

Final Work Plan: Investigation of Potential Contamination at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas

Environmental Science Division



United States Department of Agriculture

Work sponsored by Commodity Credit Corporation,
United States Department of Agriculture

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Final Work Plan: Investigation of Potential Contamination at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas

by
Applied Geosciences and Environmental Management Section
Environmental Science Division, Argonne National Laboratory

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United States Department of Agriculture

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Notation

AGEM	Applied Geosciences and Environmental Management
AMSL	above mean sea level
AST	aboveground storage tank
BGL	below ground level
°C	degree(s) Celsius
CCC	Commodity Credit Corporation
CPT	cone penetrometer
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FSA	Farm Service Agency
ft	foot (feet)
gal	gallon(s)
h	hour(s)
IDW	investigation-derived waste
in.	inch(es)
KDHE	Kansas Department of Health and Environment
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter
MCL	maximum contaminant level
mi	mile(s)
NAIP	National Agricultural Imagery Program
pg/g	picogram(s) per gram
PVC	polyvinyl chloride
PWS	public water supply
RWD	Rural Water District
SRE	site reconnaissance and evaluation
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
VOC	volatile organic compound

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1 Introduction

The Commodity Credit Corporation (CCC), an agency of the U.S. Department of Agriculture (USDA), operated a grain storage facility at the northeastern edge of the city of Hanover, Kansas, from 1950 until the early 1970s. During this time, commercial grain fumigants containing carbon tetrachloride were in common use by the grain storage industry to preserve grain in their facilities. In February 1998, trace to low levels of carbon tetrachloride (below the maximum contaminant level [MCL] of 5.0 $\mu\text{g/L}$) were detected in two private wells near the former grain storage facility at Hanover, as part of a statewide USDA private well sampling program that was implemented by the Kansas Department of Health and Environment (KDHE) near former CCC/USDA facilities.

In April 2007, the CCC/USDA collected near-surface soil samples at 1.8-2 ft BGL (below ground level) at 61 locations across the former CCC/USDA facility. All soil samples were analyzed by the rigorous gas chromatograph-mass spectrometer analytical method (purge-and-trap method). No contamination was found in soil samples above the reporting limit of 10 $\mu\text{g/kg}$.

In July 2007, the CCC/USDA sampled indoor air at nine residences on or adjacent to its former facility to address the residents' concerns regarding vapor intrusion. Low levels of carbon tetrachloride were detected at four of the nine homes.

Because carbon tetrachloride found in private wells and indoor air at the site might be linked to historical use of fumigants containing carbon tetrachloride at its former grain storage facility, the CCC/USDA is proposing to conduct an investigation to determine the source and extent of the carbon tetrachloride contamination associated with the former facility. This investigation will be conducted in accordance with the intergovernmental agreement between the KDHE and the Farm Service Agency (FSA) of the USDA.

The investigation at Hanover will be performed, on behalf of the CCC/USDA, by the Environmental Science Division of Argonne National Laboratory. Argonne is a nonprofit, multidisciplinary research center operated by UChicago Argonne, LLC, for the U.S. Department

of Energy (DOE). The CCC/USDA has entered into an interagency agreement with DOE, under which Argonne provides technical assistance to the CCC/USDA with environmental site characterization and remediation at its former grain storage facilities.

Seven technical objectives have been proposed for the Hanover investigation. They are as follows:

1. Identify the sources and extent of soil contamination beneath the former CCC/USDA facility.
2. Characterize groundwater contamination beneath the former CCC/USDA facility.
3. Determine groundwater flow patterns.
4. Define the vertical and lateral extent of the groundwater plume outside the former CCC/USDA facility.
5. Evaluate the aquifer and monitor the groundwater system.
6. Identify any other potential sources of contamination that are not related to activities of the CCC/USDA.
7. Determine whether there is a vapor intrusion problem at the site attributable to the former CCC/USDA facility.

The technical objectives will be accomplished in a phased approach. Data collected during each phase will be evaluated to determine whether the subsequent phase is necessary. The KDHE project manager and the CCC/USDA will be contacted during each phase and kept apprised of the results. Whether implementation of each phase of work is necessary will be discussed and mutually agreed upon by the CCC/USDA and KDHE project managers.

Proposed phases of work for the investigation at Hanover are as follows:

- **Phase 1.** Identify potential soil sources, and determine the vertical and lateral distribution of potential soil contamination beneath the former CCC/USDA facility.
- **Phase 2.** Determine the potential vertical and lateral extent of groundwater contamination beneath the former CCC/USDA facility, and obtain data to accurately characterize the site lithology, hydrostratigraphy, and groundwater flow.
- **Phase 3.** Delineate the off-site vertical and lateral extents of the groundwater plume emanating from any potential source areas identified on the former CCC/USDA facility, and develop a monitoring system to evaluate groundwater flow patterns. This is a contingency phase to be pursued only if data indicate that contamination associated with the former CCC/USDA facility has migrated off the property.
- **Phase 4.** Install additional monitoring wells to augment data collected during Phases 1-3 and to establish a long-term monitoring network. Conduct hydrogeologic testing to evaluate aquifer properties. This is a contingency phase to be pursued only if data indicate that a source area exists on the former CCC/USDA facility and that additional delineation and monitoring of the contaminant plume is warranted.
- **Phase 5.** Conduct a vapor intrusion investigation. The CCC/USDA is committed to implementing a program to address vapor intrusion if the data collected during Phases 1 and 2 indicate the potential for adverse vapor intrusion impacts to residences — relative to state criteria — due to CCC/USDA activities. A separate supplemental work plan will be developed for this phase of work. That supplemental work plan will follow the KDHE's guidance on vapor intrusion (KDHE 2007a).

This present site-specific *Work Plan* provides details on the specific technical objectives and scope of work proposed for the phased environmental investigation at Hanover. In addition to this document, Argonne has issued a *Master Work Plan* (Argonne 2002) that describes the general scope of all investigations at former CCC/USDA facilities in Kansas and provides

guidance for these investigations. That document has been approved by the KDHE and should be consulted for the complete details of plans for work associated with the former facility at Hanover, Kansas.

2 Background and Previous Studies

2.1 Site Background

2.1.1 Area Description

Hanover, Kansas, is a rural city located in northeastern Washington County, in Section 9, Township 2 South, Range 5 East, approximately 78 mi northwest of Manhattan, Kansas, and 90 mi southwest of Lincoln, Nebraska (Figure 2.1). Hanover is a state historic site known for the Hollenberg Pony Express Station. The city has numerous small businesses, the Farmers Co-op Association, and a hospital. It also has a public school, a library, a weekly newspaper, a recreation facility, and churches.

The 2000 Census recorded 653 people in 329 housing units in the city of Hanover. The residents of the city are served by a public water supply system that obtains water from Washington County Rural Water District (RWD) #1, which has wells outside the investigation area.

2.1.2 Former CCC/USDA Grain Storage Facility

The CCC/USDA operated a grain storage facility from 1950 to the early 1970s on approximately 6.5 acres at the northeast edge of the Hanover (Figure 2.2). The property is now a residential area with nine homes located within or adjacent to the boundary of the former facility.

The historical ownership of the former facility was determined on the basis of property documents acquired from the Washington County Courthouse. Aerial photos showing the layout of the former facility in 1957, 1969, 1978, and 2006 are shown in Figure 2.3. Figure 2.4 shows the property ownership and lease boundaries over time. A summary of historical ownership and property records is in Table 2.1. The property documents are reproduced in Appendix A.

The information in Table 2.1 and Figure 2.4 shows the progression of leases and property ownership during CCC/USDA's presence on the property. The CCC/USDA initially leased 4.0 acres from Wilfred and Loretta Poell for a period of 15 years from July 19, 1950, until

July 19, 1965. In 1954 a supplemental lease expanded the CCC/USDA property to 5.4 acres. In 1955, the Poells sold a number of tracts of land, including the property leased to the CCC/USDA, to Charles and Ruth Schwartz. The CCC/USDA lease continued with the property transfer to the Schwartzes.

The 1957 aerial photograph shows an array of 159 grain bins on the site (Figure 2.3). In 1966, the lease of the property (from Schwartz) was extended until 1971, and the size of the property was increased to 6.5 acres. The 1969 aerial photograph shows an array of 223 grain bins and one rectangular building (Figure 2.3). In addition, the community swimming pool had been installed east of the CCC/USDA grain bin facility (Figure 2.4). In 1971, the lease between Schwartz and the CCC/USDA was extended for a period of 5 years, from July 31, 1971, to July 31, 1976. No lease termination agreement was on file.

In October 16, 1971, the Schwartzes sold the property including the area of the former CCC/USDA facility to Roger Warren, who intended to develop the land for residential use. In 1973, all grain bins were sold at auction and removed from the former CCC/USDA facility. The plan was to subdivide the property into 16 lots and develop it as the Warren Addition to the city. The Warren plot plan was approved in July of 1974. The first residents (Leonard and Eleanora Meier) bought lots 11 and 12 in 1975.

The 1978 aerial photograph (Figure 2.3) shows that all grain bins had been removed and four homes built within the footprint of the grain bin array (Meier, S. Jueneman, L. Jueneman, Poell). A fifth home was on the southern boundary of the former CCC/USDA property (Goeckel). The 2006 aerial photograph indicates that the former facility is currently occupied by eight residential properties (Meier, S. Jueneman, L. Jueneman, Bruna, K. Hynek, Poell, J. Hynek, and Hagedorn.). In addition, the Goeckel property is adjacent to the southern edge of the former CCC/USDA facility.

2.1.3 Private Grain Storage Facility

A major private grain storage facility, operated by the Farmers Cooperative Association (the Co-op), is located approximately 2,000 ft west of the former CCC/USDA property (Figures 2.2 and 2.5). This facility has several grain elevators and storage buildings. The 1957 and 1969 aerial photographs indicate that the first two elevators were built on the west side of the

railroad track between 1957 and 1969. Subsequent grain operations at that location might also provide a potential source for groundwater contamination detected in some private wells.

2.2 Previous Investigations

The limited investigations of the carbon tetrachloride contamination at Hanover conducted to date include the following KDHE studies:

- Private well sampling in early 1998
- Pre-CERCLIS site reconnaissance and evaluation (SRE) in July 1998
- Private well sampling in April 2006

These prior investigations, as well as actions by the CCC/USDA to address residents' health concerns and other investigations for groundwater contamination surrounding the former facility, are discussed below.

2.2.1 Private Well Sampling in February and April 1998

Carbon tetrachloride contamination was initially detected at levels below the MCL in 1998, during the statewide USDA private well sampling program (KDHE 1998). Three private wells were sampled by the KDHE in February 1998 (Table 2.2 and Figure 2.5). Carbon tetrachloride and chloroform were detected in the Alan Bruna well (405 E. North Street), approximately 1,000 ft south of the former CCC/USDA facility, at 1.3 µg/L and 3.0 µg/L, respectively. A low level of carbon tetrachloride, 1.0 µg/L, was also detected in the Ebeling well (2285 Shady Boulevard) located north-northeast of the former facility. No carbon tetrachloride was detected at a detection limit of 0.5 µg/L in an abandoned school well (USD 223) approximately 1,100 ft east-southeast of the former facility.

The Bruna and Ebeling wells were resampled in April 1998 (KDHE 1998). Carbon tetrachloride and chloroform were detected again in the Bruna well at 1.0 µg/L and 1.8 µg/L,

respectively. Only a trace amount of carbon tetrachloride (0.5 µg/L) was found in the Ebeling well.

2.2.2 Pre-CERCLIS Site Reconnaissance and Evaluation in July 1998

On July 7, 1998, the KDHE collected soil samples at the Hanover site by using direct-push technology as part of its SRE (KDHE 1998). The objective was to determine whether the former CCC/USDA facility could be a source of the carbon tetrachloride contamination detected in the private wells. Subsurface soil samples were collected at 10.5-11.5 ft BGL at nine locations (SP-1 to SP-9) across the site (Figure 2.6). Shale was encountered at approximately 13 ft BGL in the western portion of the site and 21 ft BGL in the eastern portion of the site. Two additional soil samples were collected at a depth of 19.5 ft BGL on the eastern side (SP-6 and SP-7), where the depth to shale is relatively deep.

All soil samples were analyzed in the field by using a gas chromatograph with an electron capture detector (Table 2.2). Carbon tetrachloride was detected at 3.9 µg/kg at one location (SP-9 at 11.5 ft BGL) at the northwest edge of the former facility. Only trace concentrations (0.1-0.2 µg/kg) of carbon tetrachloride were detected in 5 of the 10 soil samples collected at other locations. Four samples (SP-1, SP-7, SP-8, and SP-9) were submitted for off-site verification analysis. The off-site analyses indicated carbon tetrachloride contamination at 7.1 µg/kg in the soil sample collected at location SP-9 (11.5 ft BGL) (which had been analyzed in the field with a result of 3.9 µg/kg). The other three soil samples showed no carbon tetrachloride or chloroform in the verification analysis, at a method limit of 1.0 µg/kg. All results are summarized in Table 2.2.

As part of the July 1998 SRE (KDHE 1998), the KDHE resampled the Bruna and Ebeling private wells and sampled two additional lawn and garden wells (Meyn and Doebele). The locations are shown in Figure 2.5, and the analytical results are in Table 2.2. Carbon tetrachloride and chloroform were detected in the Bruna well at 1.1 µg/L and 1.9 µg/L, respectively. The groundwater sample from the Ebeling well also showed a trace amount of carbon tetrachloride (0.6 µg/L). In the Meyn lawn and garden well, located approximately 1,000 ft west of the former CCC/USDA grain storage facility, carbon tetrachloride and chloroform were detected at 5.9 µg/L and 0.8 µg/L, respectively. No contamination was detected in the Doebele lawn and garden well to the south-southwest of the former facility.

2.2.3 Private Well Sampling in April 2006

In April 2006, the KDHE resampled two private wells (Bruna and Meyn) where contamination had been detected in the previous sampling events (Table 2.2 and Figure 2.5). Analysis was performed by an off-site laboratory. The sample collected from the Meyn well contained carbon tetrachloride at 4.3 µg/L, below the MCL. No carbon tetrachloride was detected in the Bruna well. A low level of chloroform (1.5 µg/L), however, was still present in the Bruna well (KDHE 2007b).

2.2.4 Near-Surface Soil and Indoor Air Sampling in 2007

In 2007, the CCC/USDA conducted near-surface soil sampling across the former facility and indoor air sampling in the nine residences on and adjacent to its former property. The objective was to address residents' concerns regarding the potential for residual carbon tetrachloride to be present in near-surface soils, as well as for vapor intrusion into homes at the former CCC/USDA grain storage facility. The results for soil samples and indoor air samples are summarized in Tables 2.3 and 2.4, respectively.

Near-surface soil samples were collected at a depth of 1.8-2 ft BGL by using a hand-driven coring device, at 61 locations across the former CCC/USDA facility (Figure 2.7). The sampling locations were evenly distributed in the accessible areas between houses. A background soil sample was collected at a location along the southern edge of the Cemetery Road, approximately 180 ft north of the former facility (Figure 2.7). All soil samples were collected on April 19, 2007, preserved on dry ice, and shipped to the Applied Geosciences and Environmental Management (AGEM) Laboratory at Argonne for analysis.

The soil samples were analyzed by using the heated-headspace and purge-and-trap methods as described in the *Master Work Plan* (Argonne 2002). Heated-headspace analysis is a highly sensitive screening method; the results can be used as an indicator of possible soil contamination in the deeper vadose zone (Alvarado and Rose 2004). In this application, the headspace data are not used quantitatively but are examined for distribution patterns in order to prioritize areas for additional, follow-up sampling and analysis of deeper subsurface soils. The purge-and-trap method is a quantitative analysis using the more rigorous gas chromatograph-mass spectrometer analytical method with a quantitation limit of 10 µg/kg.

Trace concentrations of carbon tetrachloride and chloroform were detected by the heated-headspace analytical method, and no detectable concentrations were found by the purge-and-trap analysis. Headspace results for carbon tetrachloride and chloroform are shown in Figure 2.7 and Table 2.3. Patterns of higher carbon tetrachloride concentrations in soil are illustrated as shaded areas on Figure 2.7. An area with concentrations exceeding $1.0 \mu\text{g}/\text{kg}$ in the center of the former facility, among four houses, has a southward extension to the southern edge of the former facility. Three additional small areas with carbon tetrachloride above $1.0 \mu\text{g}/\text{kg}$ are in the northern, northwestern, and southwestern parts of the former facility. The four areas, as shown on Figure 2.7, appear to be the most likely locations for possible contamination of underlying subsurface soils.

In analysis by the heated-headspace screening method, only two soil samples showed detectable concentrations of chloroform ($0.8\text{-}1.0 \mu\text{g}/\text{kg}$). These samples were collected in the northeastern part of the former facility.

In July 2007, indoor air samples were collected from the basement areas of nine residences on or adjacent to the former CCC/USDA property (Figure 2.8). Samples of background air were also collected outside two of the residences. All air samples were analyzed by Severn-Trent Laboratories with U.S. Environmental Protection Agency (EPA) Method TO-15.

As the analytical results indicate, carbon tetrachloride was detected in the air samples collected in four of the nine residences at concentrations ranging from 1.4 to $4.8 \mu\text{g}/\text{m}^3$ (Table 2.4 and Figure 2.8). The carbon tetrachloride concentrations detected in the four residences exceeded the Kansas Tier 2 risk-based regulatory standard of $0.893 \mu\text{g}/\text{m}^3$ for carbon tetrachloride in indoor air. This standard was updated by the KDHE in June 2007 (KDHE 2007c).

Chloroform was also detected in five of the nine homes, at concentrations of $1.1\text{-}4.4 \mu\text{g}/\text{m}^3$. These detections showed no apparent correlation with the chloroform concentrations identified in near-surface soil samples. Some of the homes with relatively high chloroform concentrations are near the community swimming pool east of the former CCC/USDA facility. Proximity to the pool could be a contributing factor to the concentrations detected.

2.2.5 Additional Investigations Related to Petroleum Contamination Detected in Hanover

In 1996, approximately 6,000 gal of unleaded gasoline was discovered to have leaked from a bulk aboveground storage tank (AST) at a gas station owned by Bill's Service Center, approximately 500 ft east from the east edge of Hanover (Figure 2.2). The AST is approximately 1,000 ft southeast of the former CCC/USDA facility. The releases resulted in contamination of soil and groundwater by petroleum constituents. None of the petroleum-related contamination is associated with the former CCC/USDA facility.

In 1997 and 1999, GeoCore Services, Inc., conducted two limited environmental site assessments, on behalf of the Bill's Service Center location southeast of the former CCC/USDA facility (GeoCore 1997, 1999). The site assessment work included 15 soil borings, hydrogeologic testing, and the installation of 7 permanent monitoring wells. The GeoCore reports provide detailed results regarding the distribution of petroleum products in soil and groundwater at and around the AST site (GeoCore 1997, 1999). No analytical results for carbon tetrachloride or chloroform were reported.

Groundwater at Bill's Service Center was encountered in the Permian bedrock (gray-green to brown, red-brown shale) at approximately 41-45 ft BGL. The estimated groundwater flow is generally toward the southeast, with an average hydraulic gradient of 0.016-0.026 ft/ft.

An additional release of petroleum occurred at a second Bill's Service Center site within the city (Figure 2.2). This facility is approximately 1,100 ft southwest of the former CCC/USDA facility. Leaking underground storage tanks were removed from this property in 1997. No investigation has been conducted to determine the impact and extent of contamination associated with the petroleum release at this site.

2.3 Geologic and Hydrogeologic Setting

2.3.1 Regional Geology and Hydrogeology

Hanover lies at the western edge of Glaciated Region physiographic province in northeastern Kansas. This region of Kansas experienced several periods of continental glaciation, each of which deposited a ground moraine of unconsolidated drift (till) during the Pleistocene.

Hanover, however, may have experienced limited impact by glaciers because of its location at the boundary of this region. Since withdrawal of the glaciers, this region has undergone erosion, principally by headwater migration and downcutting of streams, as well as deposition of eolian silt and clay on upland areas and alluvium sediments in floodplains along major streams. The portion of Washington County surrounding Hanover is mainly dissected and drained by the Little Blue River and its tributary creeks, such as Cottonwood Creek (Figure 2.9).

The bedrock beneath the Pleistocene eolian and/or alluvium sediments in the eastern portion of the Washington County consists of Wellington Shale of the Sumner Group and underlying interbedded shales and limestones of Chase Group. Both were deposited during the Permian age. The bedrock surface exhibits pre-Pleistocene erosion — especially near the Little Blue Valley — cutting through the entire Cretaceous System, the Permian Wellington shale of the Sumner Group, and the Chase Group. The total relief of the bedrock may exceed 200 ft. The Wellington shale of the Sumner Group has been eroded and is not present in Hanover.

The weathered zone near the top of the bedrock (the shale and limestone unit) forms a regional water-bearing unit that yields small quantities of hard water in upland areas such as Hanover. The thickness of the weathered zone at the top of the Permian shale and limestone unit is currently unknown, on the basis of available data. The degree of weathering of this unit may vary depending on lithology and depth.

2.3.2 Local Geology and Hydrogeology

The former CCC/USDA grain storage facility at Hanover is located in uplands northeast of the Little Blue River and its floodplain and northwest of Cottonwood Creek. The land surface elevation of the former facility is approximately 1,310-1,330 ft above mean sea level (AMSL). A local surface drainage divide extends roughly in a north-to-south direction through the former CCC/USDA facility.

The headwaters of several intermittent creeks dissect the surface to the east, south, and west of the site, creating local relief of 50-70 ft (Figure 2.9). The intermittent creeks drain the area of the former facility to the Cottonwood Creek southeast of the former facility and to the Little Blue River southwest and south of the former facility. Cottonwood Creek flows in a southwesterly direction into the Little Blue River. The Little Blue River flows south to

southeasterly and borders the western edge of Hanover. Coupled with the surface drainage divide, the dissecting creeks potentially create a complex hydrogeologic system that will significantly impact the course of this investigation.

Geologic and hydrogeologic information for the local Hanover area was obtained from KDHE water well registration records and results of previous investigations of groundwater contamination. In an area within 1 mi of the former CCC/USDA facility, 32 water well records were found, including records for 22 private water wells, 1 plugged city public water supply (PWS) well, and 7 monitoring wells (Figure 2.10). All of these water wells penetrate the Permian bedrock to the Chase Group shale and limestone unit, except for the shallow, hand-dug PWS well that has been plugged. The local water well data indicate that the depths of private wells and monitoring wells range from 41 ft to 110 ft BGL. Water is produced mainly from the upper portion of the Chase Group shale and limestone unit in uplands or the alluvial aquifer in the Little Blue River valley.

The water well records used to construct geologic/hydrogeologic cross sections for this document are in Appendix B. These records are summarized in Table B.1, Appendix B. The locations of the geologic/hydrogeologic cross sections are shown in Figure 2.10, and the interpretative cross sections are in Figures 2.11 and 2.12. Cross section A-A' runs approximately 1,000 ft south of the former CCC/USDA facility and extends west-east from the Little Blue River valley to the uplands across the surface drainage divide (Figure 2.11). Cross section B-B' also starts from the Little Blue River valley; it initially extends northeastward and then northward to the uplands along the surface drainage divide at the former CCC/USDA facility (Figure 2.12).

The interpretations presented in cross section A-A' (Figure 2.11) indicate that the Permian bedrock high is generally consistent with the surface drainage divide, where the former CCC/USDA facility is located. A thin eolian unit of silty clay (3-17 ft) unconformably overlies the Chase Group shale and limestone unit along the bedrock high. The thickness of the silty clay unit increases at the slope of the hill (45 ft at the D. Minge well) and becomes relatively thinner again at the Schmidt well and the former city PWS well (20-26 ft) in the valley of the Little Blue River.

Underlying the silty clay unit are alluvium deposits developed on the bedrock in the Little Blue River valley, with a thickness of more than 20 ft. The results of previous KDHE (1998)

investigations indicate an anticipated depth of 10-25 ft BGL for the shale and limestone unit at the former CCC/USDA facility.

The bedrock aquifer appears to host the potentially contaminated groundwater at and near the locations of the private wells and beneath the former CCC/USDA facility. Water levels measured from 1997 to 2007 by GeoCore (1997, 2007) in monitoring wells MW9 and MW10 were approximately 42-45 ft BGL. These values are more reliable than the water levels reported for private wells. The difference in surface elevations between the monitoring wells and the former CCC/USDA facility and the hydraulic gradient of 0.016-0.026 ft/ft indicate that the water level at the former facility can be anticipated at approximately 40-55 ft BGL.

The interpretations presented in cross section B-B' (Figure 2.12) indicate similar local geologic and hydrogeologic settings. In the uplands, the depth to the Chase Group shale and limestone unit is 1-8 ft BGL, and water levels occur at 40-60 ft BGL. The unsaturated zone extends from the silty clay to the top of the saturated bedrock unit.

In general, groundwater flow patterns on both cross sections mimic the surface topography. The former CCC/USDA facility is located on the bedrock high. Groundwater west of the bedrock high likely flows west to southwest, seeping to the Little Blue River; groundwater east of the bedrock high probably flows southeast, discharging to the Cottonwood Creek. At the Bill's Service Center AST site southeast of the former CCC/USDA facility (Figure 2.2), the groundwater flow direction has historically been to the southeast (GeoCore 1997, 1999). This finding confirms the local southeasterly groundwater flow pattern east of the bedrock high.

