at the W. Monnich residence may be due to a decreased empty bed contact time prior to the sample collection. A decrease in the empty bed contact time could occur if a large amount of water was used by the homeowner prior to, or during, the sample collection. This large amount of water use could come from a washer, an outside faucet, or an interior sink. BE&K/Terranext cannot explain why EDB was detected in the September 25, 1998 W. Monnich effluent sample when it was not present in the influent sample collected on August 11, 1998, but conceivably this detection could be due to a labeling or laboratory error.

The effluent confirmation sample collected from the Dyas Farres residence indicated a TCE concentration of 2.8 μg/l, below the MCL of 5 μg/l. This residence has indicated the highest TCE concentration of any of the Latimer residences. This high concentration, along with the possibility of a decreased empty bed contact time prior to the sample collection, may explain why TCE was detected in the effluent sample.

Influent and effluent samples were not collected from the Diekmann residence on September 25, 1998 because the plumbing issue at this residence had not been resolved. Influent and effluent samples were collected from the Diekmann residence on October 9, 1998 after the plumber re-plumbed the Diekmann residence. The effluent sample from the Diekmann residence was reported below the laboratory detection limit for TCE, CCl_4, and EDB. The results from this sampling event are also summarized in Table 2.

3.0 Maintenance and Monitoring

3.1 Maintenance

3.1.1 Primary Treatment

The carbon in the exchange tank will require replacement as the carbon adsorbs organic compounds over time and will be indicated by increasing VOC levels in the effluent. The replacement period will be determined based on analytical test data collected during the first five to eight months of operation. Each unit has an automatic backwash cycle set to activate twice weekly which will remove any sediment build up in the carbon vessels.

3.2 Secondary Treatment

The UV bulb in the UV conditioner will require periodic replacement during the life of the treatment system. Replacement of the bulb is recommended on an annual basis, or when the bulb monitor indicates bulb failure, whichever occurs first. At present, the UV lights are checked during monthly O&M visits and will be replaced by Hague when necessary. The filter screen in the in-line filter requires periodic washing when the screen becomes visually dirty.

3.3 Monitoring

BE&K/Terranext will conduct five sampling events within eight months of the system startup at the two residences with the highest combined concentration of TCE, CCl_4, and EDB (Diekmann and Peck residences), and the residence with the highest water usage (R. Harlow residence). At present, three sampling events have been conducted by BE&K/Terranext to monitor the breakthrough period of the carbon. Per the request of KDHE, the third sampling event, conducted in February 1999, included an effluent sample from the D.Farres, R. Monnich, and W. Monnich treatment systems. A schedule for the

remaining sampling events is presented in Table 3. The sampling events will allow BE&K/Terranext to monitor the performance of the GAC systems and determine the breakthrough period of the carbon. Once the breakthrough period has been determined, the spent carbon will be replaced, and two more sampling events will be conducted prior to the next anticipated breakthrough period to confirm the safe carbon replacement time. The spent carbon will be replaced by Hague by moving the lag vessel into the lead position and replacing the carbon in the lead vessel and moving it into the lag position. During each monitoring event, BE&K/Terranext personnel will collect water meter readings from each residence to determine the total flow for each system. If BE&K/Terranext personnel cannot access the flow meters during the sampling event, BE&K/Terranext will contact the resident and ask them to read the flow meter and report the results.

Table 3
Future Monitoring Schedule

Date	Flow Meter	Analytical Sample
Nov. 1, 1998	Completed	Completed
Dec. 1, 1998	Completed	Sample not scheduled
Jan. 1, 1999	Completed	Completed
Feb. 1, 1999	Completed	Sample not scheduled
Feb. 15, 1999	Completed	Completed
March 1, 1999	X	Sample not scheduled
April 1, 1999	X	X
May 1, 1999	X	X

4.0 Conclusions

BE&K/Terranext has confirmed the GAC systems are operating properly and are removing TCE, CCl_4, and EDB to levels below the MCL from the well water of the six residences, with the exception of the EDB concentration in the effluent confirmation sample at the W. Monnich residence. BE&K/Terranext believes the EDB detection at the W. Monnich residence is suspect because EDB was not detected in either the influent or effluent startup samples collected on August 11, 1998. BE&K/Terranext will conduct a sampling event the first week of April, 1999 to confirm the effectiveness on the GAC systems. BE&K/Terranext will continue to monitor the performance of the systems to determine the breakthrough period of the carbon, as stated in the Corrective Action Study Work Plan.