The interpretations for the two cross sections (Figures 2.11 and 2.12) indicate that the nature of the aquifer in the area varies significantly. The bedrock aquifer is believed to be unconfined in the uplands, semi-confined to confined along the hill slopes, and unconfined in the alluvial aquifer in the Little Blue River valley.

The permeability of the bedrock aquifer is reported to be low. The hydraulic conductivity of the upper water-bearing zone in the shale was estimated, on the basis of slug test results, at approximately 0.2 ft/day (GeoCore 1997).

2.4 Summary

The findings of a comprehensive review of data from previous investigations and regional and local data relevant to geology and hydrogeology of the Hanover site are summarized as follows:

- The CCC/USDA operated a grain storage facility from 1950 to the early 1970s on approximately 6.5 acres in the northeast part of the city. The facility reached a maximum operational scale in the late 1960s with 223 grain bins and 1 storage building. Nine residences are located on or adjacent to the former CCC/USDA property.
- In 1998, five private wells were sampled as part of the USDA private well sampling program and the subsequent KDHE SRE investigation. Carbon tetrachloride was found in groundwater at a concentration (5.9 µg/L) exceeding the MCL at one private well (Meyn). This result was confirmed in 2006 at a lower level (4.3 µg/L). The well is used for lawn and garden purposes and is approximately 1,000 ft west of the former CCC/USDA facility. Trace (~ 1 µg/L) to no contamination was detected in groundwater samples collected from five private wells surrounding the former CCC/USDA facility.
- In July 1998, the KDHE collected 11 soil samples above the bedrock (9 samples at 10.5-11.5 ft BGL and 2 samples at 19.5 ft BGL) in a pre-CERCLIS SRE investigation. All soil samples showed trace or no carbon tetrachloride contamination, except for one collected at the west edge of the former CCC/USDA facility. A low level of carbon tetrachloride (7.1 µg/kg) was detected at 11.5 ft BGL at this location (SP-9).
- In April 2007, Argonne collected near-surface soil samples at 1.8-2 ft BGL at 61 locations across the former CCC/USDA facility. Analysis of soil samples using the heated-headspace method as a screening tool indicated four areas with slightly higher carbon tetrachloride concentrations, which warrant further investigation of underlying subsurface soils. No contamination was found in

analysis of the samples by the rigorous gas chromatograph-mass spectrometer analytical method (purge-and-trap method).

- In July 2007, indoor air samples were collected from the basement areas of nine residences on or adjacent to the former CCC/USDA property. Carbon tetrachloride was detected in the air samples from four residences at concentrations ranging from 1.4 to 4.8 $\mu\text{g}/\text{kg}$.
- The regional geologic sequence consists of (1) a few feet of topsoil overlying an eolian silty clay unit in upland areas and alluvial sand deposits in the Little Blue River valley at various thicknesses and (2) an underlying weathered bedrock unit of Permian shale and limestone. Groundwater is produced mainly from the upper portion of the shale and limestone unit in uplands or the alluvial aquifer in Little Blue River valley.
- The former CCC/USDA facility is located on uplands at a local surface drainage divide that is consistent with the bedrock high. The expected geologic sequence consists of a thin (10-25 ft) layer of silty clay that unconformably overlies the weathered shale and limestone unit of the Permian Chase Group, which hosts potentially contaminated groundwater.
- Groundwater is estimated at 40-55 ft BGL within the bedrock; the groundwater might exhibit patterns of radial flow that mimic the local topographic relief. From the bedrock high at the former CCC/USDA facility, groundwater flow *east* of the facility is likely from east to southeast, while *west* of the facility flow is likely from west to southwest. Along the bedrock high (or the drainage divide), the flow may be toward the south.

TABLE 2.1 Documented transactions and activities for the former CCC/USDA property at Hanover.^a

Document Date	Lease Length	Grantor	Grantee	Description	Total Acreage Leased by CCC
7/19/50	7/19/50-7/19/65	Wilfred and Loretta Poell	CCC	Original lease.	4.0
7/31/54	7/31/54-7/31/59	Wilfred and Loretta Poell	CCC	Supplemental lease; includes property to the east of the original lease.	1.4
3/24/55	Unknown	Wilfred and Loretta Poell	Charles and Ruth Schwartz	Warranty deed for 28.8 acres, including the CCC-leased property.	5.4
3/23/59	7/31/59-7/19/65	Charles and Ruth Schwartz	CCC	Lease extension for 6 years, so that the expiration dates of both parcels will coincide.	5.4
6/15/66	7/31/66-7/31/71	Charles and Ruth Schwartz	CCC	Lease extension for 5 years; expanded the total leased acreage to the east.	6.5
2/17/71	7/31/71-7/31/76	Charles and Ruth Schwartz	CCC	Lease extension for 5 years.	6.5
10/16/71	Unknown	Charles and Ruth Schwartz	Roger D. Warren	Warranty deed for ~8 acres, including the former CCC-leased property. ^b	Unknown
1973	Unknown	Unknown	Unknown	All grain bins on the former CCC facility were sold at auction and removed from the property. No entity other than CCC used the bins prior to their removal. ^c	Unknown
7/17/74	Unknown	Unknown	Unknown	Approval of plot plan of Warren Addition (subdivided into 16 Lots), including the former CCC-leased property.	Unknown
5/1/75	Unknown	Roger and Linda Warren	Leonard and Eleanora Meier	Warranty deed for Lots 11 and 12 of the Warren Addition (the first transaction for plots in the Warren Addition).	Unknown

^a The progression of transactions and activities is illustrated in Figure 2.4. The documents are reproduced in Appendix A.

^b Neither a lease document with Warren nor a lease termination document is on file at the Washington County courthouse.

^c Schlabach (2008).

TABLE 2.2 Prior analytical results for soil and groundwater samples collected at Hanover.

Location	Sample			Field Analysis (ppb) ^a	Laboratory Analysis (ppb) ^a		
	Date	Medium	Depth (ft BGL)	Carbon Tetrachloride	Carbon Tetrachloride	Chloroform	Nitrate
<i>Private well sampling in February 1998 (µg/L)</i>							
Bruna	2/17/98	Water	–	–	1.3	3	–
Ebeling	2/17/98	Water	–	–	1.0	0.5 U ^b	–
USD 223 ^c	2/17/98	Water	–	–	0.5 U	0.5 U	–
<i>Private well sampling in April 1998 (µg/L)</i>							
Bruna	4/6/98	Water	–	–	1.0	1.8	–
Ebeling	4/6/98	Water	–	–	0.5	0.5 U	–
<i>Soil sampling in July 1998 (µg/kg)</i>							
SP-1	7/7/98	Soil	11.5	0.2	1 U	1 U	–
SP-2	7/7/98	Soil	11.5	0.1 U	–	–	–
SP-3	7/7/98	Soil	11.5	0.1 U	–	–	–
SP-4	7/7/98	Soil	10.5	0.1 U	–	–	–
SP-4	7/7/98	Soil	11.5	0.1 U	–	–	–
SP-5	7/7/98	Soil	10.5	0.1	–	–	–
SP-5	7/7/98	Soil	11.5	0.1 U	–	–	–
SP-6	7/7/98	Soil	11.5	0.1 U	–	–	–
SP-6	7/7/98	Soil	19.5	0.1	–	–	–
SP-7	7/7/98	Soil	11.5	0.2	–	–	–
SP-7	7/7/98	Soil	19.5	0.2	1 U	1 U	–
SP-8	7/7/98	Soil	11.5	0.1 U	1 U	1 U	–
SP-9	7/7/98	Soil	11.5	3.9	7.1	1 U	–
<i>Groundwater sampling in July 1998 (µg/L)</i>							
Doebele	7/7/98	Water	–	–	0.5 U	0.5 U	–
Ebeling	7/7/98	Water	–	–	0.6	0.5 U	–
Bruna	7/7/98	Water	–	–	1.1	1.9	–
Meyn	7/7/98	Water	–	–	5.9	0.8	–
<i>Private well sampling in April 2006 (µg/L)</i>							
Bruna	4/26/06	Water	–	–	1 U	1.5	2700
Meyn	4/26/06	Water	–	–	4.3	1 U	2400

^a Parts per billion are equivalent to µg/L in water or µg/kg in soil.

^b Qualifier U indicates that the constituent was not detected at the indicated detection limit.

^c Incorrectly identified as USD 233 in the SRE report (KDHE 1998).

Sources of data: KDHE (1998, 2007b).

TABLE 2.3 Analytical results for carbon tetrachloride in near-surface soil samples collected on and near the former CCC/USDA property at Hanover on April 19, 2007.

Location	Sample	Carbon Tetrachloride ($\mu\text{g}/\text{kg}$)		Location	Sample	Carbon Tetrachloride ($\mu\text{g}/\text{kg}$)	
		Headspace Screening ^a	Purge-and-Trap GC-MS ^b			Headspace Screening ^a	Purge-and-Trap GC-MS ^b
NS01	HANS01-S-23560	ND ^c	ND	NS28	HANS28-S-23590	0.7	ND
NS02	HANS02-S-23561	0.2	ND	NS29	HANS29-S-23589	1.4	ND
NS03	HANS03-S-23562	2.5	ND	NS30	HANS30-S-23587	0.5	ND
NS04	HANS04-S-23565	0.2	ND	NS31	HANS31-S-23586	0.3	ND
NS05	HANS05-S-23566	0.1	ND	NS32	HANS32-S-23571	0.9	ND
NS06	HANS06-S-23568	0.4	ND	NS33	HANS33-S-23572	ND	ND
NS07	HANS07-S-23607	1.1	ND	NS34	HANS34-S-23573	ND	ND
NS08	HANS08-S-23609	0.6	ND	NS35	HANS35-S-23574	ND	ND
NS09	HANS09-S-23610	0.8	ND	NS36	HANS36-S-23575	ND	ND
NS10	HANS10-S-23612	0.5	ND	NS37	HANS37-S-23576	ND	ND
NS11	HANS11-S-23613	1.1	ND	NS38	HANS38-S-23579	ND	ND
NS12	HANS12-S-23614	0.6	ND	NS39	HANS39-S-23581	0.4	ND
NS13	HANS13-S-23599	1.2	ND	NS40	HANS40-S-23582	ND	ND
NS14	HANS14-S-23600	0.2	ND	NS41	HANS41-S-23584	0.2	ND
NS15	HANS15-S-23601	0.5	ND	NS42	HANS42-S-23585	1.3	ND
NS16	HANS16-S-23603	1.0	ND	NS43	HANS43-S-23583	0.1	ND
NS17	HANS17-S-23604	0.3	ND	NS44	HANS44-S-23567	ND	ND
NS18	HANS18-S-23569	ND	ND	NS45	HANS45-S-23619	0.5	ND
NS19	HANS19-S-23597	0.4	ND	NS46	HANS46-S-23618	0.2	ND
NS20	HANS20-S-23598	0.1	ND	NS47	HANS47-S-23617	ND	ND
NS21	HANS21-S-23596	ND	ND	NS48	HANS48-S-23616	ND	ND
NS22	HANS22-S-23595	1.0	ND	NS49	HANS49-S-23620	ND	ND
NS23	HANS23-S-23594	0.2	ND	NS50	HANS50-S-23615	0.9	ND
NS24	HANS24-S-23593	2.4	ND	NS51	HANS51-S-23578	ND	ND
NS25	HANS25-S-23591	1.7	ND	NS52	HANS52-S-23577	0.5	ND
NS26	HANS26-S-23592	3.2	ND	NS53	HANS53-S-23563	0.2	ND
NS27	HANS27-S-23570	1.9	ND	NS54	HANS54-S-23564	0.4	ND

TABLE 2.3 (Cont.)

Location	Sample	Carbon Tetrachloride ($\mu\text{g}/\text{kg}$)		Location	Sample	Carbon Tetrachloride ($\mu\text{g}/\text{kg}$)	
		Headspace Screening ^a	Purge-and-Trap GC-MS ^b			Headspace Screening ^a	Purge-and-Trap GC-MS ^b
NS55	HANS55-S-23580	ND	ND	NS59	HANS59-S-23625	1.2	ND
NS56	HANS56-S-23588	1.0	ND	NS60	HANS60-S-23626	ND	ND
NS57	HANS57-S-23623	0.3	ND	NS61	HANS61-S-23627	ND	ND
NS58	HANS58-S-23624	4.0	ND	BG	Background sample	ND	ND

^a Analysis by EPA Method 5021.

^b Analysis by EPA Method 8260B (gas chromatograph-mass spectrometer).

^c ND, not detected at a reporting limit of 0.1 $\mu\text{g}/\text{kg}$ for headspace analysis or 10 $\mu\text{g}/\text{kg}$ for purge-and-trap analysis.

TABLE 2.4 Carbon tetrachloride concentrations measured in indoor air at residences in Hanover, Kansas, July 2007.

Residence	Carbon Tetrachloride in Indoor Air ($\mu\text{g}/\text{m}^3$)
M. Goeckel	4.8
E. Meier	3.7
L. Jueneman	1.4
S. Jueneman	1.4
Bruna	ND ^a
Hagedorn	ND
J. Hynek	ND
K. Hynek	ND
Poell	ND

^a ND, carbon tetrachloride was not detected at a reporting limit of $1.3 \mu\text{g}/\text{m}^3$ by EPA Method TO-15.

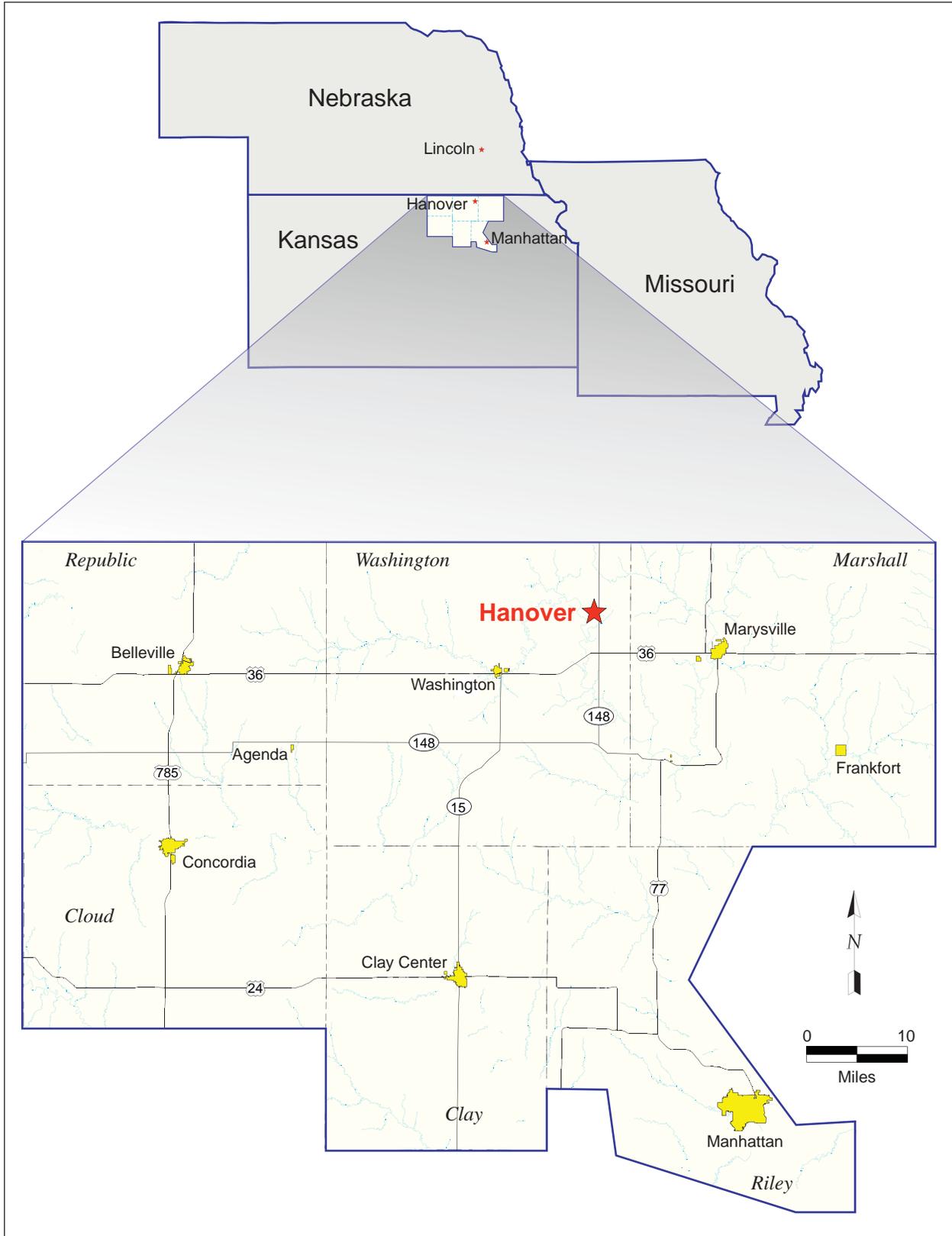


FIGURE 2.1 Location of Hanover, Kansas.



FIGURE 2.2 Location of the former CCC/USDA facility, Farmers Co-op Association, and petroleum-contaminated sites in Hanover, Kansas. Source of photograph: NAIP (2006).

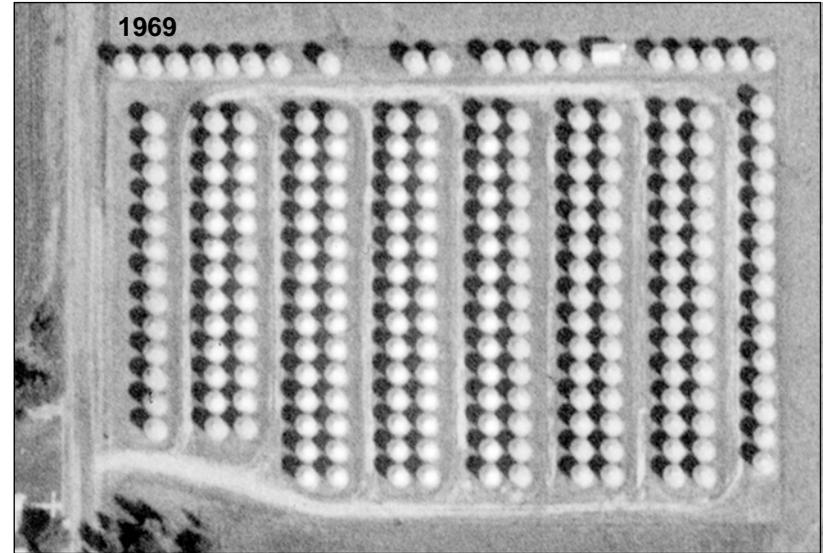
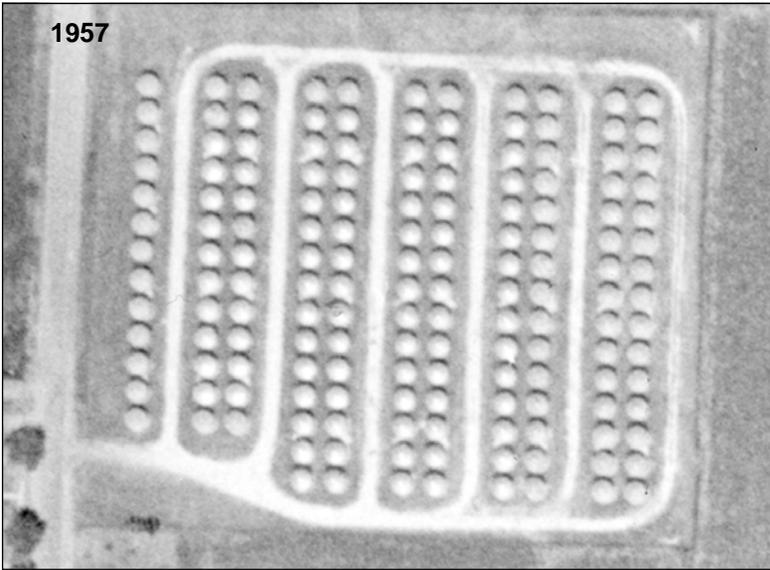


FIGURE 2.3 Historical aerial photographs of the former CCC/USDA grain storage facility at Hanover taken in 1957, 1969, 1978, and 2006. Sources of photographs: USDA (1957, 1969, 1978); NAIP (2006).

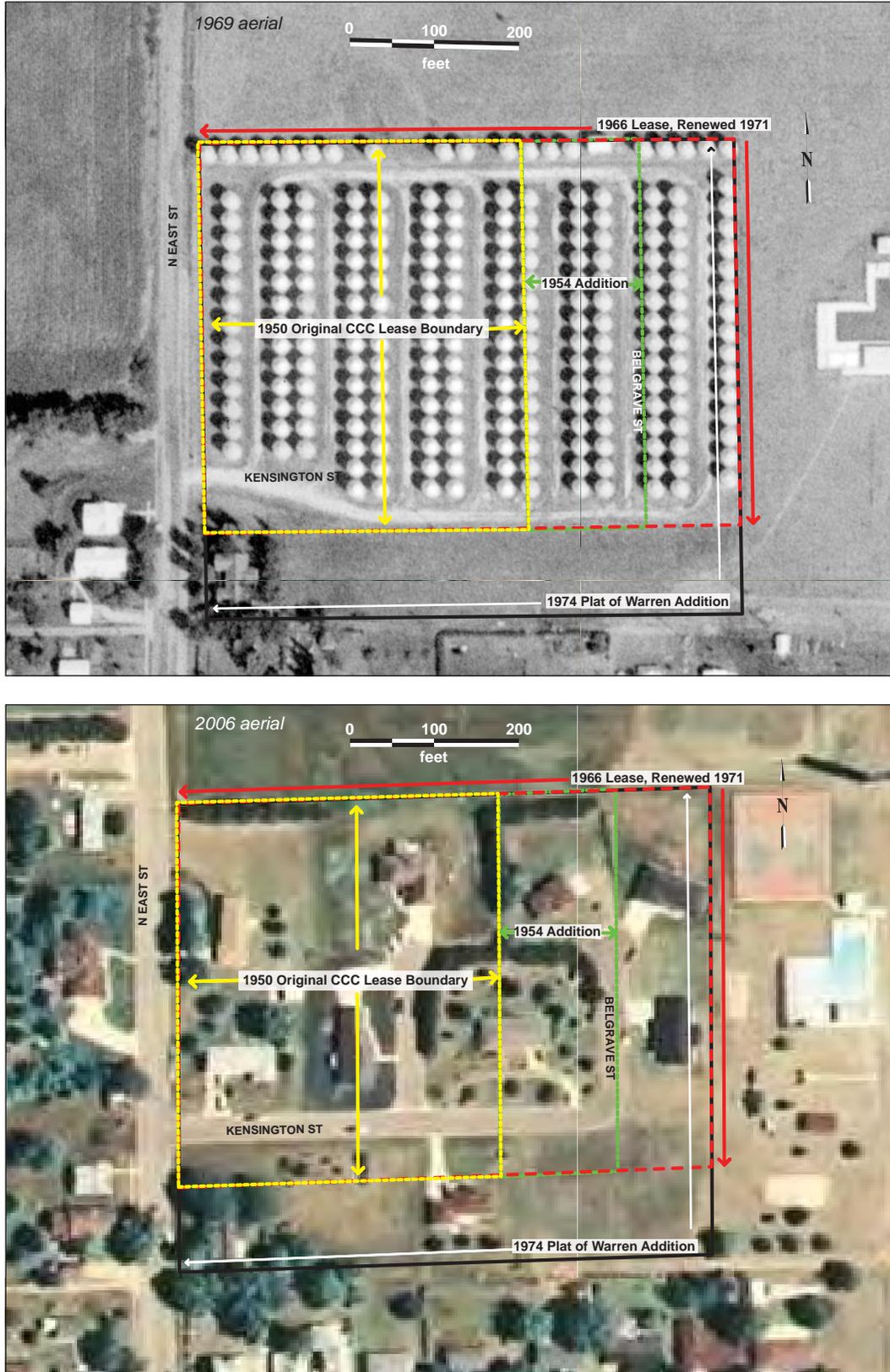


FIGURE 2.4 Progression of the CCC/USDA leases at Hanover in 1950-1971, overlain on 1969 and 2006 aerial photographs. Sources of photographs: USDA (1969); NAIP (2006).

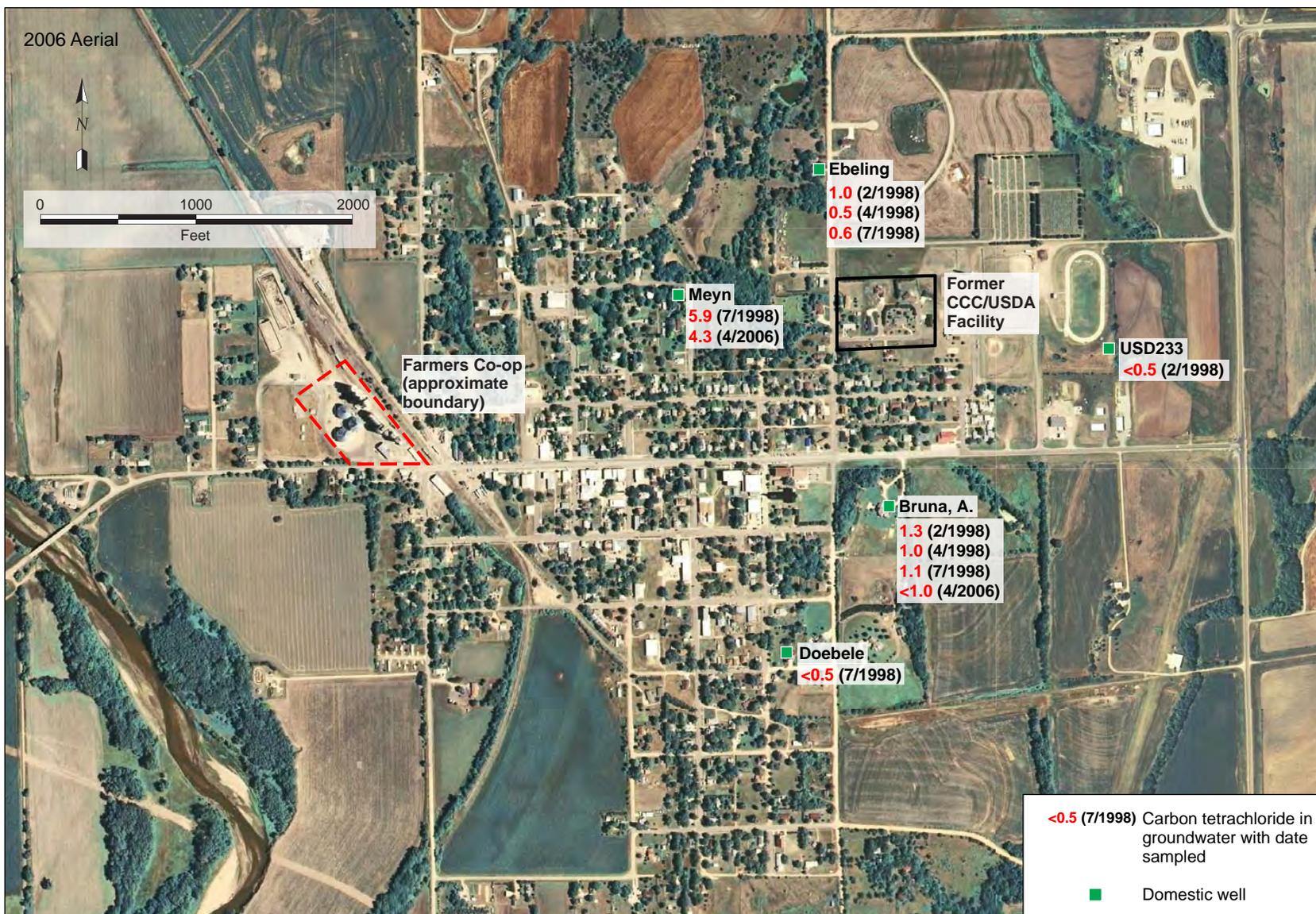


FIGURE 2.5 Historical results of analyses for carbon tetrachloride in groundwater samples collected by the KDHE from private wells in and near Hanover in February, April, and July 1998 and in April 2006. Source of photograph: NAIP (2006).

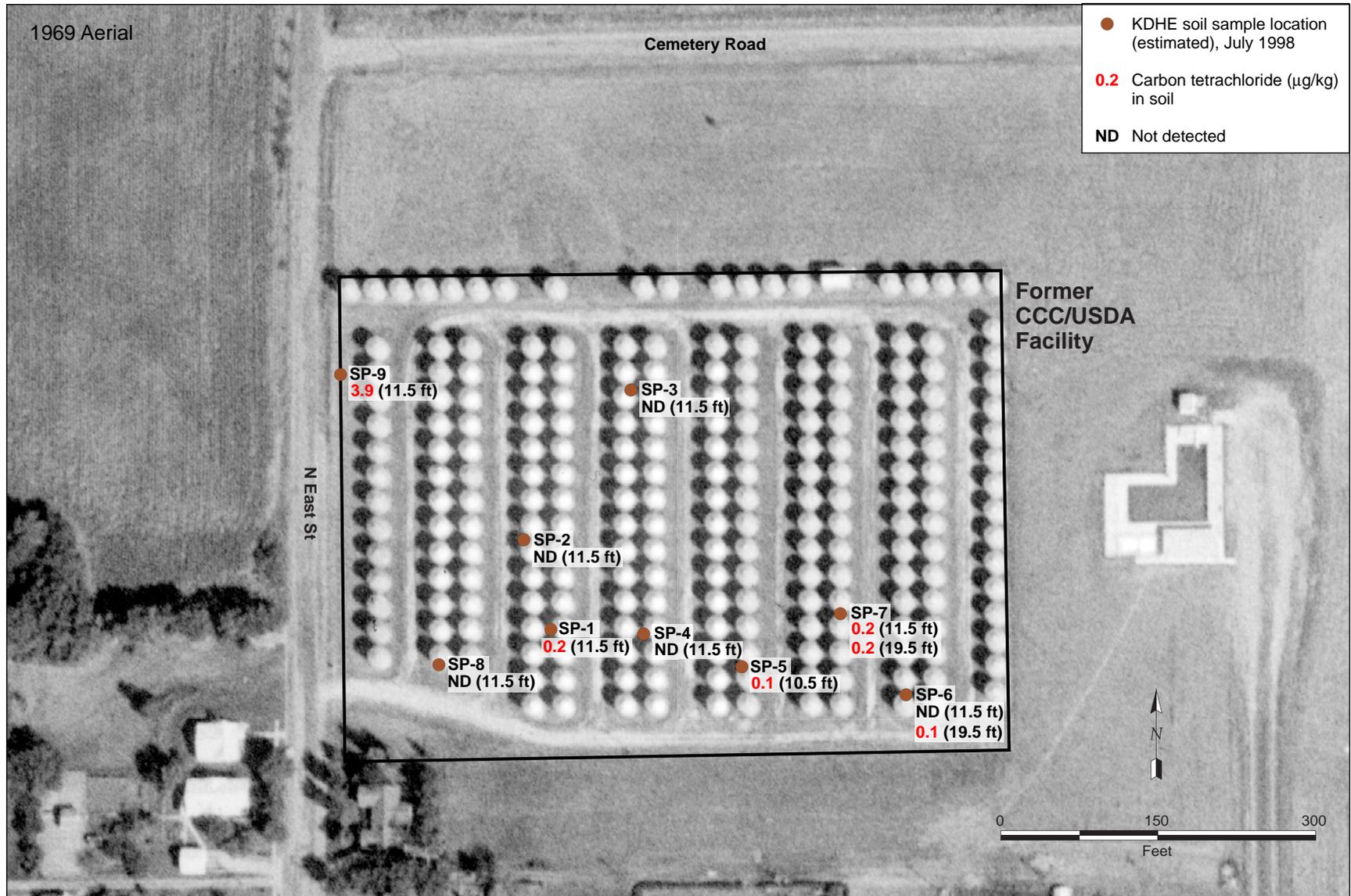


FIGURE 2.6 Field laboratory results for carbon tetrachloride in soil samples collected by the KDHE in 1998 at the former CCC/USDA facility. Sample depths were 10.5, 11.5, and 19.5 ft BGL (with the deepest samples only locations SP-6 and SP-7). Source of photograph: USDA (1969).

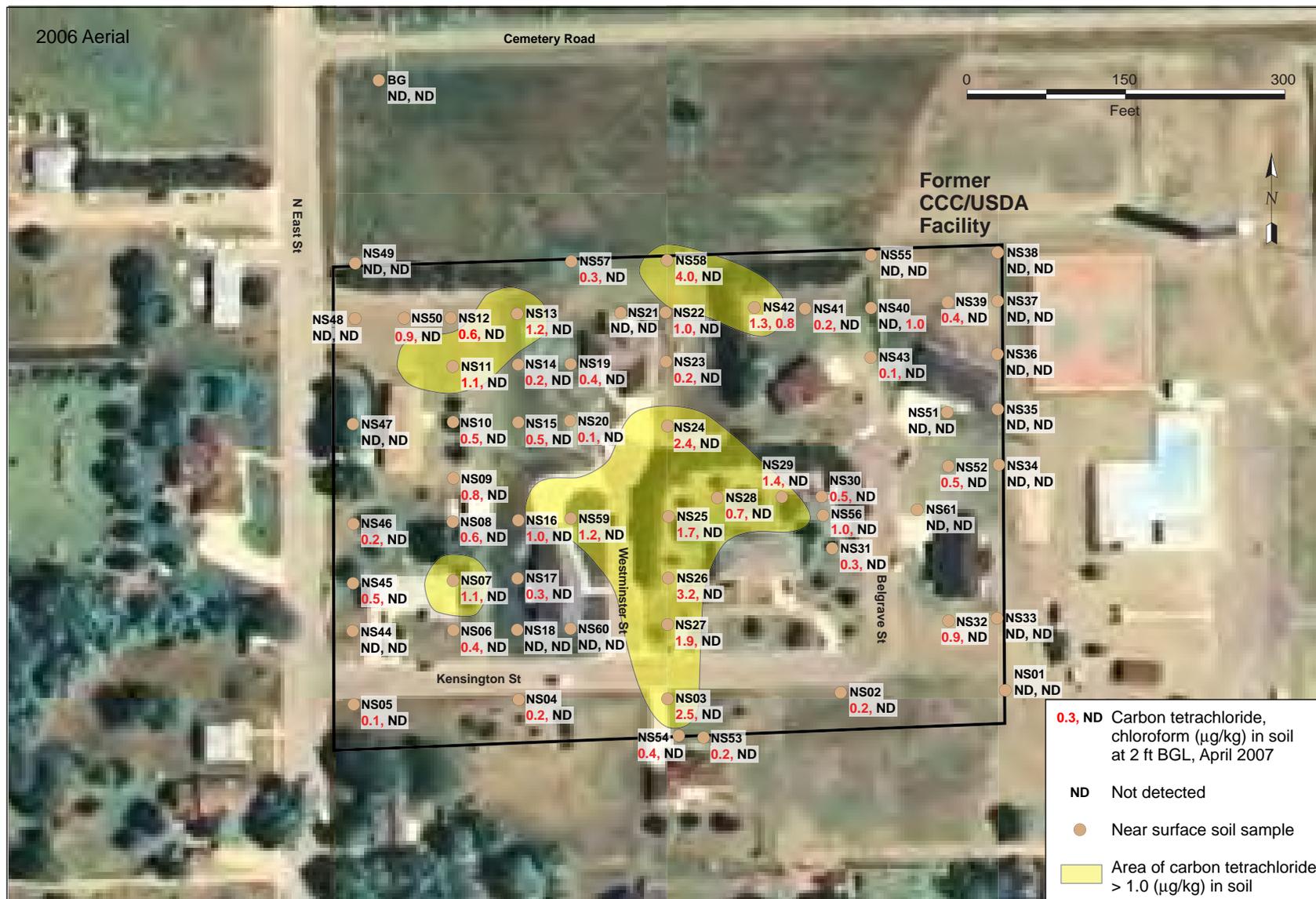


FIGURE 2.7 Results of headspace screening analyses for carbon tetrachloride in near-surface soil samples collected in 2007 at the former CCC/USDA facility. Source of photograph: NAIP (2006).



FIGURE 2.8 Results of analyses for carbon tetrachloride and chloroform in indoor air samples collected in 2007 at the former CCC/USDA facility. Source of photograph: NAIP (2006).

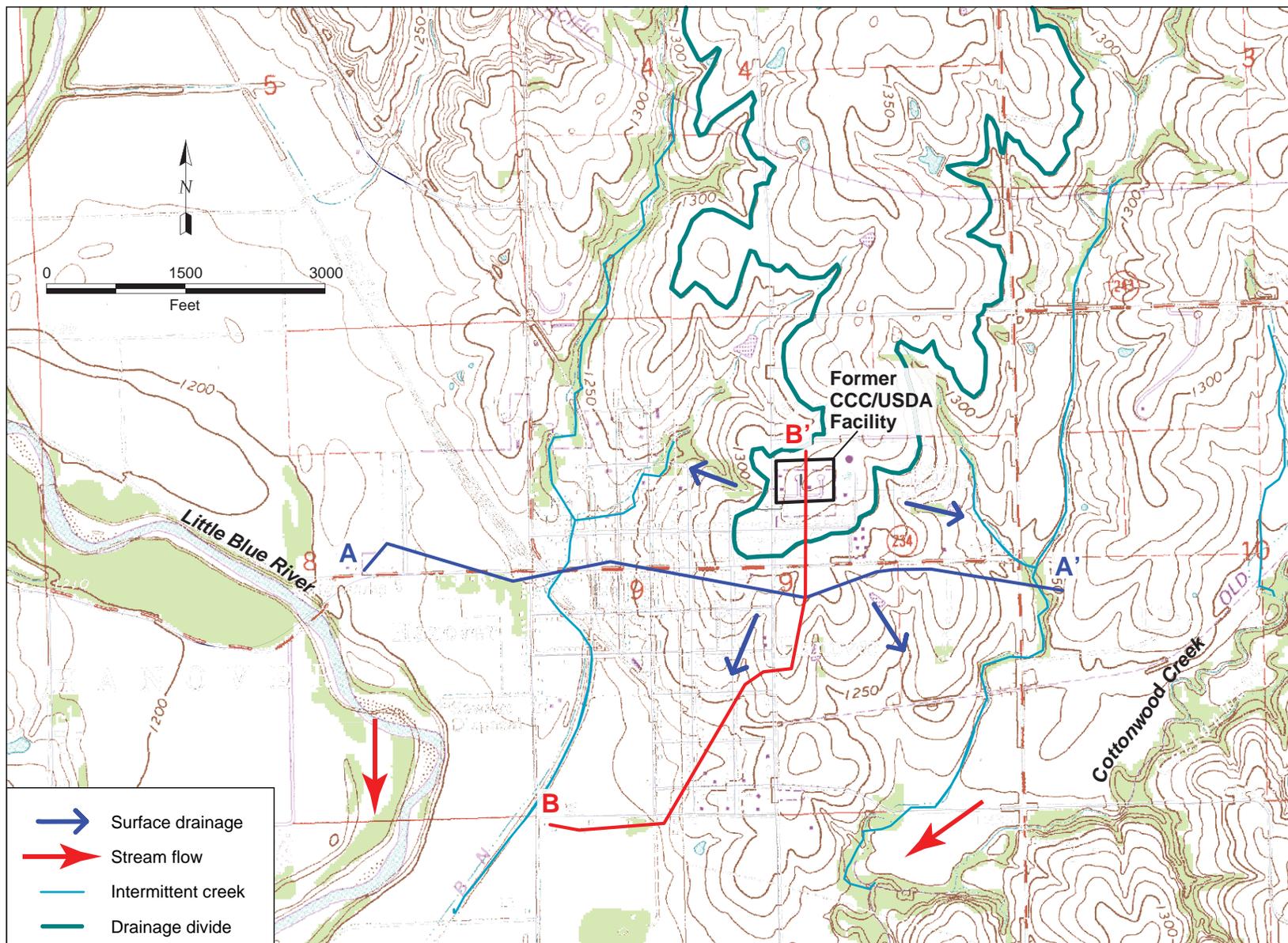


FIGURE 2.9 Surface topography in the Hilton area, showing estimated surface drainage directions. Source of map: USGS (1997).

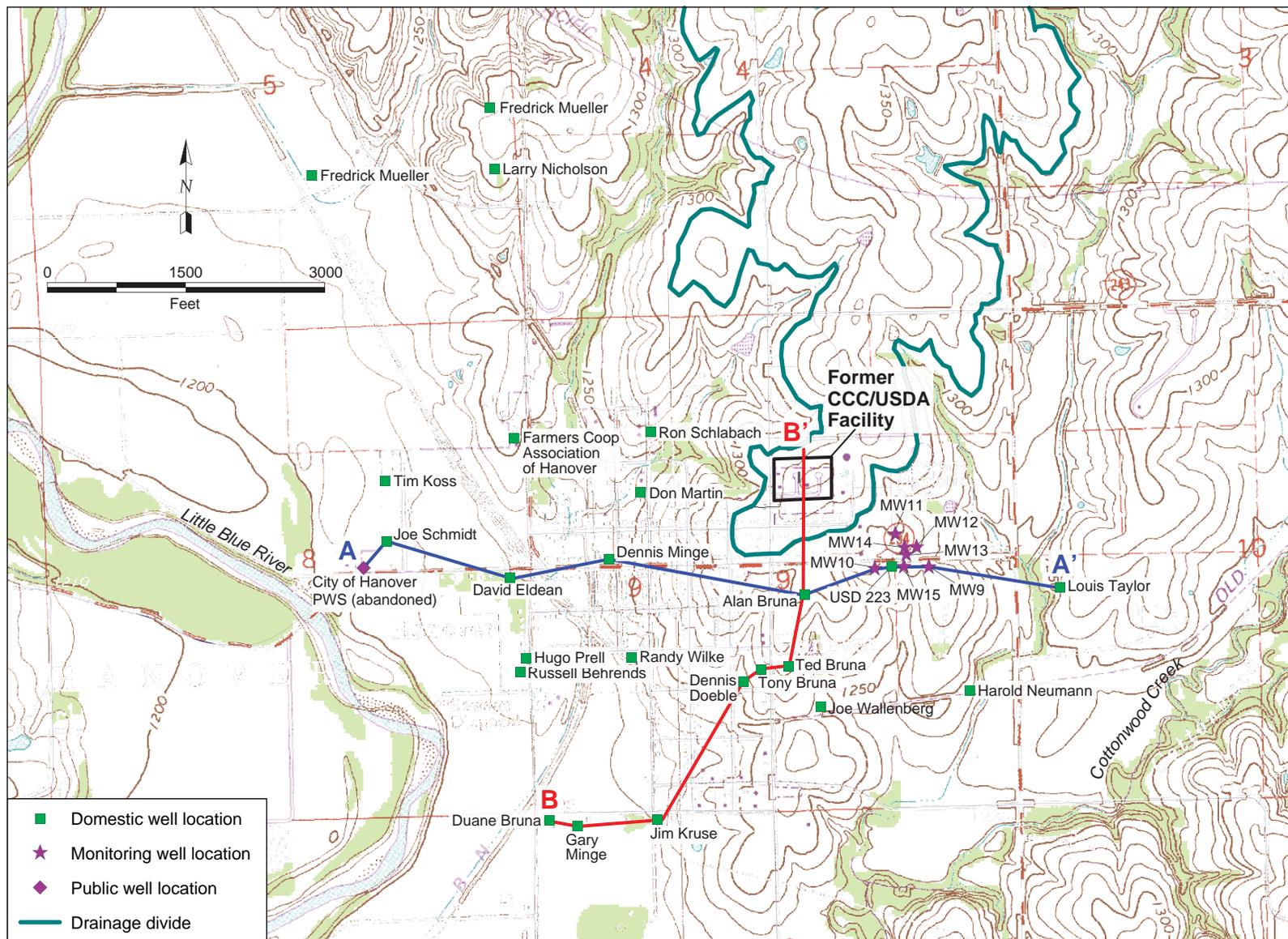


FIGURE 2.10 Locations of registered water wells within 1 mi of the former CCC/USDA facility, with locations of geologic cross sections A-A' and B-B'. Source of map: USGS (1997).

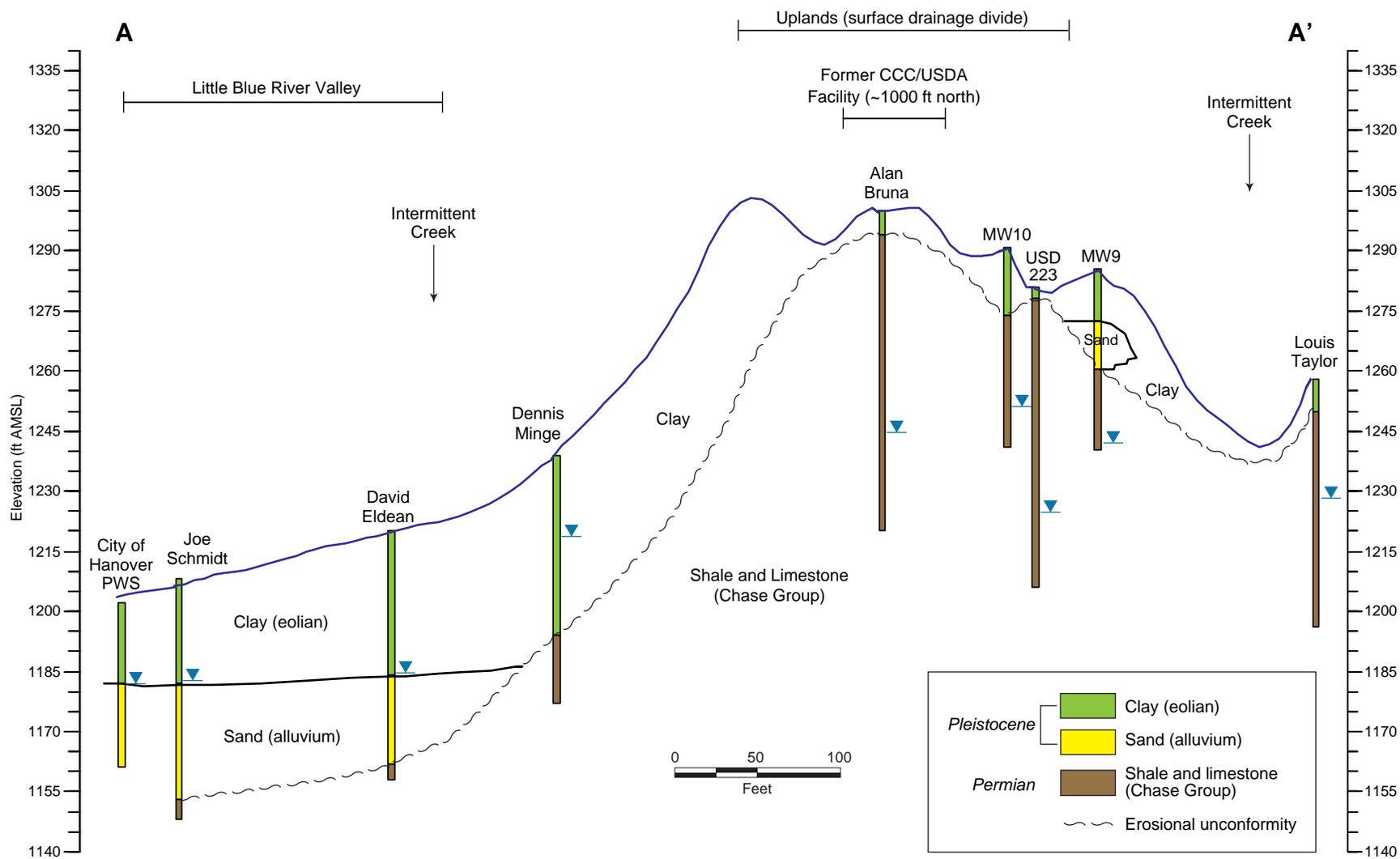


FIGURE 2.11 West-to-east geologic cross section A-A' (vertically exaggerated), illustrating the stratigraphic relationships and water levels near the former CCC/USDA facility.

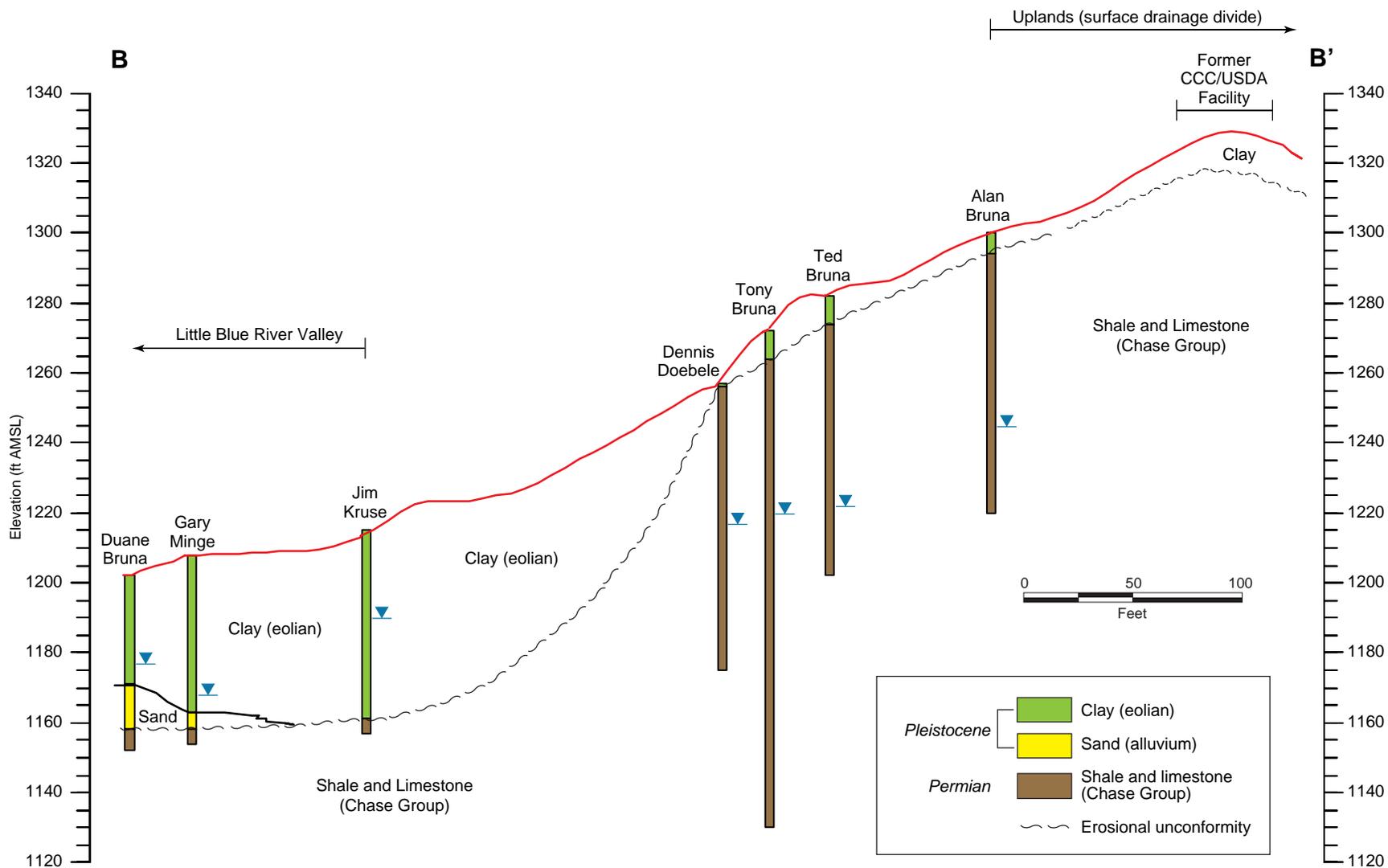


FIGURE 2.12 Southwest-to-northeast geologic cross section B-B' (vertically exaggerated), illustrating the stratigraphic relationships and water levels near the former CCC/USDA facility.

3 Proposed Technical Program

The goal of the proposed technical program at Hanover is to characterize soil and groundwater contamination associated with the past use of carbon tetrachloride-based grain fumigants at the former CCC/USDA facility. The results of the investigation will be used to determine whether the potential contamination warrants remedial action. This section describes the detailed technical objectives, the scope of proposed work, methods of investigation, and quality assurance/quality control procedures.

3.1 Technical Objectives

Seven technical objectives have been identified to meet the investigational goals. The objectives are as follows:

1. Identify the sources and extent of soil contamination beneath the former CCC/USDA facility.
2. Characterize groundwater contamination beneath the former CCC/USDA facility.
3. Determine groundwater flow patterns.
4. Define the vertical and lateral extent of the groundwater plume outside the former CCC/USDA facility.
5. Evaluate the aquifer and monitor the groundwater system.
6. Identify any other potential sources of contamination that are not related to activities of the CCC/USDA.
7. Determine whether there is a vapor intrusion problem at the site attributable to the former CCC/USDA facility.

The proposed investigation activities are guided by these technical objectives. The activities are divided into five implementation phases. Data collected during each phase will be evaluated to determine whether the subsequent phase is necessary. The CCC/USDA and KDHE project managers will be contacted during each phase and kept apprised of the results. Whether implementation of each phase of work is necessary will be discussed and mutually agreed upon by the CCC/USDA and KDHE project managers.

Proposed phases of work for the investigation at Hanover are as follows:

- **Phase 1.** Identify potential soil sources, and determine the vertical and lateral distribution of potential soil contamination beneath the former CCC/USDA facility.
- **Phase 2.** Determine the potential vertical and lateral extent of groundwater contamination beneath the former CCC/USDA facility, and obtain data to accurately characterize the site lithology, hydrostratigraphy, and groundwater flow.
- **Phase 3.** Delineate the off-site vertical and lateral extents of the groundwater plume emanating from any potential source areas identified on the former CCC/USDA facility, and develop a monitoring system to evaluate groundwater flow patterns. This is a contingency phase to be pursued only if data indicate that contamination associated with the former CCC/USDA facility has migrated off the property.
- **Phase 4.** Install additional monitoring wells to augment data collected during Phases 1-3 and to establish a long-term monitoring network. Conduct hydrogeologic testing to evaluate aquifer properties. This is a contingency phase to be pursued only if data indicate that a source area exists on the former CCC/USDA facility and that additional delineation and monitoring of the contaminant plume is warranted.
- **Phase 5.** Conduct a vapor intrusion investigation. The CCC/USDA is committed to implementing a program to address vapor intrusion if the data collected during Phases 1 and 2 indicate the potential for adverse impacts to

residences — relative to state criteria — due to CCC/USDA activities. A separate supplemental work plan will be developed for this phase of work. That supplemental work plan will follow the KDHE's guidance on vapor intrusion (KDHE 2007a).

3.2 Investigation Phases

3.2.1 Phase 1 — Identify and Characterize Potential Soil Sources beneath the Former CCC/USDA Facility

Phase 1 of the investigation is designed to target potential soil sources that might be contributing to contamination in groundwater, to vapor intrusion, or to both. Soil profiling will be conducted in the vadose zone above bedrock on the former CCC/USDA property. The depth to bedrock is estimated at 10-25 ft BGL. Proposed sample locations are based on results of the 2007 near-surface soil sampling across the former CCC/USDA facility, the 2007 indoor air sampling, and the KDHE's previous subsurface soil sampling (KDHE 1998).

Soil samples will be collected during Phase 1 by using a cone penetrometer (CPT) unit or other direct-push technique. The procedures in the *Master Work Plan* (Argonne 2002) will be followed.

Activities conducted during Phase 1 will be as follows:

- Initial shallow boreholes will be advanced with the CPT or other direct-push technology at 15 locations (TI01-TI15) in areas (1) where carbon tetrachloride was found at concentrations above 1.0 µg/kg in the 2007 near-surface soil sampling or the KDHE's 1998 subsurface soil sampling and (2) that are near the homes in which carbon tetrachloride was detected in indoor air. Soils will be cored continuously from the ground surface to the top of bedrock. The anticipated depths will be approximately 10-25 ft BGL. The proposed sample locations are shown on the 2006 aerial photograph in Figure 3.1 and on the 1969 aerial photograph in Figure 3.2.

- Upon completion of the initial sampling at TI01-TI15, up to 10 additional shallow boreholes will be advanced with the CPT or other direct-push technology at selected locations (TI16-TI25, Figures 3.1 and 3.2) to the top of bedrock at an approximate depth of 10-25 ft BGL. Results for these additional locations will address potential data gaps and validate data collected at or near selected near-surface soil sampling (2007) locations. Additional locations TI16-TI25 may be modified or omitted if analytical data from the initial 15 borehole locations (TI01-TI15) identify a specific source area or if soil analytical data show that the proposed location is no longer integral in advancing the investigation. Soils will be cored continuously from the ground surface to the top of bedrock.
- Soil samples will be collected at intervals of approximately 4 ft from the ground surface to bedrock at an anticipated depth of 10-25 ft BGL, for analysis for volatile organic compounds (VOCs). Continuous cores will be logged for lithologic evaluation. Selected samples may be submitted for geotechnical analysis such as grain size and other hydrogeologic testing, as appropriate, if contamination is identified.
- The actual number of boreholes advanced during this phase will depend on the physical feasibility of access to the location with the proper sampling equipment and will require permission from property owners.
- If groundwater is encountered in this upper unconsolidated zone, then groundwater samples will be collected for laboratory analysis.
- As data are collected in the field, adjustments to the number of sampling points, sample locations, and sampling intervals may be necessary. The CCC/USDA and KDHE project managers will be kept apprised of the results. Any proposed changes to this *Work Plan* will be discussed with and mutually agreed upon by the CCC/USDA and KDHE project managers.

3.2.2 Phase 2 — Determine the Extent of Groundwater Contamination beneath the Former CCC/USDA Facility and Characterize Lithology, Hydrostratigraphy, and Groundwater Flow

No investigations have been conducted on the former CCC/USDA facility to evaluate the groundwater characteristics; however, data collected from well records for the Hanover area provide information on local geology and hydrogeology. The estimated groundwater depth, as discussed in Section 2, is approximately 40-55 ft BGL in the bedrock formation (Permian Chase Group) under the former CCC/USDA facility. The sampling locations for Phase 2 will be selected on the basis of analytical results for shallow soil sampling conducted during Phase 1.

Soil and groundwater samples will be collected during Phase 2 by using a CPT or other direct-push technology, a sonic rig, or another conventional drilling method. The procedures in the *Master Work Plan* (Argonne 2002) will be followed. Activities during Phase 2 will be as follows:

- For the purpose of groundwater sampling from the saturated bedrock, up to eight deep boreholes will be advanced on the former CCC/USDA property to a depth that penetrates the upper part of the saturated bedrock. Five tentative locations for deep boring and groundwater sampling are presented in Figure 3.3. These five tentative locations were chosen on the basis of data collected during the 2007 near-surface soil sampling. In addition to the groundwater sampling, groundwater levels will be measured at the deep boring locations for the purpose of determining the groundwater flow direction at and near the former CCC/USDA property. Additional deep boring-groundwater sampling locations will be selected, if warranted, on the basis of data collected during Phase 1. The actual number and locations of boreholes advanced will depend on the results from Phase 1, the potential for gaining access with the appropriate drilling methods, and obtaining permission from property owners. Activities will include the following:
 - Groundwater samples will be collected for VOCs analyses from the saturated bedrock at all deep boreholes. At each borehole, vertical-profile groundwater samples will be collected to identify groundwater contamination through at least the upper part of the saturated bedrock. Selected groundwater samples may be submitted for inorganic analyses.

- Soil samples for VOCs analyses will be collected, at intervals of approximately 4 ft, from the top of the bedrock (at a depth of 10-25 ft BGL) to immediately above the top of groundwater within the bedrock formation. The collected soil samples will be shipped to and stored at the AGEM Laboratory. If groundwater samples from any deep boreholes are found to be contaminated, the soil samples collected from those boreholes will be analyzed for VOCs.
- Core samples will be collected continuously in the deep boreholes for lithologic and hydrostratigraphic evaluation. Selected samples may be submitted for geotechnical analyses, such as grain size and other hydrogeologic testing, as necessary to accomplish the technical objectives.
- Monitoring wells will be installed in selected boreholes. Wells will be completed at the locations expected to yield the most advantageous data for resolving the complex hydrologic system. The proposed locations will be discussed with the CCC/USDA and KDHE project managers.
- One of the groundwater sampling locations on the former CCC/USDA facility will be selected, as necessary, for drilling to collect a deeper core and acquire continuous geologic records such as lithologic changes, weathered zones, and multiple zones of saturation. The data gathered will be used to characterize the site-specific lithologies and hydrostratigraphy that control groundwater and contaminant movement. These data will guide the potential off-site investigations in subsequent phases. The total depth of this core will not exceed 100 ft. Most of the private wells in the Hanover area were installed at lesser depths.
- As data are collected in the field, adjustments to the number of locations and sampling intervals may be necessary. The CCC/USDA and KDHE project managers will be kept apprised of the results. Any proposed changes will be discussed with and mutually agreed upon by the CCC/USDA and KDHE project managers.

3.2.3 Phase 3 — Delineate the Extent of Any Identified Groundwater Plume and Develop a Groundwater Monitoring System

Phase 3 is a contingency phase of investigation outside the former CCC/USDA property, to be pursued only if data gathered in Phases 1 and 2 indicate that contamination associated with the former facility has migrated off-site.

Groundwater sampling during contingency Phase 3 will be conducted by using a CPT or other direct-push technology, a sonic rig, or another conventional drilling method. The procedures in the *Master Work Plan* (Argonne 2002) will be followed.

Additional monitoring wells may be advanced in Phase 3 at off-site locations to determine the full extent of any groundwater plume emanating from the former CCC/USDA facility. This work will be guided by contaminant source areas identified at the former CCC/USDA facility in Phase 1, together with available information on groundwater flow patterns. The exact number and locations of wells will be determined after data are collected from Phase 2 wells and the initial wells are installed during Phase 3. The need for the additional wells and their locations will be discussed with the CCC/USDA and KDHE project managers.

Activities in Phase 3 will be as follows:

- Groundwater samples will be collected for VOCs analyses from the existing private wells (Ebeling, Meyn, Bruna, Doebele) that were sampled in 1998. Additional private wells may be sampled if the results are determined to be integral to advancing the investigation.
- At the beginning of Phase 3, if the groundwater flow pattern cannot be determined adequately from the monitoring wells installed during Phase 2, three or four monitoring wells may be installed at locations outside the former CCC/USDA facility to measure off-site groundwater levels in the upper part of the saturated bedrock. The exact locations will be determined on the basis of available data. The flow pattern derived from all monitoring wells installed in Phase 2 and the initial Phase 3 work will be used to guide groundwater sampling outside the former CCC/USDA facility.

- Groundwater samples will be collected for VOCs analyses at selected locations to delineate any off-site groundwater plume determined to be emanating from the former CCC/USDA facility. The exact number and locations of sampling points will be determined on the basis of the size and extent of the actual groundwater plume identified outside the former facility. At each sampling point, groundwater samples will be collected at intervals of 5-10 ft throughout the vertical extent of the contaminant plume. Some groundwater samples may also be selected for inorganic analysis as needed.
- Core samples may be collected at selected intervals as necessary for lithologic and hydrostratigraphic evaluation.
- Groundwater levels will be measured in all wells installed in Phase 2 and at the beginning of Phase 3, at least 24 h after the wells have been completed and after they have stabilized. Location coordinates and surface elevations of all wells will be estimated by Argonne personnel using a global positioning system and survey equipment.
- During the sitewide water level measurements (after the wells have stabilized), changes in groundwater levels will be monitored continuously at one or more locations for at least 24 h to identify any immediate nearby pumping effects that might distort the flow pattern.

3.2.4 Phase 4 — Install Additional Monitoring Wells to Complete the Long-Term Monitoring Network and Conduct Hydrogeologic Testing

Phase 4 is a contingency to be pursued only if data indicate that a source area exists on the former CCC/USDA property and that additional delineation and monitoring of the contaminant plume is warranted.

After completion of Phases 1-3, monitoring wells may be installed at selected locations by using a CPT or other direct-push technology, a sonic rig, or another conventional drilling method. The procedures in the *Master Work Plan* (Argonne 2002) will be followed. Activities conducted during Phase 4 will be as follows:

- Additional monitoring wells may be installed at off-site locations to establish a complete network for monitoring and characterizing groundwater flow. The exact numbers and locations of wells will be determined after data are collected in Phases 1-3, in consultation with the CCC/USDA and KDHE project managers.
- Groundwater samples will be collected at each Phase 4 borehole location for VOCs analyses. Selected soil core samples will be collected for lithologic and hydrostratigraphic evaluation.
- Selected monitoring wells installed in Phases 2-4 will be fitted with data loggers to record accurate water levels at specific time intervals. The data generated will be used to evaluate groundwater flow throughout the area.
- All monitoring wells will be surveyed by a licensed surveyor for their location coordinates and the elevations of ground surface and reference points. Slug testing may be conducted at selected wells to generate data on the range and distribution of the aquifer hydraulic conductivity values across the area. This information will be used to evaluate potential remedial options.

3.2.5 Phase 5 — Conduct a Vapor Intrusion Investigation

Phase 5 is a contingency to be pursued if data collected during Phases 1 and 2 indicate a potential for adverse vapor intrusion impacts to residences — relative to state criteria — due to CCC/USDA activities. The CCC/USDA is committed to implementing this investigation if needed. A separate supplemental work plan will be developed for the Phase 5 work. The vapor intrusion investigation work plan will follow KDHE's guidance document on vapor intrusion (KDHE 2007a).

After completion of Phases 1-3, potential vapor sources in contaminated groundwater and soil will be evaluated on the basis of KDHE screening criteria (KDHE 2007a). The areas of concern for potential vapor intrusion will be identified for further investigation. Procedures for conducting Phase 5 of the investigation will be detailed in the supplemental work plan.

3.3 Investigation Methods

The investigation at Hanover will be conducted in accordance with procedures in the *Master Work Plan* (Argonne 2002), which provides details concerning investigation procedures at former CCC/USDA facilities in Kansas and has been approved by the KDHE.

Acquiring the data needed to meet the technical objectives of this investigation will require, at a minimum, the collection of groundwater level measurements, aquifer parameter data, soil samples, and groundwater samples. The samples collected will be analyzed for VOCs, as well as for lithologic, hydrostratigraphic, and hydrogeologic properties. Some groundwater samples also may be analyzed for inorganic compounds including nitrate. The resulting data can be used for evaluating potential remedial options.

Shallow vertical-profile soil sampling (to the top of bedrock) will be conducted by using a CPT or other direct-push technology. Soil samples will be collected continuously at intervals of approximately 4-5 ft or at each change of lithology, from the surface to the top of bedrock at approximately 10-25 ft BGL. Deeper soil samples will be collected at intervals of 5-10 ft by using a sonic rig or other conventional drilling methods, if the data are determined to be integral to the accomplishment of the investigational goals. Methods for drilling into bedrock will include collection of discrete soil samples through use of dual-tube sampling methods.

Groundwater samples will be collected from the bedrock aquifer at 5-ft intervals within the water producing zone. One to three vertical-profile samples are expected to be collected at each location for rapid-turnaround analysis. Groundwater depth is estimated to be approximately 40-55 ft BGL.

At each sampling location in the bedrock aquifer, a single hole will be drilled with a mini-sonic rig. The hole will be drilled to the first aquifer by using an 8.625-in. overriding casing. The overriding casing will be stopped at the top of the aquifer, and the inner drill string will be advanced 5 ft deeper into the aquifer. The inner drill string will then be retracted from the hole, and a water sample will be collected by using a stainless steel bailer. The overriding casing will then be advanced deeper to protect the 5-ft section just sampled. The inner drill string will be drilled an additional 5 ft or until the next water-bearing zone is encountered. The overriding casing will be stopped at the top of the next sampling interval, and the inner drill string will be advanced another 5 ft into the water-bearing zone. The inner casing will be retracted from the

hole, and the next sample will be collected as previously. These steps will be repeated until the discrete water sampling requirement has been satisfied. The well can be completed as a permanent installation with up to three sampling points in a single borehole by using a 1-in. × 10-ft PVC screen and riser pipe. Each screen will have a filter pack of the appropriate size emplaced. A minimum of 3 ft of bentonite seal will be placed on top of the filter pack.

After collection of the initial soil and groundwater data, small-diameter piezometers or 2-in. monitoring wells will be installed in selected boreholes. The data collected during this work will further delineate the vertical and horizontal extent of potential contaminant source areas associated with historical activities at the former CCC/USDA facility and will establish additional sampling points for future monitoring and aquifer evaluation. The numbers and locations of piezometers or monitoring points will be mutually agreed upon by the CCC/USDA and KDHE project managers prior to installation.

Small-diameter piezometers and monitoring wells installed during this investigation will be completed in accordance with KDHE regulations by using a sonic rig or other conventional drilling methods. These regulations include installation of wells in boreholes at least 2 in. larger than the outside diameter of the well casing. Wells will be cased by using Schedule 40 PVC with a 0.010-in. slotted screen. Screen lengths and depths will be dictated by the aquifer thickness and the groundwater analytical data collected during the initial sampling. The KDHE project manager will be consulted before the exact screen depth intervals are determined.

Appropriate quantities of sand and grout will be used to complete each piezometer or well. Sand (10-20 silica) will be placed from total depth to at least one foot above the screened zone. Five feet of bentonite chips will be used to provide a seal immediately above the sand pack. An appropriate quantity of water will be added to the bentonite to ensure that an adequate seal is obtained. Bentonite grout slurry will be added to a depth of approximately 3 ft BGL. A tremie pipe will be used to ensure that materials are placed properly in all annular spaces. Wells will be completed flush to the ground where necessary. All other piezometers or wells will be completed above grade. Piezometer or well completions will be in accordance with KDHE regulations and with the procedures in the *Master Work Plan* (Argonne 2002). Flush-mount waivers will be obtained from the KDHE as needed. Any deviations from the standard well installation regulations will be discussed with the KDHE project manager, and a waiver will be obtained from the Bureau of Water.

Before groundwater samples are collected, field parameters will be recorded to ensure that each sample is representative of groundwater conditions. All data collected during groundwater sampling will be recorded for documentation in the final report.

Private wells sampled as part of this investigation will be evaluated for well total depth, water level, well condition, and (if possible) well construction information. If necessary, private wells will be purged prior to sampling. Purging will continue until field parameters indicate that a representative groundwater sample can be collected. Data obtained in this effort will be recorded for documentation in the final report.

Soil and groundwater samples will be collected in laboratory-approved containers and shipped overnight to the AGEM Laboratory at Argonne. Before shipment, soil samples will be preserved on dry (carbon dioxide) ice, and groundwater samples will be preserved on regular (water) ice. All soil and groundwater samples will be analyzed within the holding times required by the analytical methods. The groundwater samples will be analyzed first, and then the soil samples.

At the AGEM Laboratory, the soil samples will be analyzed for carbon tetrachloride and chloroform by using a gas chromatograph-mass spectrometer, according to EPA Methods 5030B and 8260B (EPA 1998). Groundwater samples will be analyzed at the AGEM Laboratory, within 24 h after sampling, for VOCs including carbon tetrachloride and chloroform, according to EPA Method 524.2 (EPA 1995). In addition, selected groundwater samples may be analyzed for cations and anions at a certified reference laboratory, and hydrogeologic testing will be conducted on selected soil samples. Proposed tests that may be conducted include porosity, organic carbon content, dry bulk density, and grain size.

3.4 Handling and Disposal of Investigation-Derived Waste

Investigation-derived waste (IDW) will include soil from well installations and groundwater from sampling activities at private and monitoring wells. All waste generated from field activities will be stored in 55-gal drums, roll-off containers, or polyurethane tanks on the former CCC/USDA property.

Soil samples from the IDW will be collected and analyzed by a KDHE-certified laboratory. A Special Waste Disposal Authorization will be obtained from the KDHE for disposal in a permitted landfill. If analytical results indicate that the soil waste cannot be disposed of as special waste, alternative disposal methods will be determined.

Groundwater samples from the IDW will be collected and analyzed by a KDHE-certified laboratory. Disposal methods will be discussed with the KDHE project manager and will be dependent on the analytical results.

3.5 Sampling and Reporting Schedule

Argonne will notify the KDHE project manager a minimum of seven days prior to the start of field activities. After field activities have been completed and the data have been received and evaluated, a comprehensive final report will be completed. The report will include documentation and discussions of all field activities and analytical data, in accordance with KDHE policy BER-RS-018 (KDHE 2005).

3.6 Quality Assurance and Quality Control

The procedures necessary to maintain the quality of data will be implemented during all phases of the proposed investigation. Descriptions of the quality assurance and quality control methods are in Section 4 of the *Master Work Plan* (Argonne 2002). That document should be consulted for a more detailed narrative of these procedures.

TABLE 3.1 Summary of planned activities in Phases 1-4 of the Hanover investigation.^a

Activity	Boring Equipment	Number, Location	Soil VOCs Samples	Soil Coring	Soil Geotech Samples	GW VOCs Samples ^b	Max Depth BGL	GW Levels
<i>Phase 1 (on-site)</i>								
Initial shallow borings	Push	15, TI01-TI15	4-ft intervals to bedrock	Continuous	If contamination is found	If present	To top of bedrock at 10-25 ft	
Additional shallow borings	Push	≤ 10, TI16-TI25	4-ft intervals to bedrock	Continuous	If contamination is found	If present	To top of bedrock at 10-25 ft	
<i>Phase 2 (on-site)</i>								
Deep borings	Push/drill	≤ 8, TBD	4-ft intervals to GW — analyze for VOCs if VOCs are found in GW	Continuous	Selected intervals	1-3 samples in vertical profile	Penetrate upper bedrock to 50-60 ft	
Install MWs	Drill	TBD, selected deep borings					~ 60 ft	Manual (all)
Deeper boring	Drill	1, selected GW location		Continuous	Selected intervals		≤ 100 ft	
<i>Phase 3 (off-site; contingency)</i>								
Sample existing wells	—	4 (+ more?)				4 (+) wells Intervals 5-10 ft through plume		
GW sampling	Drill	3-4, TBD		Selected intervals				
Install MWs	Drill	3-4, TBD					~ 60 ft	Manual (all); 1 or more loggers
<i>Phase 4 (off-site; contingency)</i>								
Install MWs to complete network	Push/Drill	TBD, TBD		Selected intervals		Intervals 5-10 ft through plume	~ 60 ft	Manual (all); loggers at selected MWs
Survey MWs	—	All MWs						
Optional: Slug testing	—	TBD						

^a Abbreviations: BGL, below ground level; GW, groundwater; max, maximum; MW, monitoring well; TBD, to be determined; VOC, volatile organic compound.

^b Some groundwater samples will also be analyzed for inorganic compounds including nitrate.



FIGURE 3.1 Proposed soil sampling locations on and adjacent to the former CCC/USDA property, in relation to present structures. Source of photograph: NAIP (2006).

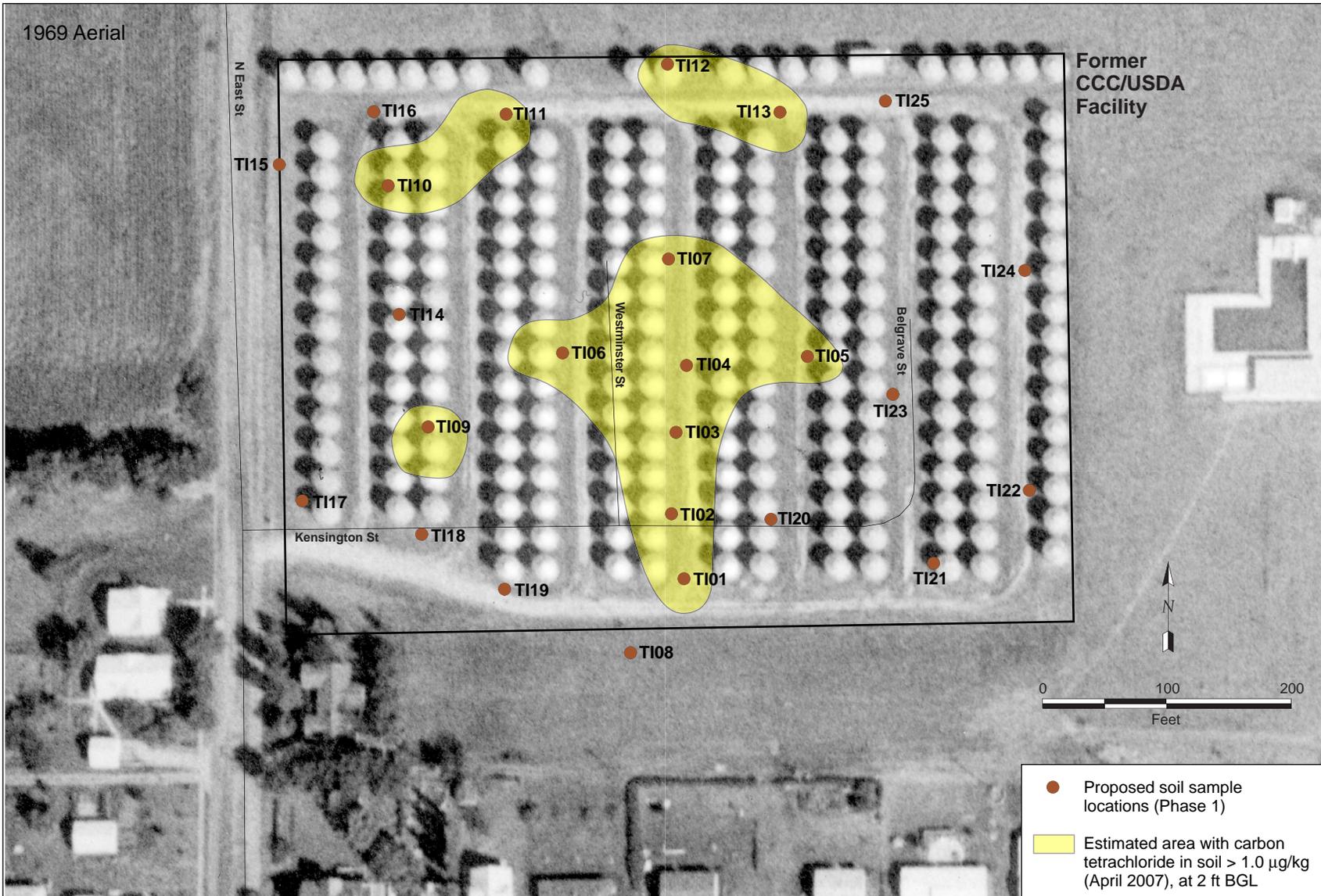


FIGURE 3.2 Proposed soil sampling locations on and adjacent to the former CCC/USDA property, in relation to the former CCC/USDA grain storage structures. Source of photograph: USDA (1969).

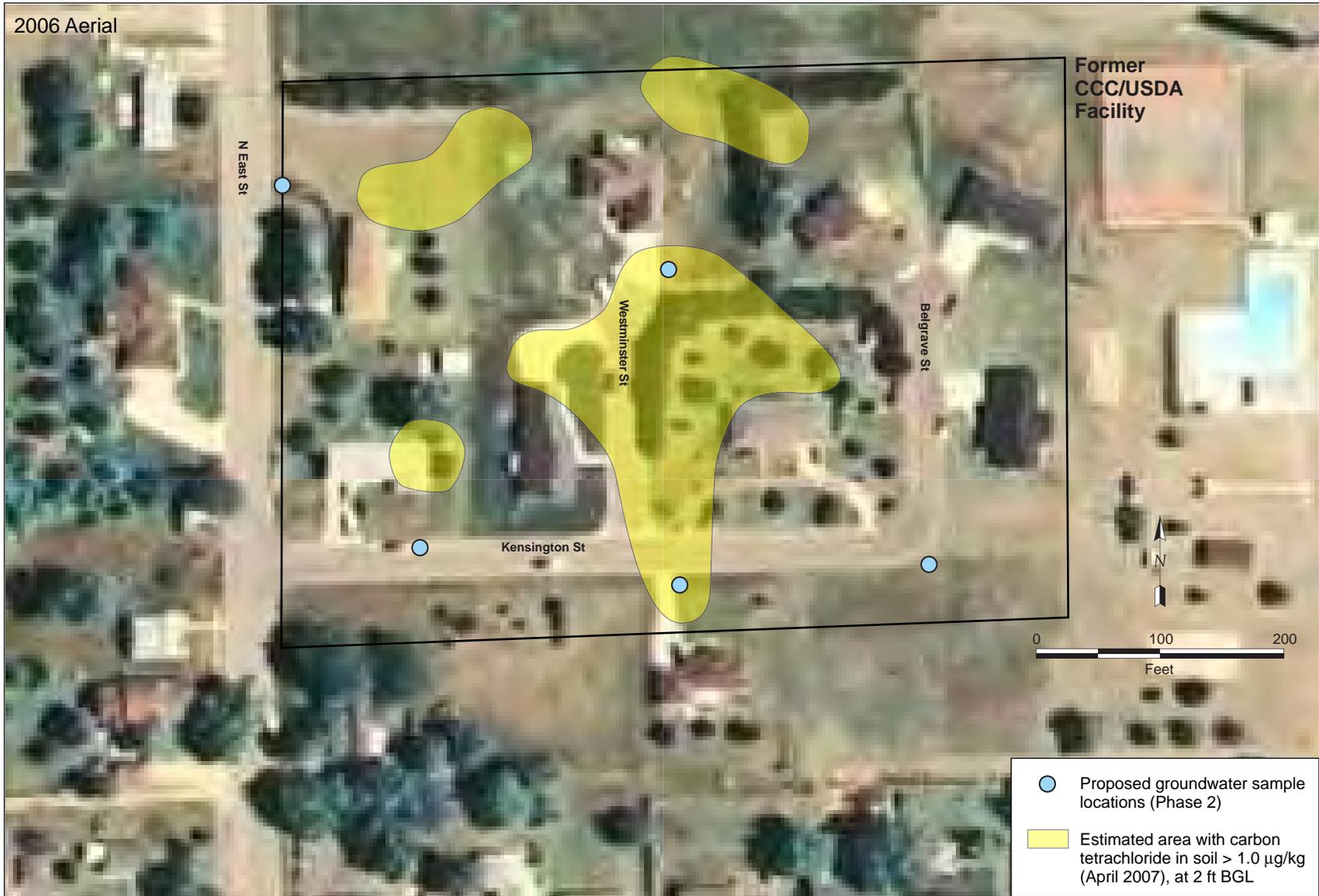


FIGURE 3.3 Tentatively proposed locations for deep boring and groundwater sampling. Source of photograph: NAIP (2006).

4 Community Relations Plan

This community relations plan outlines activities to be conducted during the investigation at Hanover, Kansas.

The CCC/USDA, which operated a former grain storage facility at the northeast corner of the Hanover city limits from 1950 until the early 1970s, has assumed lead responsibility for all technical and community relations activities at Hanover. Argonne will conduct these activities for the CCC/USDA. These efforts will be closely coordinated with the KDHE, which will oversee the work performed at the site.

Hanover residents obtain their drinking water from the Washington County RWD #1 and are not affected by the groundwater contamination detected in private wells near the former CCC/USDA facility. The contamination detected has been confined to two private wells used for lawn and garden watering.

Nine residences are located within or adjacent to the boundaries of the former CCC/USDA facility. The initial investigation will be conducted in this area. Argonne will work closely with the residents in these homes prior to, during, and after the investigation, to address any access issues regarding the work to be conducted and any other concerns that may arise. All residents will be provided with the results of the work in a timely manner. In addition, Argonne will work with residents in homes adjacent to or near the investigation area to inform them of the work being performed and to answer any questions.

The city park and swimming pool are located just east of investigation area. Local interest is likely to increase when the field work begins and Argonne's presence becomes known. Argonne will work with the city of Hanover to ensure that interested citizens can learn about the investigation and the results.

Argonne has developed a fact sheet for review by the KDHE that describes the investigation and will provide copies to residents in and near the investigation area, to other interested citizens, and to the city office. The fact sheet provides the names and contact information for the KDHE and CCC/USDA officials and the Argonne staff involved in the investigation.

This community relations plan is divided into sections including site description, community background, community relations objectives, timing of community relations activities, and contact list of key officials.

4.1 Site Description

Section 2 of this report contains a complete description of the site and its history.

4.2 Community Background

The incorporated city of Hanover is governed by a mayor and a city council. In addition to public works and other city responsibilities, the mayor and council have authority to provide and maintain the municipal water supply system. The city operates an office that is staffed by the city clerk.

Residents within the Hanover municipal limits receive their drinking water from a municipal distribution system that obtains its water supply from the Washington County RWD #1.

4.3 Community Relations Objectives

The Hanover community relations plan has the following major objectives:

1. Explain the investigation plans of the CCC/USDA and provide general information about the program.
2. Inform residents within the former boundaries of the CCC/USDA facility, other interested residents, and city officials of the investigation's findings and developments.
3. Respond to citizens' inquiries about site activities and the presence of health and environmental hazards.

4. Ensure that the public has appropriate opportunities for involvement in site-related decisions.
5. Provide appropriate opportunities for interested residents to learn about the site.

4.4 Timing of Community Relations Activities

This section describes the activities needed to meet the community relations objectives. Many of these activities need to take place before the field work begins. Milestones and planned activities are discussed below.

4.4.1 Activities before Field Work Begins

The CCC/USDA and Argonne will conduct of the following community relations activities, to the extent practicable, before field work begins:

1. A point of contact will be designated for Argonne. The individual will be Argonne's liaison with interested residents.
2. Upon obtaining approval from the CCC/USDA, Argonne will make initial contact with local residents and officials of the city government to explain proposed activities and schedules.
3. Argonne will make arrangements to conduct discussions (by telephone and in person) with interested residents and any other affected parties, as appropriate, to address their concerns and information needs.
4. Upon completion and approval of this site-specific *Work Plan*, Argonne will provide a copy of the document to the city for public viewing by interested parties.

4.4.2 Activities during Field Work

The CCC/USDA and Argonne will provide for the conduct of the following community relations activities, to the extent practicable, during field work:

1. Meet with interested residents and other parties when needed.
2. Prepare and distribute fact sheets or letters to inform the community of the investigation's progress, significant milestones, or changes in plans.
3. Continue telephone contact with interested residents and with state and local officials.
4. Allow for site visits by interested parties, within allowable safety limitations.

4.4.3 Activities upon Completion of Field Work Activities

The CCC/USDA and Argonne will conduct the following community relations activities, to the extent practicable, upon completion of the field work:

1. If requested, arrange for a meeting with interested citizens, as appropriate, to present and discuss the investigation's findings, results, and recommendations, as well as any future activities at the site.
2. Prepare and distribute information outlining the investigation's results and any future activities at the site, as appropriate.

4.5 Contact List of Key Officials

State Officials

Beth Finzer, Environmental Scientist
Bureau of Environmental Remediation
Kansas Department of Health and Environment
1000 SW Jackson, Suite 410
Topeka, KS 66612-1367
Telephone: 785-296-1936
BFinzer@kdhe.state.ks.us

Christopher C. Carey, Post-Remediation Unit
Bureau of Environmental Remediation
Kansas Department of Health and Environment
1000 SW Jackson, Suite 410
Topeka, KS 66612-1367
Telephone: 785-296-0225
CCarey@kdhe.state.ks.us

Federal Officials

Caroline Roe
Conservation and Environmental Protection Division
Farm Service Agency
Commodity Credit Corporation
U.S. Department of Agriculture
Room 4723, Stop 0513, South Agriculture Building
1400 Independence Avenue, SW
Washington, DC 20250-0513
202-720-9964
caroline.roe@wdc.usda.gov

Local Officials

Hanover City Hall
201 North Railroad
Hanover, KS 66949
Court Street
Telephone 785-337-2261
cityclerk@networksplus.net

4.6 Contact Information for the Investigation Team at Hanover, Kansas

The Argonne program manager is Lorraine LaFreniere (630-252-7969). The Argonne community relations representative is James Hansen (202-488-2453). Further information is in Section 5, Table 5.1.

5 Health and Safety

A site-specific health and safety plan for the investigation at Hanover has been developed and approved by the Argonne field safety coordinator. That plan is to be brought to the site for reference during the investigation. An Argonne health-safety-environmental protection representative will visit the site during field activities to observe, monitor, and report on operations.

The general health and safety plan for use during the work at Hanover is in Section 3 of the *Master Work Plan* (Argonne 2002). That document addresses all anticipated safety issues for activities at the Hanover site. Specific emergency information for use at the site is in Table 5.1.

Hanover has emergency 911 service. All emergency calls, including police, fire, and ambulance calls, will be directed for an appropriate response from this number. The city of Hanover also has a hospital with emergency medical facilities. Driving directions to the hospital and the map showing the route are in Figure 5.1. Additional emergency information is in Table 5.1.

TABLE 5.1 Emergency information for the investigation at Hanover, Kansas.^a

Resource	Telephone Number	Name
All Emergencies	911	
Medical Care	785-337-2214	Hanover Hospital ^b 205 S. Hanover St., Hanover, Kansas
Fire Protection	911	Hanover Fire Department 206 S. Hanover St., Hanover, Kansas
(County Fire Protection)	911	Washington County Fire District #10 2832 Hilltop Ave., Hanover, Kansas
Police	785-337-2591	210 W Elm St., Hanover, Kansas
Industrial Hygiene	630-252-3310	Argonne-Industrial Hygiene
Safety	630-252-2885 630-252-3294	EVS Division ^c Field Safety Coordinator (Monte Brandner) EVS Division ^c Environmental, Safety, and Health Coordinator (Dave Peterson)
Project Management	630-252 7969 630-252-1275 630-408-7114 630-252-6322	Argonne Program Manager (Lorraine LaFreniere) Argonne Field Project Manager (David Surgnier) (Surgnier cellular) Argonne Technical Project Manager (Eugene Yan)
Security	630-252-5737 630-252-5731	Argonne-Operations Security (workdays) (after hours and weekends)
Poison Control	800-222-1222 913-588-6633	Mid-America Poison Control Center, University of Kansas Medical Center
Utilities Survey	800-344-7233 800-DIG-SAFE	Kansas One Call, Wichita, Kansas

^a Post this table in the field operations base.

^b The route from the investigation site to Hanover Hospital is shown in Figure 5.1.

^c Environmental Science Division at Argonne.

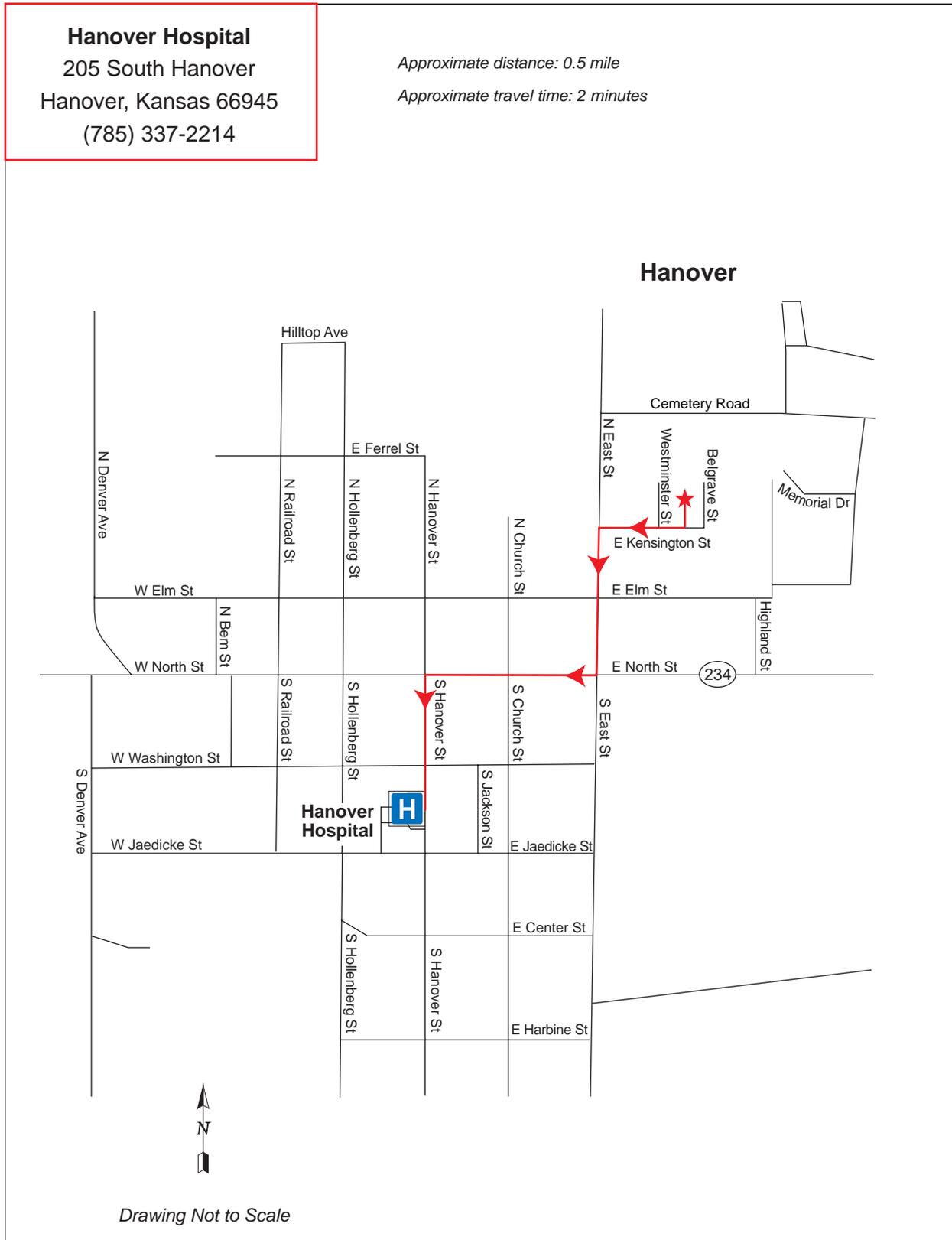


FIGURE 5.1 Emergency route from the Hanover investigation site to the Hanover Hospital.

6 References

Alvarado, J.S., and C. Rose, 2004, "Static Headspace Analysis of Volatile Organic Compounds in Soil and Vegetation Samples for Site Characterization," *Talanta* 62:17-23.

Argonne, 2002, *Final Master Work Plan: Environmental Investigations at Former CCC/USDA Facilities in Kansas, 2002 Revision*, ANL/ER/TR-02/004, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, December.

EPA, 1995, *Method 524.2: Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry, Revision 4.1*, edited by J.W. Munch, National Exposure Research Laboratory, Office of Research and Development, U.S. Environmental Protection Agency, Cincinnati, Ohio.

EPA, 1998, *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*, EPA SW-846, 3rd edition, Draft Update IVA, U.S. Environmental Protection Agency, January.

GeoCore, 1997, *Environmental Site Assessment Report of Bill's Service Center, 1/4 Mile East of Town, Hanover, Kansas*, KDHE UST Project Code A5 101 40078, prepared by GeoCore Services, Inc., Salina, Kansas, March 17.

GeoCore, 1999, *Environmental Site Assessment Report of Bill's Service Center, 1/4 Mile East of Town, Hanover, Kansas*, KDHE UST Project Code A5 101 40078, prepared by GeoCore Services, Inc., Salina, Kansas, September 24.

GeoCore, 2007, letter from J.W. Miller (GeoCore Services, Inc., Salina, Kansas), to N. Luna (Storage Tank Section, Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas), regarding the first of four monitoring events at the KDHE underground storage tank trust fund site at Bill's Service Center (KDHE site identifier A5-101-40078), Hanover, Kansas, November 1.

KDHE 1998, *Site Reconnaissance and Evaluation: Hanover USDA/CCC Site, Hanover, Kansas, KDHE Identification Number P5-101-70430*, prepared by the Kansas Department of Health and Environment, Bureau of Environmental Remediation, Topeka, Kansas, July.

KDHE, 2005, *Scope of Work (SOW) for a Comprehensive Investigation*, policy BER-RS-018, Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas, revised December 19 (linked at <http://www.kdheks.gov/ber/policies.htm>).

KDHE 2007a, *Kansas Vapor Intrusion Guidance: Chemical Vapor Intrusion and Residential Indoor Air*, Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas, June (http://www.kdheks.gov/ber/download/Ks_VI_Guidance.pdf).

KDHE, 2007b, *Private Well Sampling at CCC/USDA Sites in Kansas*, memorandum from C. Carey to R. Bean (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas), January 30.

KDHE, 2007c, *Risk Based Standards for Kansas: RSK Manual — 4th Version*, Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas, June (www.kdheks.gov/remedial/rsk_manual_page.htm).

KDHE, 2008, letter from E. McWilliams (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas), to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding a supplemental work plan for investigation of upward vapor intrusion at the former CCC/USDA grain storage facility at Hanover, Kansas.

NAIP, 2006, aerial photograph of Hanover, Kansas, naip_1-1_1n_s_ks201_2006_1, National Agricultural Imagery Program, Field Service Agency, U.S. Department of Agriculture, Salt Lake City, Utah, August 31 (<http://www.apfo.USDA.gov/NAIP.html>).

Schlabach, D., 2008, telephone conversation between Schlabach (resident of Hanover, Kansas) and J. Hansen (Argonne National Laboratory, Argonne Illinois), regarding the sale and removal of the grain storage bins from the former CCC/USDA property at Hanover, July 8.

USDA, 1957, Aerial photograph YV-6T-59L, U.S. Department of Agriculture, Washington, D.C., July 12.

USDA, 1969, Aerial photograph YV-2KK-146D, U.S. Department of Agriculture, Washington, D.C., September 20.

USDA, 1978, Aerial photograph 20201-177-294L, U.S. Department of Agriculture, Washington, D.C., October 11.

USGS, 1997, *Digital Raster Graphics (DRG) UTM NAD 83 of Washington County, Kansas*, (created from USGS 1982 7.5-minute topographic maps), U.S. Geological Survey, Reston, Virginia.

Appendix A:

**Property Ownership Records for the
Former CCC/USDA Grain Storage Facility at Hanover**

LEASE:

From Wilfred J. Poell and Loretta E. Poell, Lessor, To Commodity Credit Corporation, Lessee.

THIS LEASE, made and entered into this 19 day of July, 1950, by and between Wilfred J. Poell and Loretta E. Poell, of Hanover, Kansas, Lessor, and Commodity Credit Corporation, Lessee.

WITNESSETH THAT:

1. The Lessor leases to the Lessee, and the Lessee hereby leases from the Lessor, upon the terms and conditions hereinafter stated, the following described real estate (hereinafter called "property") situated in the County of Washington and State of Kansas:

Township two (2) Range Five (5), east of the 6th P.M. Described as follows:
Tract of Land (4 acres) in the South West quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) Section Nine commencing at a point One hundred twenty-two (122) feet due North of the North west corner of Lot 8 Block 2 Brockmeyer's Addition. Thence running due east three hundred eighty-two (382) feet, thence running due north Four hundred fifty (450) feet, thence running due west three hundred eighty-two (382) feet, thence running due south Four hundred fifty (450) feet to the point of beginning.

2. The term of the lease shall be for a period of Fifteen (15) years, commencing the 19 day of July 1950 and ending the 19 day of July, 1965, with the right of the Lessee to terminate said lease, and liability for any further rent, on the 19 day of July of any year, by giving thirty (30) days' previous notice in writing to the Lessor.

3. As rent for said property, the Lessee shall pay the Lessor Fifty & no/100 Dollars (\$50.00) per acre per year, such rent to be payable annually July 19 of each year.

4. The Lessor warrants that he is the owner of the property, has the right to give the Lessee possession under this lease, and will, so long as this lease remains in effect, warrant and defend the Lessee's possession against any and all persons whomsoever.

5. The Lessee shall have the right to construct or erect storage structures or facilities on said property and, at the expiration of said lease or any renewal or extension thereof or at any time this lease is in effect, may remove said storage structures or facilities or any part thereof, whether or not such structures or facilities have become legally a fixture.

6. The Lessee shall not assign this lease nor sublet said property or any part thereof without the written consent of the Lessor.

7. (Special provisions)

Wilfred J. Poell, Lessor
Loretta E. Poell, Wife

(Title)
Commodity Credit Corporation, Lessee
By Edw J. Knedlik
Contracting officer.

State of Kansas, County of Washington, ss.

BE IT REMEMBERED, That on this 19 day of July A.D. 1950, before me the undersigned, Notary Public in and for the County and State aforesaid, came Wilfred J. Poell and Loretta E. Poell and Edw. J. Knedlik, Chairman Washington County PMA and Contracting Officer who are personally known to me to be the same persons' who executed the

LEASE OF PROPERTY:

From Wilfred J. Poell and
Loretta E. Poell

To Commodity Credit Corporation

U.S. Department of Agriculture
Agriculture Stabilization and Conservation
Commodity Credit Corporation

Supplemental Lease of Additional
land to the Hanover Bin Site-005, Hanover,
Kansas

THIS LEASE, made and entered into this 31st day of July, 1954, by and between Wilfred J. Poell and Loretta E. Poell of Hanover, Kansas, Lessor, and Commodity Credit Corporation, Lessee.

WITNESSETH THAT:

1. The Lessor leases to the Lessee, and the Lessee hereby leases from the Lessor, upon the terms and conditions hereinafter stated, the following described real estate (hereinafter called "property") situated in the County of Washington and State of Kansas:

Described as follows: Commencing at a point 122 feet due north of the NW corner of Lot 8, Block 2, Brockmeyer's addition, and 382 feet east, the additional land to be leased starts at this point, thence runs due east 138 feet, thence due north 450 feet, thence due west 138 feet to meet the NE corner of land already under lease to the Commodity Credit Corporation. Containing 1.4 acres, more or less.

2. The term of the lease shall be for a period of five years, commencing the 31st day of July, 1954, and ending the 31st day of July, 1959, with the right of the Lessee, during such term or any extension thereof, to terminate said lease, and liability for any further rent, on the 31 day of July of any year, by giving thirty days previous notice in writing to the Lessor.

3. As rent for said property, the Lessee shall pay the Lessor fifty and no/100 Dollars (\$50.00) per acre pre year, such rent to be payable in advance, but to be apportionable in the event the lease is terminated as provided in paragraph 2 hereof:

4. The Lessor warrants that he is the owner of the property, has the right to give the Lessee possession under this lease, and will, so long as this lease remains in effect, warrant and defend the Lessee's possession against any and all persons whomsoever.

5. The Lessee shall have the right, during this lease, to erect storage structures, or facilities, make alterations, install scales, fences, or signs, in or upon the premises hereby leased and, at the expiration of said lease or any renewal or extension thereof or at any time this lease is in effect, may remove said storage structure, facilities, scales, fences, or signs or any part thereof, whether or not such structures, facilities, scales, fences or signs have become legally a fixture.

6. The Lessee shall not assign this lease without the written consent of the Lessor. The Lessee, may, however, sublet the structures on the premises leased hereunder, or any one or more of them for the term of the lease or any part thereof upon such terms and conditions as Lessee may wish to so sublet.

7. The Lessee, if required by the Lessor, shall upon the expiration of this lease, or renewal thereof, restore the premises to the same condition as that existing at the time of entering upon the same under this lease, reasonable and ordinary wear and tear and damages by the elements or by circumstances over which the Lessee has no control excepted: Provided, however, That if the Lessor requires such restoration, the Lessor shall give written notice thereof to the Lessee thirty days before the termination of the lease.

8. The Lessor grants and gives the Lessee the option as a consideration of this lease and for the further consideration of one dollar, the receipt of which is hereby acknowledged, to renew said lease for a period of 15 years from the Lessor, his heirs, executors, administrators, and assigns, for the sum of Fifty and no/100 Dollars (\$50.00 per acre) per year.

9.

10. In the event any increased tax assessment is made against the Lessor or the property by virtue of the erection of storage structures and facilities thereon by the Lessee, the Lessor agrees to cooperate fully in any contest of such increased assessment which the Lessee feels should be made. The Lessee agrees that the rental hereunder shall be adjusted upward by the amount of any such increased tax assessment which the Lessor and Lessee mutually agree to be proper or which is determined to be legally valid in court proceedings.

11. No member of or Delegate to Congress or Resident Commissioner, shall be admitted to any share or part of this lease or purchase or to any benefit that may arise therefrom, but this provisions shall not be construed to extend to this lease or purchase if made with a corporation for its general benefit.

12. The Lessor warrants that he has not employed any person to solicit or secure this lease upon any agreement for a commission, percentage, brokerage, or contingent fee and that no such consideration or payment has been or will be made. Breach of this warranty shall give CCG the right to annul the lease, or, in its discretion, to deduct from the rental or purchase price the amount of such commission, percentage, brokerage or contingent fees. This warranty shall not apply to commissions payable by the Lessor if the lease is secured or made through a bona-fide agent maintained by the Lessor for the purpose of leasing or selling his property.

(Seal) Wilfred J. Poell, Lessor

(Seal) Loretta E. Poell, Lessor

Commodity Credit Corporation, Lessee
By Edw. J. Knedlik
Chairman, Washington County
ASC Committee

3. As rent for said property, the Lessee shall pay the Lessor fifty and no/100 Dollars (\$50.00) per acre, per year, such rent to be payable in advance, but to be apportionable in the event the lease is terminated as provided in paragraph 2 hereof.

4. The Lessor warrants that he is the owner of the property, has the right to give the Lessee possession under this lease, and will, so long as this lease remains in effect, warrant and defend the Lessee's possession against any and all persons whomsoever.

5. The Lessee shall have the right, during this lease, to erect storage structures, or facilities, make alterations, install scales, fences, or signs, in or upon the premises hereby leased and, at the expiration of said lease or any renewal or extension thereof or at any time this lease is in effect, may remove said storage structures, facilities, scales, fences, or signs or any part thereof, whether or not such structures, facilities, scales, fences, or signs have become legally a fixture.

6. The Lessee shall not assign this lease without the written consent of the Lessor. The Lessee, may, however, sublet the structures on the premises leased hereunder, or any one or more of them for the term of the lease or any part thereof upon such terms and conditions as Lessee may wish to so sublet.

7. The Lessee, if required by the Lessor, shall upon the expiration of this lease, or renewal thereof, restore the premises to the same condition as that existing at the time of entering upon the same under this lease, reasonable and ordinary wear and tear and damages by the elements or by circumstances over which the Lessee has no control excepted; Provided, however, That if the Lessor requires such restoration, the Lessor shall give written notice thereof to the Lessee Thirty days before the termination of the lease.

8. The Lessor grants and gives the Lessee the option as a consideration of this lease and for the further consideration of one dollar, the receipt of which is hereby acknowledged, to renew said lease for a period of 15 years from the Lessor, his heirs, executors, administrators, and assigns, for the sum of Fifty and no/100 Dollars (\$50.00) per acre per year.

9.

10. In the event any increased tax assessment is made against the Lessor or the property by virtue of the erection of storage structures and facilities thereon by the Lessee, the Lessor agrees to cooperate fully in any contest of such increased assessment which Lessee feels should be made. The Lessee agrees that the rental hereunder shall be adjusted upward by the amount of any such increased tax assessment which the Lessor and Lessee mutually agree to be proper or which is determined to be legally valid in court proceedings.

11. No member of or Delegate to Congress or Resident Commissioner, shall be admitted to any share or part of this lease or purchase or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this lease or purchase if made with a corporation for its general benefit.

12. The Lessor warrants that he has not employed any person to solicit or secure this lease upon any agreement for a commission, percentage, brokerage, or contingent fee and that no such consideration or payment has been or will be made. Breach of this warranty shall give CCC the right to annul the lease, or, in its discretion, to deduct from the rental or purchase price the amount of such commission, percentage, brokerage or contingent fees. This warranty shall not apply to commissions payable by the Lessor if the lease is secured or made through a bona-fide agent maintained by the Lessor for the purpose of leasing or selling his property.

(Seal) Christian E. Sawyer, Lessor
(Seal) Clara Elizabeth Sawyer, Lessor

Commodity Credit Corporation
Lessee
By Edw. J. Knedlik
Chairman, Washington County
ASC Committee

State of Kansas, County of Washington, ss.

BE IT REMEMBERED, That on this 31st day of July A.D. 1954, before me, the undersigned Notary Public in and for the County and State aforesaid, came Christian E. Sawyer and Clara Elizabeth Sawyer and Edward J. Knedlik, Chairman, Washington County ASC and Contracting Officer, who are personally known to me to be the same persons who executed the within instrument of writing, and such persons duly acknowledged the execution of the same.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my Notarial seal, the day and year last above written.

(SEAL)

A.W. Soller, Notary Public.

Term expires May 7, 1955.

State of Kansas, Washington County, ss.

This instrument was filed for record on the 10th day of December A.D. 1954, at 4 o'clock P.M., and duly recorded in book 132 of Deeds on page 84.

(SEAL)

W.B. Westing, Register of Deeds.

WARRANTY DEED:

From Wilfred J. Poell and
Loretta E. Poell, his wife,

To

Ruth Corinne Schwartz
and Charles T. Schwartz, or
survivor.

THIS INDENTURE, Made this 24th day of March A.D. 1955 between Wilfred J. Poell and Loretta E. Poell, husband and wife, of Washington County, in the State of Kansas, of the first part, and Ruth Corinne Schwartz and Charles T. Schwartz, wife and husband, and the survivor of them, as joint tenants and not as tenants in common, of Washington County, in the State of Kansas, of the second part.

WITNESSETH, That said parties of the first part, in consideration of the sum of One Dollar (\$1.00) and other valuable consideration and No. 100 Dollars, the receipt whereof is hereby acknowledged, do by these presents Grant, Bargain, Sell and Convey unto said parties of the second part, their heirs and assigns, all the following-described REAL ESTATE, situated in the County of Washington and State of Kansas, to-wit:

A part of portion of the Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of Section Nine (9), Township Two (2), Range Five (5), described as follows, to-wit:

BEGINNING at a point 122 feet due North of the Northwest corner of Lot 8 in Block 2 in Brockmeyer's Addition to the City of Hanover, Kansas; and running thence due North 64 $\frac{1}{2}$ feet, more or less, to a point 16 $\frac{1}{2}$ feet South of the North line of the said Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of said Section Nine (9), said point being on the South line of the road known as the Cemetery Road; thence East along the South line of said Cemetery Road, 1290 feet, to the East line of said Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of said Section Nine (9); thence South along said East line, 1250.8 feet, more or less, to a point 52.7 feet North of the Southeast Corner of said South west Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of said Section Nine (9), being a point on the North line of the Highway; thence West on said Highway line, 495 feet, more or less, to the Southeast corner of Poell's First Addition to Hanover; thence North 372.6 feet to the Northeast corner of said Poell's First Addition; thence West along the North line of said Poell's First Addition, 399 feet, to the East line of said Brockmeyer's Addition; thence North to the Northeast corner of said Brockmeyer's Addition; thence West, 261 feet, more or less, to a point on the North line of said Brockmeyer's Addition 16 feet North and 95 feet East of the Northwest corner of Lot 8 in Block 2 of said Brockmeyer's Addition; thence North, 106 feet; thence West, 95 feet, to the place of beginning; containing 28.8 Acres, more or less, situated in the County of Washington and State of Kansas.

TO HAVE AND TO HOLD THE SAME, Together with all and singular the tenements, hereditaments and appurtenances thereunto belonging or in anywise appertaining forever.

And said parties of the first part, for themselves, their heirs, executors, and administrators, do hereby covenant, promise and agree, to and with said parties of the second part that at the delivery of these presents they are lawfully seized in their own right of an absolute and indefeasible estate of inheritance, in fee simple, of and in all and singular the above granted and described premises, with the appurtenances; that the same are free, clear, discharged and unincumbered of and from all former and other grants, titles, charges, estates, judgments, taxes, assessments and incumbrances, of what nature or kind soever; Except, subject to leases to the Commodity Credit Corporation for Hanover Bin Site-005, Hanover, Kansas, and that they will Warrant and Forever Defend the same unto said parties of the second part, their heirs and assigns, against said parties of the first part, their heirs, and all and every person or persons whomsoever, lawfully claiming or to claim the same.

IN WITNESS WHEREOF, The said parties of the first part have hereunto set their hands, the day and year first above written.

\$5.50 U.S. Documentary Revenue
Stamps Attached and Cancelled.

Wilfred J. Poell
Loretta E. Poell

State of Kansas, Washington County, ss.

BE IT REMEMBERED, That on this 24th day of March A.D. 1955 before me, the undersigned, a Notary Public in and for the County and State aforesaid, came Wilfred J. Poell and Loretta E. Poell, husband and wife, who are personally known to me to be the same persons who executed the within instrument of writing, and such persons duly acknowledged the execution of the same.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my seal, the day and year last above written.

(SEAL)

A.C. Wurtz, Notary Public.

Term expires June 27, 1957.

Entered in Transfer Record in my office, this 29th day of March A.D. 1955.

Loren A. Lobaugh, County Clerk.

State of Kansas, Washington County, ss.

This instrument was filed for record on the 29th day of March A.D. 1955 at 1:30 o'clock P.M., and duly recorded in Book 133 of Deeds, at page 120.

(SEAL)

W.B. Westing, Register of Deeds.

EXTENSION OF LEASE

From Ruth Corinne Schwartz & Charles T. Schwartz To Commodity Credit Corporation

This extension of lease made and entered into this 23rd day of March, 1959, by and between Ruth Corinne Schwartz and Charles T. Schwartz, wife and husband, and the survivor of them, as joint tenants and not as tenants in common, Lessors, hereinafter called Lessor, and Commodity Credit Corporation, hereinafter called Lessee.

WITNESSETH: WHEREAS, The parties hereto have heretofore entered into a certain lease dated July 31, 1954, wherein the lessor leased to the lessee the following described property:

Described as follows: commencing at a point 122 feet due north of the North West corner of Lot 8, Block 2, Brockmeyer's Addition, and 382 feet east the additional land to be leased starts at this point, thence runs due east 138 feet, thence due north 450 feet, thence due west 138 feet to meet the North East corner of land already under lease to the Commodity Credit Corporation.

For a term ending July 31, 1959 and Whereas, it is desired by the parties hereto to extend the said lease for an additional term under the same terms and conditions:

Now Therefore, it is mutually understood and agreed by and between the parties hereto as follows:

(1) The said lease is hereby extended for an additional term beginning July 31, 1959, and ending July 19, 1965.

(2), Lessors grant and give to the lessee the option of further renewals of the lease for an additional period of Five (5) years ending July 19, 1970, under the same terms and conditions of the lease as extended herein provided the Lessee gives the lessors written notice to renew at least Thirty (30) days prior to the time the lease, as extended, would otherwise expire.

IN WITNESS WHEREOF, The parties hereto have executed this extension of lease on the day first above written.

Ruth Corinne Schwartz, Lessor
(Ruth Corinne Schwartz)

COMMODITY CREDIT CORPORATION

Charles T. Schwartz, Lessor
(Charles T. Schwartz)

By: John R. Dummermuth
(John R. Dummermuth)
Contracting Officer)

State of Kansas, Washington County, ss:

I, A.D. Wurtz, do hereby certify that Ruth Corinne Schwartz and Charles T. Schwartz, to me known to be the person (or persons) who executed the foregoing instrument, personally appeared before me and acknowledged that he (she or they) executed the same as his (her or their) free act and deed and, in case said instrument was executed the same as his (her or their) free act and deed and, in case said instrument was executed on behalf of a corporation, that he (she or they) as John R. Dummermuth, contracting officer, was duly authorized by the Board of Directors of said corporation to execute the said instrument on behalf of said corporation and to affix the corporate seal thereto.

Given under my official hand and seal this day of March 23, 1959.

(SEAL)

A. C. Wurtz, Notary Public
(A. C. Wurtz)

My commission expires June 27, 1961

State of Kansas, Washington County, ss:

This instrument was filed for record on the 11th day of May, 1959 at 4:45 o'clock P.M., and duly recorded in Book 132 of Deeds on Page 446.

(SEAL)

W. B. Westing, Register of Deeds
By: Karel Johnson, Deputy

EXTENSION OF LEASE

FROM Charles T. Schwartz and Ruth Corine
Schwartz, Husband and wife TO Commodity Credit
Corporation

THIS EXTENSION OF LEASE, made and entered into this 15th day of June, 1966, by and between Ruth Corine Schwartz and Charles T. Schwartz, hereinafter called Lessor, and Commodity Credit Corporation, hereinafter called Lessee.

WITNESSETH

WHEREAS, the parties hereto have heretofore entered into a certain lease dated July 19, 1950, wherein the Lessor leased to the Lessee the following described property: (Enter legal description of the property)

Tract of land in the South West Quarter of the North East Quarter (SW¹/₄NE¹/₄) Section Nine (9), Township Two (2), Range Five (5); Described as follows: Commencing at a point, One Hundred Twenty Two Feet due North of the North West Corner of Lot 8 Block 2 Brockmeyer's Addition. Then running due East Six Hundred Thirty-three (633) Feet; then North Four Hundred Fifty (450) feet; then West Six Hundred Twenty-eight (628) feet; then South Four Hundred Fifty (450) feet to the point of beginning.

for a term ending July 31, 1966 and

WHEREAS, it is desired by the parties hereto to extend the said lease for an additional term under the same terms and conditions:

NOW, THEREFORE, it is mutually understood and agreed by and between the parties hereto as follows:

- (1) The said lease is hereby extended for an additional term beginning July 31, 1966, and ending July 31, 1971.
- (2) Lessors grant and give to the Lessee the option of further renewal of the lease for an additional period of five (5) years ending July 31, 1976, under the same terms and conditions of the lease as extended herein provided the Lessee gives the Lessors written notice to renew at least thirty (30) days prior to the time the lease, as extended, would otherwise expire.
- (3) The option to purchase included as paragraph 9 of the said lease is hereby made expressly applicable to this extension and to any renewal of the lease provided for herein.

IN WITNESS WHEREOF, the parties hereto have executed this Extension of Lease on the day first above written.

Charles T. Schwartz
(Lessor)

COMMODITY CREDIT CORPORATION

Ruth Corine Schwartz
(Lessor's spouse)

By: John R. Dummermuth
Chairman Washington ASC County
Committee

ACKNOWLEDGMENT

I, Paul K. Wilkinson, do hereby certify that Ruth Corine Schwartz & Charles T. Schwartz, to me known to be the persons who executed the foregoing instrument, personally appeared before me and acknowledged that they executed the same as their free act and deed and, in case said instrument was executed the same as his (her or their) free act and deed and, in case said instrument was executed on behalf of a corporation, that he as John R. Dummermuth, Contracting Officer, Commodity Credit Corporation was duly authorized by the Board of Directors of said corporation to execute the said instrument on behalf of said corporation and to affix the corporate seal thereto.

Given under my official hand and seal this day of June 22, 1966, My commission expires Aug. 7, 1966.

(SEAL)

Paul K. Wilkinson
Notary Public

STATE OF KANSAS, WASHINGTON COUNTY, SS:

This instrument was filed for record on the 28th day of June 1966 at 10:45 o'clock A.M., and duly recorded in Book 136 of Misc. on Page 429.

(SEAL)

W.B. Westing
Register of Deeds

LEASE OF PROPERTY

FROM Ruth C. Schwartz &
Charles T. Schwartz.

TO Commodity Credit Corporation

THIS LEASE, made and entered into this 17th day of February, 1971, by and between Ruth C. Schwartz & Charles T. Schwartz, Hanover, Ks. 66945 (hereinafter called the "Lessor") and Commodity Credit Corporation, (hereinafter called the "Lessee").

WITNESSETH THAT:

1. The Lessor leases to the Lessee, and the Lessee hereby leases from the Lessor, upon the terms and conditions hereinafter stated, the following described real estate (hereinafter called "property") situated in the County of Washington and State of Kansas.

Tract of land in the Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) Section Nine (9), Township Two (2), Range Five (5); described as follows: Commencing at a point, one hundred and twenty-two feet due North of the Northwest corner of Lot 8, Block 2, Brockmeyer's addition. Then running due East Six Hundred and thirty-three (633) feet; then North four hundred and Fifty (450) feet; then West Six Hundred and twenty-eight (628) feet; then South Four Hundred and fifty (450) feet to the point of beginning. containing 6.5 acres, more or less.

2. The term of the lease shall be for a period of 5 years, commencing the 31st day of July, 1971 and ending the 31st day of July, 1976, with the right of the Lessee, at any time during such term or any extension thereof, to terminate said lease, and liability for any further rent, by giving 30 days' previous notice in writing to the Lessor.

3. As rent for said property, the Lessee shall pay the Lessor Three Hundred and twenty-five Dollars (\$325.00) per year, such rent to be payable in advance, but to be apportionable in the event the lease is terminated as provided in paragraph 2 hereof.

4. The Lessor warrants that he is the owner of the property, has the right to give the Lessee possession under this lease, and will, so long as this lease remains in effect, warrant and defend the Lessee's possession against any and all persons whomsoever.

5. The Lessee shall have the right, during this lease, to erect storage structures of facilities, make alterations, install scales, fences, or signs, in or upon the premises hereby leased and, at the expiration of said lease or any renewal or extension thereof or at any time this lease is in effect, may remove said storage structures, facilities, scales, fences or signs or any part thereof, whether or not such structures, facilities, scales, fences or signs have become legally a fixture.

6. The Lessee shall not assign this lease without the written consent of the Lessor. The Lessee, may, however, sublet the structures on the premises leased hereunder, or any one or more of them for the term of the lease or any part thereof upon such terms and conditions as Lessee may wish to so sublet.

7. The Lessee, if required by the Lessor, shall upon the expiration of this lease, restore the premises to the same condition as that existing at the time of first entering upon the same under this lease or under any prior lease from the Lessor to the Lessee which has been continuous, reasonable and ordinary wear and tear and damages by the elements or by circumstances over which the Lessee has no control excepted: Provided, however, That if the Lessor requires such restoration, the Lessor shall give written Notice thereof to the Lessee 30 days before the termination of the lease.

8. The Lessor grants and gives the Lessee the option as a consideration of this lease and for the further consideration of one dollar, the receipt of which is hereby acknowledged, to renew said lease for a period of 5 years from the Lessor, his heirs, executors, administrators, and assigns, for the sum of Three Hundred Twenty-five Dollars (\$325.00) per year.

9. As a consideration of this lease and for the further consideration of one dollar, the receipt of which is hereby acknowledged, the Lessor grants and gives the Lessee the option, at any time while this lease is in effect, to purchase said property from the Lessor, his heirs, executors, administrators, and assigns, for the sum of Dollars (\$). In the event the Lessee shall exercise this option to purchase said property, the Lessor agrees to furnish at his own expense an abstract of title, certificate of title, or other evidence of title satisfactory to CCC and to execute a good and sufficient warranty deed conveying fee simple title to said property free and clear of all taxes, liens, or encumbrances except for the following, and no others.

10. In the event any increased tax assessment is made against the Lessor or the property by virtue of the erection of storage structures and facilities thereon by the Lessee, the Lessor agrees to cooperate fully in any contest of such increased assessment which the Lessee feels should be made. The Lessee agrees that the rental hereunder shall be adjusted upward by the amount of any such increased tax assessment which the Lessor and Lessee mutually agree to be proper or which is determined to be legally valid in court proceedings.

11. No member of or Delegate to Congress or Resident Commissioner, shall be admitted to any share or part of this lease or purchase or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this lease or purchase if made with a corporation for its general benefit.

12. The Lessor warrants that he has not employed any person to solicit or secure this lease upon any agreement for a commission, percentage, brokerage, or contingent fee and that no such consideration or payment has been or will be made. Breach of this warranty shall give CCC the right to annul the lease, or, in its discretion, to deduct from the rental or purchase price the amount of such commission, percentage, brokerage, or contingent fees. This warranty shall not apply to commissions payable by the Lessor if the lease is secured or made through a bona-fide

Entered in Transfer Record in my office, this 22nd day of March A.D. 1974.

~~Elissa Cox
County Clerk~~

~~STATE OF KANSAS, WASHINGTON COUNTY, 39:~~

~~This instrument was filed for record on the 22nd day of March A.D. 1974,
at 3:30 P.M. and duly recorded in Book 150 of Deeds, at page 15.~~

~~(SEAL) W. B. Westing
Register of Deeds~~

WARRANTY DEED

FROM: Ruth Corinne Schwartz and Charles T. Schwartz, Husband and wife TO: Roger D. Warren

THIS INSTRUMENT, Made this 16 day of October A.D. 1971, between Ruth Corinne Schwartz and Charles T. Schwartz, wife and husband of Washington County, in the State of Kansas of the first part, and Roger D. Warren of Washington County, in the State of Kansas of the second part,

WITNESSETH, That said parties of the first part, in consideration of the sum of One Dollar and other valuable consideration ---Dollars, the receipt whereof is hereby acknowledged, do by these presents grant, bargain, sell and convey unto said party of the second part, his heirs and assigns, all the following described real estate, situated in the County of Washington and State of Kansas, to wit:

All of the following described real estate, situated in the county of Washington and State of Kansas, to-wit:

A part of portion of the Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of Section Nine (9), Township Two (2), Range Five (5) described as follows, to-wit: BEGINNING at a point 122 feet due north of the Northwest corner of Lot 8 in Block 2 in Brodmeier's Addition to the City of Hanover, Kansas; and running thence due North 64 $\frac{1}{2}$ feet, more or less, to a point 16 $\frac{1}{2}$ feet south of the North line of the Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of said Section Nine (9), said point being on the south line of the road known as the Cemetery Road; thence East along the south line of said Cemetery Road 1290 feet, to the East line of said Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of said Section Nine (9); thence South along said East line, 1250.8 feet, more or less, to a point 52.7 feet north

of the Southeast corner of the Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of said Section Nine (9), being a point on the North line of the Highway; thence West on said highway line, 495 feet, more or less, to the Southeast corner of Poell's First Addition to Hanover; thence North 372.6 feet to the Northeast corner of said Poell's First Addition; thence West along the North line of said Poell's First Addition, 399 feet, to the east line of said Brockmeyer's Addition; thence North to the Northeast corner of said Brockmeyer's Addition; thence West 261 feet, more or less, to a point on the North line of said Brockmeyer's Addition 16 feet north and 90 feet east of the Northwest corner of Lot 8 in Block 2 of said Brockmeyer's Addition; thence North 106 feet; thence West 90 feet, to the place of beginning, containing 28.8 acres, more or less, situated in the County of Washington and State of Kansas;

EXCEPT the following described tract of land: A tract of land in the Southeast corner of the Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of Section Nine (9), Township Two (2) South, Range Five (5) East of the 6th P.M. described as follows: Beginning at a point 250 feet east of the Northeast corner of Poell's Addition to the City of Hanover, which is 250 feet east of the steel stake in the ground at a point 35 feet east and 70 feet north of the Northeast corner of Lot One (1) in said Poell's Addition to the City of Hanover; thence running East 245 feet, more or less, to the east line of the Southwest Quarter of the Northeast Quarter of said Section Nine (9); thence South to a point on the north line of Highway 15-B which point is about 52 feet north of the Southeast corner of the Southwest Quarter of the Northeast Quarter of said Section Nine (9); thence West 245 feet, more or less, to the east line of the tract heretofore conveyed to said grantees by warranty deed recorded in Book 135, Page 704 of the Deed Records of said county; thence North to the place of beginning, all in Washington County, Kansas;

ALSO EXCEPT the following described tract of land: A tract of land beginning at a point 35 feet east and 70 feet north of the northeast corner of Lot One (1), in Poell's Addition to the City of Hanover, Washington County, Kansas, said point being designated by a steel stake driven in the ground, thence east 250 feet, thence South to the north line of Highway 15, thence West 250 feet, to a point 35 feet directly east of the Southeast corner of Lot Eight (8) in said Addition; thence North to the place of beginning, being out of the Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of Section Nine (9), Township Two (2) Range Five (5), in Washington County, Kansas;

AND ALSO EXCEPT the following described tract of land: A tract of land beginning at a point 425.3 feet north of the Southeast corner of the Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of Section Nine (9), Township Two (2) Range Five (5), thence north 878.2 feet, more or less, to a point 16.5 feet south of the north line of said Southwest Quarter of the Northeast Quarter (SW $\frac{1}{4}$ NE $\frac{1}{4}$) of Section Nine (9), Township Two (2) Range Five (5), said point being on the south line of the road known as the Cemetery Road; thence west along the south line of said Cemetery Road 1290 feet; thence South 191.5 feet; thence East 638 feet, more or less, thence South 450 feet; thence West 538 feet; thence South 106 feet; thence East 660 feet; thence South 158 feet to the Northeast corner of Poell's Addition, thence east 495 feet to the place of beginning, all in Washington County, Kansas.

TO HAVE AND TO HOLD THE SAME, Together with all and singular the tenements, hereditaments and appurtenances thereunto belonging or in anywise appertaining, forever.

And said Grantors, for for themselves, their heirs, executors or administrators, do hereby covenant, promise and agree to and with said party of the second part, that at the delivery of these presents they are lawfully seized in their own right, of an absolute and indefeasible estate of inheritance, in fee simple, of and in all and singular the above granted and described premises, with the appurtenances; that the same are free, clear, discharged and unincumbered of and from all former and other grants, titles, charges, estates, judgments, assessments and incumbrances, of what nature or kind soever, and that they will warrant and forever defend the same unto said party of the second part, his heirs and assigns, against said parties of the first part, their heirs, and all and every person or persons, whomsoever, lawfully claiming or to claim the same.

IN WITNESS WHEREOF, the said parties of the first part have hereunto set their hands, the day and year first above written.

Ruth Corinne Schwartz
(Ruth Corinne Schwartz)

Charles T. Schwartz
(Charles T. Schwartz)

STATE OF KANSAS, WASHINGTON COUNTY, ss.

The foregoing instrument was acknowledged before me this 16 day of October, 1971 by Ruth Corinne Schwartz and Charles T. Schwartz, wife and husband,

William Byrnes (SEAL)
Notary Public
Washington County, Kansas
My commission expires March 29, 1974

William Byrnes
(William Byrnes) Notary Public

Entered in Transfer Record in my office this 25th day of March A. D. 1974.

Eileen Cox
County Clerk

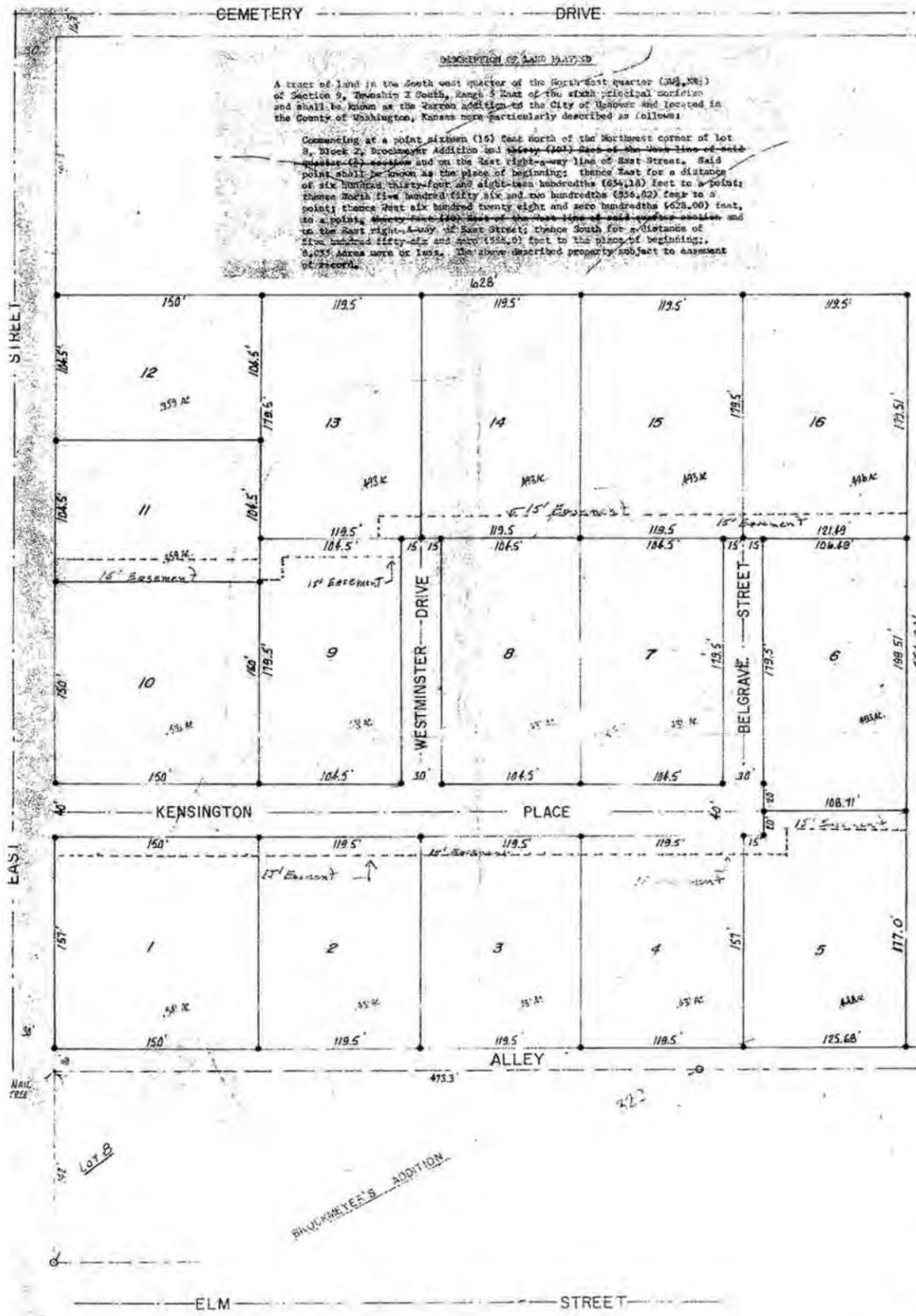
STATE OF KANSAS ss.
Washington County,

This instrument was filed for record on the 25th day of March A. D. 1974,
at 2:45 o'clock P.M., and duly recorded in Book 150 of Deeds, at page 16.

(SEAL)

W. B. Westing
Register of Deeds

WARRANTY DEED



DESCRIPTION OF LAND PLAT

A tract of land in the South west quarter of the North-East quarter (SW NE) of Section 9, Township 1 South, Range 3 East of the sixth principal meridian and shall be known as the Warren Addition to the City of Hanover and located in the County of Washington, Kansas more particularly described as follows:

Commencing at a point sixteen (16) feet north of the Northwest corner of lot 8, Block 2, Brookmeyer Addition and thence (101) feet to the West line of said block (12) feet and on the East right-of-way line of East Street, said point shall be known as the place of beginning; thence East for a distance of six hundred thirty-four and eight-tenths (634.8) feet to a point; thence South five hundred fifty six and two hundredths (556.02) feet to a point; thence East six hundred twenty eight and zero hundredths (628.00) feet, to a point; thence East 100 feet to the East line of said block and on the East right-of-way of East Street; thence South for a distance of five hundred fifty six and zero hundredths (556.0) feet to the place of beginning; 0.05' Area save or lose. The above described property subject to assessment of taxes.

STATE OF KANSAS)
COUNTY OF WASHINGTON)

THIS is to certify that the above named are the owners of land described in (44) A. 1. and that they have caused the same to be surveyed and subdivided as indicated thereon, for the uses and purposes therein set forth, and do hereby acknowledge and adopt the same under the style and title thereon indicated.

All streets and avenues shown on this plat are hereby dedicated to the public.

Given under hand at Hanover, Kansas, this 17 day of July, 1974.

De Koon Warren *Lo Anna Warren*
De Koon Warren Lo Anna Warren

STATE OF KANSAS)
COUNTY OF WASHINGTON)

I, the undersigned a Notary Public in and for said County and State, do hereby certify that *De Koon Warren* and *Lo Anna Warren*, personally known to me to be the true persons whose names are subscribed to the foregoing instrument as such owners, appeared before me this day, in person, and acknowledged that they signed and delivered this plat of said tract and voluntary act for the uses and purposes therein set forth.

Given under my hand and Notary Seal this 17 day of July, 1974.

Richard A. Anderson
Notary Public

STATE OF KANSAS)
COUNTY OF WASHINGTON)

I do hereby certify that there are no delinquent general taxes, no unpaid current general taxes, no unpaid forfeited taxes and no redeemable tax sales against any of the land included in the plat.

I further certify that I have received all statutory fees in connection with duplicate.

Given under my hand and seal at Hanover, Kansas, this 17 day of July, 1974.

Edison Cox *Manetta Halle*
County Clerk - Edison Cox City Clerk - Manetta Halle

STATE OF KANSAS)
COUNTY OF WASHINGTON)

I do hereby certify that there are no delinquent or unpaid current or forfeited special assessments or any delinquent taxes thereon that have not been provided against the tract of land included in the plat.

Given under my hand and seal at Hanover, Kansas, this 17 day of July, 1974.

Edison Cox *Manetta Halle*
County Clerk - Edison Cox City Clerk - Manetta Halle

LEGEND

- IRON PINS SET
- IRON PINS RELOCATED

I, *Edison Cox*, County Engineer of Washington County, Kansas, do hereby certify that this plat conforms to the applicable Kansas State Statute 20-2005 to the best of my knowledge.

Edison Cox
County Engineer - Washington County

STATE OF KANSAS)
COUNTY OF WASHINGTON)

Approved by the governing body of the City of Hanover, Kansas, this 17 day of July, 1974.

Manetta Halle
Manetta Halle, City Clerk

Approved by the Board of County Commissioners, Washington County, Kansas, this 17 day of July, 1974.

Edward J. Hebert
Chairman - Edward J. Hebert
County Clerk - Edison Cox

STATE OF KANSAS)
COUNTY OF WASHINGTON)

This instrument was filed for records on the 17 day of July, 1974, A. M. at 11 o'clock and duly recorded in Book of Page No. 17.

William B. Blanton
William B. Blanton, Registrar of Deeds

Retained in Transfer Records in my office 17th day of July, 1974.

Edison Cox
Edison Cox - County Clerk

PLOT PLAN OF WARREN ADDITION HANOVER, KANSAS

APPROVED AND FILED FOR RECORDS

1974 JUL 17

WILLIAM B. BLANTON
REGISTRAR OF DEEDS

EDISON COX
COUNTY CLERK

<p style="text-align: center;">FROM</p> <p>Roger D. Warren & Linda D. Warren Husband and wife</p> <p style="text-align: center;">TO</p> <p>Leonard G. Meier & Eleanora C. Meier, husband and wife</p>	<p>Entered in Transfer Record in my office this 13th day of May, A. D., 19 75 .</p> <p style="text-align: right;">Eileen Cox, County Clerk. Deputy.</p> <hr/> <p>STATE OF KANSAS, WASHINGTON COUNTY, ss. This instrument was filed for record on the 13th day of May, A. D. 19 75, at 11 o'clock A. M. and duly recorded in Book 153 of Deeds Page 331 (Seal) W. B. Westing, Register of Deeds.</p> <p>By _____, Deputy.</p>
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THIS INDENTURE, Made this 1st day of May A. D. 19 75, between
Roger D. Warren & Linda D. Warren, husband & wife
of Washington County, in the State of Kansas, of the first part, and
Leonard G. Meier and Eleanora C. Meier, husband & wife
of Washington County, in the State of Kansas as joint tenants
with the right of survivorship and not as tenants in common, of the second part:
WITNESSETH, That the said part ies of the first part, in consideration of the sum of
One Dollar and other valuable consideration - - - and - 100 DOLLARS,
the receipt whereof is hereby acknowledged, do by these presents grant, bargain, sell and convey unto the said part ies
of the second part, as joint tenants with the right of survivorship, and not as tenants in common,
all of the following-described REAL ESTATE, situated in the County of Washington, and State of Kansas, to wit:

Lots Eleven (11) and Twelve (12), in Warren's Addition
to the City of Hanover, subject to restrictions and easements
of record.

TO HAVE AND TO HOLD THE SAME, Together with all and singular the tenements, hereditaments and appurtenances there-
unto belonging or in anywise appertaining, forever as joint tenants, the survivor to take the whole estate.
And said grantors,
for themselves, their heirs, executors, or administrators, do hereby covenant, promise and
agree, to and with said part ies of the second part, that at the delivery of these presents they are lawfully seized in
their own right of an absolute and indefeasible estate of inheritance, in fee simple, of and in all and singular the above granted
and described premises, with the appurtenances; that the same are free, clear, discharged and unincumbered of and from all former
and other grants, titles, charges, estates, judgments, taxes, assessments and incumbrances, of what nature or kind soever;

and that they will WARRANT AND FOREVER DEFEND the same unto the said part ies of the second part,
as joint tenants with the right of survivorship and not as tenants in common, their
heirs, and the heirs and assigns of the survivor of them,
against the said part ies of the first part, their heirs, and all and every person or persons whomsoever,
lawfully claiming or to claim the same.

IN WITNESS WHEREOF, The said part ies of the first part ha ve hereunto set their hands,
the day and year first above written.

Roger D. Warren Linda D. Warren
(Roger D. Warren) (Linda D. Warren)

STATE OF KANSAS WASHINGTON COUNTY, ss.
The foregoing instrument was acknowledged before me this 1st day of May, 1975
by Roger D. Warren and Linda D. Warren, husband and wife.
(SEAL) PAUL L. MONTY Paul L. Monty
NOTARY PUBLIC (Paul L. Monty)
WASHINGTON COUNTY, KANS. My commission expires July 21, 1978

STATE OF KANSAS, COUNTY, ss.
BE IT REMEMBERED, That on this day of A. D. 19 before me,
the undersigned, a Notary Public in and for the County and State aforesaid, came

who personally known to me to be the same person who executed the within instrument of
writing, and such person duly acknowledged the execution of the same. Seal,
(SEAL) IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed my
the day and year last above written.

Appendix B:

**Water Well Registration Data Used in Construction
of Hydrogeologic Cross Sections A-A' and B-B'**

Contents

Table B.1 Summary of water well records used to construct hydrogeologic cross sections A-A' and B-B'

Water well records for cross section A-A':

- City of Hanover PWS
- Joe Schmidt
- David Eldean
- Dennis Minge
- Alan Bruna
- Bill's Service Center (MW10)
- USD 223
- Bill's Service Center (MW9)
- Louis Taylor

Water well records for cross section B-B':

- Duane Bruna
- Gary Minge
- Jim Kruse
- Dennis Doebele
- Tony Bruna
- Ted Bruna
- Alan Bruna

TABLE B.1 Summary of water well logs used for cross sections A-A' and B-B'.

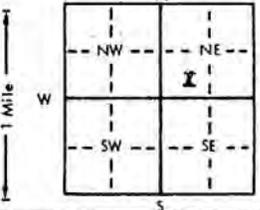
Owner	Well	Static Water Level)	Depth (ft BGL)				Well Use	Date of completion
			Screen Interval	Clay/silt	Sand/Gravel	Shale and Limestone		
A-A' (W-E)								
1 City of Hanover PWS	41	20	unknown	0-20	20-41		Plugged	07/28/87
2 Joe Schmidt	52	25	42-52	0-26	26-55	55-60	Lawn/garden	04/21/99
3 David Eldean	58	35	38-58	0-36	36-58	58-62	Lawn/garden	10/27/03
4 Dennis Minge	62	20	32-52	0-45		45-62	Lawn/garden	10/27/01
5 Alan Bruna	80	55	40-60	0-6		6-80	Domestic	07/03/89
6 Bill's Service Center (MW10)	50	39.6	30-50	0-17		17-50	Monitoring well	02/13/97
7 USD 223	75	56	55-75	0-3		3-75	Lawn/garden	04/08/92
8 Bill's Service Center (MW9)	45	42.9	25-45	0-13	13-25	25-45	Monitoring well	02/12/97
9 Louis Taylor	62	29	42-62	0-8		8-62	Domestic	11/17/99
B-B' (SW-NE)								
1 Duane Bruna	45	25	25-45	0-31	31-44	44-50	Lawn/garden	06/02/00
2 Gary Minge	54	40	34-54	0-45	45-50	50-54	Domestic	08/17/82
3 Jim Kruse	58		48-58	0-54		54-58	Domestic	04/08/92
4 Dennis Doeble	82	40	42-62	0-1		1-82	Domestic	11/07/90
5 Tony Bruna	82	52	62-82	0-8		8-142	Lawn/garden	07/07/00
6 Ted Bruna	80	60	65-75	0-8		8-80	Domestic	07/03/89
7 Alan Bruna	80	55	40-60	0-6		6-80	Domestic	07/03/89

Source: KDHE water well registration WWC-5 records.

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

1 LOCATION OF WATER WELL: County: Washington Fraction $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ Section Number 8 Township Number T 2 S Range Number R 5 E
Distance and direction from nearest town or city street address of well if located within city?
605 W. North St.

2 WATER WELL OWNER: City of Hanover
RR#, St. Address, Box #: P. O. Box 416
City, State, ZIP Code: Hanover, Ks.
Board of Agriculture, Division of Water Resources
Application Number: Not Available

3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:  DEPTH OF COMPLETED WELL: \$ 41 ft. ELEVATION: _____
Depth(s) Groundwater Encountered 1. 20 ft. 2. _____ ft. 3. _____ ft.
WELL'S STATIC WATER LEVEL 20 ft. below land surface measured on 7/14/87
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: 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 Observation 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 _____

5 TYPE OF BLANK CASING USED: 1 Steel 3 RMP (SR) 5 Wrought iron 8 Concrete tile CASING JOINTS: Glued _____ Clamped _____
2 PVC 4 ABS 6 Asbestos-Cement 9 Other (specify below) Welded _____
7 Fiberglass Dug well Brick walls Threaded _____
Blank casing diameter 12 ft. Dia. _____ in. to _____ ft. Dia. _____ in. to _____ ft.
Casing height _____ and surface 5 ft. below in., weight _____ lbs./ft. Wall thickness or gauge No. _____
TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 3 Stainless steel 5 Fiberglass 7 PVC 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: 1 Continuous slot 3 Mill slot 5 Gauzed wrapped 8 Saw cut 11 None (open hole)
2 Louvered shutter 4 Key punched 7 Torch cut 9 Drilled holes 10 Other (specify) _____
SCREEN-PERFORATED INTERVALS: From _____ ft. to _____ ft., From _____ ft. to _____ ft.
GRAVEL PACK INTERVALS: From _____ ft. to _____ ft., From _____ ft. to _____ ft.

6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite 4 Other _____
Grout Intervals: From 5 ft. to 4.5 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
Direction from well?
FROM TO LITHOLOGIC LOG FROM TO LITHOLOGIC LOG
41 20 21 ft. sand _____ _____
20 5 Clay type soil _____ _____
5 4.5 6 inch concrete slab _____ _____
4.5 0 Black topsoil _____ _____

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) 7/28/87 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. _____ This Water Well Record was completed on (mo/day/yr) 1/28/88 under the business name of _____ by (signature) Stan Martin
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, Division of Environment, Environmental Geology Section, Topeka, KS 66620. Send one to WATER WELL OWNER and retain one for your records.

WATER WELL RECORD Form WWC-5 KSA 88a-1212

1) LOCATION OF WATER WELL:		Fraction	Section Number	Township Number	Range Number
County <u>Washington</u>		<u>SE</u> $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$	<u>8</u>	<u>T</u> <u>2</u> <u>S</u>	<u>R</u> <u>5</u> (<u>W</u>)
Distance and direction from nearest town or city street address of well if located within city? <u>212 N Wulff</u>					
2) WATER WELL OWNER: <u>Joe Schmidt</u>		Board of Agriculture, Division of Water Resources Application Number:			
RR#, St. Address, Box # : <u>Rt. 1</u>		City, State, ZIP Code : <u>Hanover, KS, 66945</u>			
3) LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:		4) DEPTH OF COMPLETED WELL <u>52</u> ft. ELEVATION: _____			
		Depth(s) Groundwater Encountered 1. _____ ft. 2. _____ ft. 3. _____ ft.			
		WELL'S STATIC WATER LEVEL <u>25</u> ft. below land surface measured on (m/d/yr) <u>4/21/99</u>			
Pump test data: Well water was _____ ft. after _____ hours pumping _____ gpm		Est. Yield <u>50</u> gpm: Well water was _____ ft. after _____ hours pumping _____ gpm			
Bore Hole Diameter: <u>9</u> in. to <u>60</u> in. and _____ in. to _____ in.		WELL WATER TO BE USED AS:			
1 Domestic 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below)		5 Public water supply 8 Air conditioning 11 Injection well			
2 Irrigation 4 Industrial 7 Lawn and garden only 10 Monitoring well		Was a chemical/bacteriological sample submitted to Department? Yes _____ No _____ * If yes, m/d/yr sample was submitted _____			
Water Well Disinfected? Yes _____ No _____		CASING JOINTS: Glued _____ Clamped _____			
5) TYPE OF BLANK CASING USED:		1 Steel 3 RMP (SR) 6 Asbestos-Cement 9 Other (specify below) Welded _____			
2 PVC 4 ABS 7 Fiberglass _____ Threaded _____		Blank casing diameter _____ in. to _____ in. Dia. _____ in. to _____ in. Dia. _____ in. to _____ in. Dia.			
Casing height above land surface: <u>18</u> in. weight <u>200</u> lbs./ft. Wall thickness or gauge No. <u>265</u>		TYPE OF SCREEN OR PERFORATION MATERIAL:			
1 Steel 3 Stainless steel 5 Fiberglass _____ 7 PVC _____ 10 Asbestos-cement _____		2 Brass 4 Galvanized steel 6 Concrete etc. 9 ABS _____ 11 Other (specify) _____ 12 None used (open hole)			
SCREEN OR PERFORATION OPENINGS ARE:		5 Gauzed wrapped 8 Saw cut 11 None (open hole)			
1 Continuous slot 3 Mill slot 6 Wire wrapped 9 Drilled holes		2 Louvered strainer 4 Key punched 7 Torch cut 10 Other (specify) _____			
SCREEN-PERFORATED INTERVALS: From <u>42</u> ft. to <u>52</u> ft. From _____ ft. to _____ ft.		From _____ ft. to _____ ft. From _____ ft. to _____ ft.			
GRAVEL PACK INTERVALS: From <u>25</u> ft. to <u>52</u> ft. From _____ ft. to _____ ft.		From _____ ft. to _____ ft. From _____ ft. to _____ ft.			
6) GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite 4 Other _____		GROUT INTERVALS: From <u>5</u> ft. to <u>25</u> ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft.			
What is the nearest source of possible contamination:		10 Livestock pens 14 Abandoned water well			
1 Septic tank 4 Lateral lines 7 Pit privy 11 Fuel storage 15 Oil well/Gas well		2 Sewer lines 5 Cross pool 8 Sewage lagoon 12 Fertilizer storage 16 Other (specify below)			
3 Watertight sewer lines 6 Seepage pit 9 Feedyard 13 Insecticide storage		Direction from well? <u>None</u> How many feet? _____			
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 (m/d/yr) <u>4/21/99</u> and this record is true to the best of my knowledge and belief, Kansas Water Well Contractor's License No. <u>518</u> . This Water Well Record was completed on (m/d/yr) <u>4/28/99</u> under the business name of <u>Blue Valley Drilling</u> by (signature) <u>[Signature]</u>		LITHOLOGIC LOG			
FROM	TO	LITHOLOGIC LOG		FROM	TO
0	3	Topsoil			
3	26	Brown Clay			
26	34	Sand (Fine)			
34	55	Sand (Med.-Coarse)			
55	60	shale			
PLUGGING INTERVALS					
INSTRUCTIONS: Use typewriter or ball point pen, PLEASE PRINT NAME Y and AVOID cursive. Please fill in blanks, underline or circle the correct answers. Send top free copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66603-0001, Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.					

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

1 LOCATION OF WATER WELL: County: Washington	Fraction NE 1/4 NW 1/4 SE 1/4	Section Number 9	Township Number T 2 S	Range Number R 5 EW
---------------------------------------------------------------	-----------------------------------------	----------------------------	---------------------------------	-------------------------------

Distance and direction from nearest town or city street address of well if located within city?
East edge of Hanover

2 WATER WELL OWNER: UNIFIED SCHOOL DISTRICT NO. 223 RR#, St. Address, Box # : Box 188 City, State, ZIP Code : Barnes, Ks. 66933	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: 75 ft. ELEVATION: Depth(s) Groundwater Encountered 1. _____ ft. 2. _____ ft. 3. _____ ft. WELL'S STATIC WATER LEVEL 56 ft. below land surface measured on 4/8/92 Pump test data: Well water was _____ ft. after _____ hours pumping _____ gpm Est. Yield 15 gpm; Well water was _____ ft. after _____ hours pumping _____ gpm Bore Hole Diameter 8 in. to 7.5 ft. and _____ in. to _____ ft. WELL WATER TO BE USED AS: 1 Domestic 3 Feedlot 5 Public water supply 8 Air conditioning 11 Injection well 2 Irrigation 4 Industrial 7 <u>Lawn and garden only</u> 9 Dewatering 12 Other (Specify below) 10 Monitoring well Was a chemical/bacteriological sample submitted to Department? Yes _____ No <input checked="" type="checkbox"/> * If yes, mo/day/yr sample was submitted _____ Water Well Disinfected? Yes <input checked="" type="checkbox"/> No _____
-------------------------------------------------------------	-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

1 Mile

5 TYPE OF BLANK CASING USED:	1 Steel 3 RMP (SR) 5 Wrought iron 8 Concrete tile 2 PVC 4 ABS 6 Asbestos-Cement 9 Other (specify below) 7 Fiberglass Blank casing diameter 5 in. to 5.5 ft. Dia _____ in. to _____ ft. Dia _____ in. to _____ ft. Casing height above land surface 24 in. weight 200 lbs./ft. Wall thickness or gauge No. _____	CASING JOINTS: Glued <input checked="" type="checkbox"/> Clamped _____ Welded _____ Threaded _____
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TYPE OF SCREEN OR PERFORATION MATERIAL: 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: 1 Continuous slot 3 Mill slot 5 Gauzed wrapped 8 Saw cut 11 None (open hole) 2 Louvered shutter 4 Key punched 6 Wire wrapped 9 Drilled holes 10 Other (specify) _____ SCREEN-PERFORATED INTERVALS: From 55 ft. to 75 ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft. GRAVEL PACK INTERVALS: From 30 ft. to 75 ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft.
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6 GROUT MATERIAL:	1 Neat cement 2 Cement grout 3 <u>Bentonite</u> 4 Other _____ Grout Intervals: From 5 ft. to 30 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 Direction from well? SW How many feet? 500
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FROM	TO	LITHOLOGIC LOG	FROM	TO	PLUGGING INTERVALS
0	3	Topsoil			
3	27	Yellow Shale			
27	29	Gray Shale			
29	38	Yellow Shale			
38	56	Red Shale			
56	60	Yellow Shale			
60	66	Limestone			
66	75	Gray Shale			

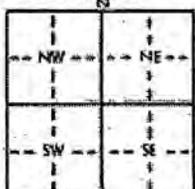
7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) 4/8/92 and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. 518 . This Water Well Record was completed on (mo/day/yr) 4/8/92 under the business name of Blue Valley Drilling by (signature) <i>Eric Strader</i>

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 66820-7320. Telephone: 913-296-5545. Send one to WATER WELL OWNER and retain one for your records.

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

1 LOCATION OF WATER WELL: County: <u>Washington</u>		Fracton <u>NW</u> $\frac{1}{4}$ <u>NW</u> $\frac{1}{4}$ <u>SW</u> $\frac{1}{4}$	Section Number <u>10</u>	Township Number <u>T 2 S</u>	Range Number <u>R 5 EW</u>
Distance and direction from nearest town or city street address of well if located within city? <u>1/2 East of Hanover</u>					
2 WATER WELL OWNER: <u>Louis THYMX Taylor</u> RR#, St. Address, Box #: <u>206 East Elm</u> City, State, ZIP Code: <u>Hanover, KS, 66945</u> 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: <u>62</u> ft. ELEVATION: _____ ft.			
		Depth(s) Groundwater Encountered 1. _____ ft. 2. _____ ft. 3. _____ ft. WELL'S STATIC WATER LEVEL: <u>29</u> ft. below land surface measured on (m/d/yr) <u>11/17/99</u> Pump test data: Well water was _____ ft. after _____ hours pumping _____ gpm Est. Yield: <u>30</u> gpm; Well water was _____ ft. after _____ hours pumping _____ gpm Bore Hole Diameter: <u>9"</u> in. to <u>62</u> 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 _____ * If yes, m/d/yr sample was submitted: _____ Water Well Disinfected? Yes <u>2</u> No _____			
5 TYPE OF BLANK CASING USED:					
1 Steel 3 RMP (SR)		5 Wrought iron 8 Concrete tile		CASING JOINTS: Gasketed _____ Clamped _____	
2 PVC 4 ABS		6 Asbestos-Cement 9 Other (specify below)		Welded _____	
Blank casing diameter: <u>5</u> in. to <u>42</u> ft. Dia. _____ in. to _____ ft. Dia. _____ in. to _____ ft.		7 Fiberglass		Threaded: _____	
Casing height above land surface: <u>18</u> in. weight: <u>280</u> lbs./ft. Well thickness or gauge No. <u>265</u>		TYPE OF SCREEN OR PERFORATION MATERIAL:			
1 Steel 3 Stainless steel 5 Fiberglass 7 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:			
1 Continuous slot 3 Mill slot 5 Gauzed wrapped 9 Saw cut 11 None (open hole)		2 Lowered shutter 4 Key punched 6 Wire wrapped 8 Drilled holes			
7 Torch cut 10 Other (specify) _____		SCREEN-PERFORATED INTERVALS:			
From: <u>42</u> ft. to <u>62</u> ft. From: _____ ft. to _____ ft.		GRAVEL PACK INTERVALS:			
From: <u>30</u> ft. to <u>62</u> ft. From: _____ ft. to _____ ft.		From: _____ ft. to _____ ft. From: _____ ft. to _____ ft.			
6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite 4 Other					
Grout intervals: From: <u>5</u> ft. to <u>30</u> 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 Watersight sewer lines 6 Sepsage pit 9 Feedyard 12 Fertilizer storage 16 Other (specify below)	
13 Insecticide storage		Direction from well? <u>None Present</u> How many feet? _____			
LITHOLOGIC LOG					
FROM	TO		FROM	TO	PLUGGING INTERVALS
0	1	Topsoil			
1	8	Red Clay			
8	13	Tan Shale			
13	15	Limestone			
15	26	Gray Shale			
26	30	Limestone			
30	36	Gray Shale			
36	47	Limestone			
47	62	Red 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 (m/d/yr) <u>11/17/99</u> and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. <u>518</u> This Water Well Record was completed on (m/d/yr) <u>11/27/99</u> under the business name of <u>Blue Valley Drilling</u> by (signature) <u>Tom [unclear]</u>					
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 66605-0001. Telephone: 913-296-0345. Send one to WATER WELL OWNER and retain one for your records.					

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

1 LOCATION OF WATER WELL: County: <u>Washington</u>		Fracton <u>NW 1/4 NW 1/4 NW 1/4</u>	Section Number <u>16</u>	Township Number <u>T 2 S</u>	Range Number <u>R 5 E/W</u>
Distance and direction from nearest town or city street address of well if located within city? <u>South edge of Hanover</u>					
2 WATER WELL OWNER: <u>Duane Bruna</u> RR#, St. Address, Box # : <u>Rt. 1</u> City, State, ZIP Code : <u>Hanover, KS, 66945</u>		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: <u>45</u> ft. ELEVATION: Depth(s) Groundwater Encountered 1. _____ ft. 2. _____ ft. 3. _____ ft. WELL'S STATIC WATER LEVEL: <u>25</u> ft. below land surface measured on mo/day/yr <u>6/2/00</u> Pump test data: Well water was _____ ft. after _____ hours pumping _____ gpm Est. Yield: <u>50+</u> gpm; Well water was _____ ft. after _____ hours pumping _____ gpm Bore Hole Diameter: <u>10</u> in. to <u>50</u> ft. and _____ in. to _____ ft. WELL WATER TO BE USED AS: 1 Domestic 3 Feedlot 5 Public water supply 8 Air conditioning 11 Injection well 2 Irrigation 4 Industrial <u>7 Lawn and garden only</u> 10 Monitoring well Was a chemical/bacteriological sample submitted to Department? Yes _____ No _____; if yes, mo/day/yr sample was submitted Water Well Disinfected? Yes <u>*</u> No _____			
5 TYPE OF BLANK CASING USED: 1 Steel 3 RMP (SR) 5 Wrought iron 8 Concrete tile 2 PVC 4 ABS 7 Fiberglass 9 Other (specify below)		CASING JOINTS: Gauged <u>*</u> Clamped _____ Welded _____ Threaded _____ Blank casing diameter: <u>5</u> in. to <u>25</u> ft. Dia. _____ in. to _____ ft. Dia. _____ in. to _____ ft. Dia. Casing height above land surface: <u>18</u> in. weight: <u>160</u> lbs./ft. Well thickness or gauge No. <u>265</u>			
TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 3 Stainless steel 5 Fiberglass 8 RMP (SR) 2 Brass 4 Galvanized steel 6 Concrete tile 9 ABS		10 Asbestos-cement 11 Other (specify) _____ 12 None used (open hole)			
SCREEN OR PERFORATION OPENINGS ARE: 1 Continuous slot 3 Mill slot 5 Gauzed wrapped 8 Saw cut 11 None (open hole) 2 Louvered shutter 4 Key punched 6 Wire wrapped 7 Torch cut 9 Drilled holes 10 Other (specify) _____		SCREEN-PERFORATED INTERVALS: From <u>25</u> ft. to <u>45</u> ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft. GRAVEL PACK INTERVALS: From <u>20</u> ft. to <u>45</u> ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft.			
6 GROUT MATERIAL: 1 Neat cement 2 Cement grout 3 Bentonite 4 Other _____		GROUT INTERVALS: From <u>5</u> ft. to <u>20</u> ft. From _____ ft. to _____ ft. From _____ ft. to _____ ft.			
What is the nearest source of possible contamination: 1 Septic tank 4 Latent lines 7 FR 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 cover lines 6 Seepage pit 9 Feedyard 12 Fertilizer storage 18 Other (specify below) 13 Insecticide storage		Direction from well? <u>West</u> How many feet? <u>150</u>			
FROM TO LITHOLOGIC LOG FROM TO PLUGGING INTERVALS					
0 1 Topsoil					
1 22 Brown Clay					
22 31 Black Clay					
31 44 Sand (Med. - Coarse)					
44 50 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) <u>6/2/00</u> and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. <u>518</u> . This Water Well Record was completed on (mo/day/yr) <u>6/10/00</u> under the business name of <u>Blue Valley Drilling</u> by (signature) _____					
INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS HARDY and PRINT clearly. Pencil is all right, underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water, Topeka, Kansas 66606-0001. Telephone: 913-296-5245. Send one to WATER WELL OWNER and retain one for your records.					

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

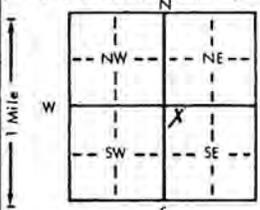
1 LOCATION OF WATER WELL: County: Washington		Fraction NW $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$		Section Number 16	Township Number T 2 S	Range Number R 5 E
Distance and direction from nearest town or city street address of well if located within city? In Hanover (Southern Part)						
2 WATER WELL OWNER: Gary Minge RR#, St. Address, Box #: Box 375 City, State, ZIP Code: Hanover, Kansas 66945 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... 54 ... ft. ELEVATION:				
		Depth(s) Groundwater Encountered 1. ft. 2. ft. 3. ft. WELL'S STATIC WATER LEVEL ... 40 ... ft. below land surface measured on mo/day/yr 8/17/82 ... Pump test data: Well water was ... NA ... ft. after ... hours pumping ... gpm Est. Yield ... 10 ... gpm; Well water was ... ft. after ... hours pumping ... gpm Bore Hole Diameter ... 8 ... in. to ... 54 ... ft., and ... in. to ... ft. WELL WATER TO BE USED AS: 5 Public water supply 8 Air conditioning 11 Injection well <input checked="" type="checkbox"/> Domestic 3 Feedlot 6 Oil field water supply 9 Dewatering 12 Other (Specify below) 2 Irrigation 4 Industrial 7 Lawn and garden only 10 Observation well Was a chemical/bacteriological sample submitted to Department? Yes.....No... <input checked="" type="checkbox"/>; If yes, mo/day/yr sample was submitted Water Well Disinfected? Yes <input checked="" type="checkbox"/> No				
		TYPE OF BLANK CASING USED: 1 Steel 3 RMP (SR) 5 Wrought iron 8 Concrete tile CASING JOINTS: Glued <input checked="" type="checkbox"/> Clamped <input checked="" type="checkbox"/> PVC 4 ABS 6 Asbestos-Cement 9 Other (specify below) Welded 7 Fiberglass Threaded Blank casing diameter ... 5 ... in. to ... 34 ... ft., Dia ... in. to ... ft., Dia ... in. to ... ft. Casing height above land surface ... 12 ... in., weight ... 3 ... lbs./ft. Wall thickness or gauge No. 258 TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 3 Stainless steel 5 Fiberglass <input checked="" type="checkbox"/> PVC 10 Asbestos-cement 2 Brass 4 Galvanized steel 6 Concrete tile 8 RMP (SR) 11 Other (specify) 9 ABS 12 None used (open hole) SCREEN OR PERFORATION OPENINGS ARE: 1 Continuous slot 3 Mill slot 5 Gauzed wrapped <input checked="" type="checkbox"/> Saw cut 11 None (open hole) 2 Louvered shutter 4 Key punched 6 Wire wrapped 9 Drilled holes 7 Torch cut 10 Other (specify) SCREEN-PERFORATED INTERVALS: From ... 34 ... ft. to ... 54 ... ft., From ... ft. to ... ft. From ... ft. to ... ft., From ... ft. to ... ft. GRAVEL PACK INTERVALS: From ... 14 ... ft. to ... 54 ... ft., From ... ft. to ... ft. From ... ft. to ... ft., From ... ft. to ... ft.				
6 GROUT MATERIAL: <input checked="" type="checkbox"/> 1 Neat cement 2 Cement grout 3 Bentonite 4 Other Grout Intervals: From ... 4 ... ft. to ... 14 ... ft., From ... ft. to ... ft. What is the nearest source of possible contamination: 1 Septic tank <input checked="" type="checkbox"/> 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 Direction from well? East How many feet? 75						
FROM		TO		LITHOLOGIC LOG		
0		3		topsoil		
3		18		brown clay		
18		45		brown sandy clay		
45		50		limestone gravel		
50		54		limestone (hard)		
7 CONTRACTOR'S OR LANDOWNER'S CERTIFICATION: This water well was <input checked="" type="checkbox"/> (1) constructed, (2) reconstructed, or (3) plugged under my jurisdiction and was completed on (mo/day/year) ... 8/17/1982 ... and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. ... 359 ... This Water Well Record was completed on (mo/day/yr) ... 9/13/1982 ... under the business name of Daryl Cox & Sons Inc. by (signature)						

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, Division of Environment, Environmental Geology Section, Topeka, KS 66620. Send one to WATER WELL OWNER and retain one for your records.

WATER WELL RECORD Form WAC-5 KSA 52a-1212

1 LOCATION OF WATER WELL:		Fraction		Section Number		Township Number		Range Number																																																																																																																									
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3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX:			4 DEPTH OF COMPLETED WELL: 82 ft. ELEVATION:																																																																																																																														
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WATER WELL RECORD Form WWC-5 KSA 82a-1212

1 LOCATION OF WATER WELL: County: <u>Washington</u> Fraction <u>NW 1/4 NW 1/4 SE 1/4</u> Section Number <u>9</u> Township Number <u>T 2 S</u> Range Number <u>R 5 E/W</u>	
Distance and direction from nearest town or city street address of well if located within city? <u>East edge of Hanover</u>	
2 WATER WELL OWNER: <u>Jed Bruna</u> RR#, St. Address, Box #: <u>210 S Jackson</u> Board of Agriculture, Division of Water Resources City, State, ZIP Code: <u>Hanover, Kansas 66945</u> Application Number:	
3 LOCATE WELL'S LOCATION WITH AN "X" IN SECTION BOX: 	4 DEPTH OF COMPLETED WELL: <u>80</u> ft. ELEVATION: Depth(s) Groundwater Encountered 1. ft. 2. ft. 3. ft. WELL'S STATIC WATER LEVEL: <u>60</u> ft. below land surface measured on <u>7-3-89</u> Pump test data: Well water was ft. after hours pumping gpm Est. Yield <u>15</u> gpm: Well water was ft. after hours pumping gpm Bore Hole Diameter: <u>8</u> in. to <u>8 1/2</u> in. and in. to in. WELL WATER TO BE USED AS: 1 Domestic <input checked="" type="checkbox"/> 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 <input checked="" type="checkbox"/> ; If yes, mo/day/yr sample was submitted
5 TYPE OF BLANK CASING USED: 1 Steel 3 RMP (SR) 5 Wrought iron 8 Concrete tile CASING JOINTS: Glued <input checked="" type="checkbox"/> Clamped 2 PVC <input checked="" type="checkbox"/> 4 ABS 6 Asbestos-Cement 9 Other (specify below) Welded 7 Fiberglass Threaded Blank casing diameter <u>5</u> in. to in. Dia. in. to in. Dia. in. to in. to ft. Casing height above land surface: <u>24</u> in. weight lbs./ft. Wall thickness or gauge No. TYPE OF SCREEN OR PERFORATION MATERIAL: 1 Steel 3 Stainless steel 5 Fiberglass 7 PVC <input checked="" type="checkbox"/> 10 Asbestos-cement 2 Brass 4 Galvanized steel 6 Concrete tile 8 RMP (SR) 11 Other (specify) 9 ABS 12 None used (open hole) SCREEN OR PERFORATION OPENINGS ARE: 1 Continuous slot 3 Mill slot 5 Gauzed wrapped 8 Saw cut <input checked="" type="checkbox"/> 11 None (open hole) 2 Louvered shutter 4 Key punched 6 Wire wrapped 9 Drilled holes 7 Torch cut 10 Other (specify) SCREEN-PERFORATED INTERVALS: From <u>65</u> ft. to <u>75</u> ft. From ft. to ft. From ft. to ft. From ft. to ft. GRAVEL PACK INTERVALS: From <u>30</u> ft. to <u>80</u> ft. From ft. to ft. From ft. to ft. From ft. to ft.	
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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) <u>7-3-89</u> and this record is true to the best of my knowledge and belief. Kansas Water Well Contractor's License No. <u>2340</u> . This Water Well Record was completed on (mo/day/yr) <u>10/14/89</u> under the business name of <u>Shader's Blue Valley Drilling</u> by (signature) <u>Eric Shank</u>	
INSTRUCTIONS: Use typewriter or ball point pen. PLEASE PRESS FIRMLY and PRINT clearly. Please fill in blank underline or circle the correct answers. Send top three copies to Kansas Department of Health and Environment, Bureau of Water Protection, Topeka, Kansas 66620-7320. Telephone: 913-296-5514. Send one to WATER WELL OWNER and retain one for your records.	

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

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**Addendum 1 to Final Work Plan: Investigation of Potential Contamination
at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas,
for Slug Testing for Groundwater Zone 1 at Hanover, Kansas**

Introduction

In January-March, 2009, Argonne initiated an investigation in five phases (Phases 1-5) at and near the former CCC/USDA grain storage facility at Hanover, on behalf of the CCC/USDA, according to a *Work Plan* (Argonne 2008)¹ approved by the KDHE. As proposed, the investigation included (1) site characterization for soil and groundwater (Phases 1-4) and (2) a vapor intrusion investigation including collection of soil vapor and indoor air samples (Phase 5). The preliminary results of the ongoing site characterization to date are summarized as follows:

- Carbon tetrachloride concentrations in soil did not exceed the KDHE Tier 2 risk-based standard (200 µg/kg). Soil sampling was conducted at 30 locations on and near the former CCC/USDA property, which is a potential source area, from the ground surface to the top of the uppermost groundwater zone. The highest carbon tetrachloride concentration found in soil was 35 µg/kg. (The highest chloroform concentration found in soil was 44 µg/kg; the Tier 2 standard for chloroform is 960 µg/kg.)
- Four water-bearing zones (groundwater Zones 1-4) were identified in the Hanover investigation area, in a bedrock unit consisting mainly of limestone, siltstone, and shale. The primary sources of groundwater are zones of limited thickness through the secondary pore spaces developed along bedding planes and fractures in the bedrock unit.
- Groundwater Zone 1 is the uppermost local water-bearing zone in the Permian Chase Group bedrock unit. Carbon tetrachloride concentrations in this zone ranged up to 617 µg/L. Contaminated groundwater Zone 1, a potential source of concern for vapor intrusion and downward leakage to the underlying groundwater zones, was investigated extensively. The extent of contamination in groundwater Zone 1 was delineated, and the zone's qualitative characteristics were identified through coring and groundwater sampling at 45 locations.
- Also identified were three additional water-bearing zones observed at two locations west of the former CCC/USDA facility. Carbon tetrachloride was found at 11-28 µg/L in groundwater Zone 2, but carbon tetrachloride concentrations above the maximum contaminant level (MCL) of 5.0 µg/L were not detected in any well with a screen interval and gravel pack located exclusively in groundwater Zone 3 or Zone 4. Further investigation will be conducted to delineate the extent of contamination in groundwater Zone 2, on

¹ Argonne, 2008, *Final Work Plan: Investigation of Potential Contamination at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas*, ANL/EVS/AGEM/TR-08-10, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, November.

the basis of discussions between the CCC/USDA and the KDHE. A work plan outlining the proposed scope of this further investigation for Zone 2 has been prepared and submitted for approval (Addendum 2 to the Hanover site investigation *Work Plan* [Argonne 2008]).

On the basis of the preliminary results from the recent investigation, groundwater Zone 1 was identified as a critical water-bearing unit with the potential to provide a migration pathway for both upward vapor intrusion and downward leakage to underlying groundwater Zone 2. During sampling and well purging, groundwater Zone 1 displayed a slow recharge rate and poor transmissivity at many locations. These characteristics were particularly evident along the western erosional limit of the zone. Further investigation of the hydraulic properties associated with groundwater Zone 1 will assist in the identification of the critical hydrogeologic factors that govern contaminant migration within the unit. Consequently, we propose in this Addendum 1 to conduct slug tests in some of the recently installed monitoring wells completed in groundwater Zone 1, as described in Section 3.2.4 and Table 3.1 of the approved site investigation *Work Plan* (Argonne 2008).

Objectives

The primary objectives of the slug tests proposed in this Addendum 1 are as follows:

- Determine the hydraulic properties of groundwater Zone 1 along and near the apparent contaminant migration pathways defined previously in the ongoing investigation.
- Determine the lateral distribution of hydraulic properties in groundwater Zone 1.
- Provide quantitative information for evaluation of potential options to be considered in a Corrective Action Study (CAS).

If the results of the proposed slug tests indicate that further hydraulic testing of groundwater Zone 1 is necessary, a pumping test will be recommended.

Proposed Slug Tests

Slug Testing Locations

In the recent ongoing site investigation, 45 groundwater monitoring wells were installed at depths of 19-36 ft BGL (below ground level) and screened to target groundwater Zone 1. Groundwater was recovered at 37 locations (Table 1). Carbon tetrachloride was detected at concentrations above the MCL at 22 locations (Figure 1 and Table 1). In order to characterize the hydraulic properties of groundwater Zone 1, 20 existing well locations have been identified for the performance of slug tests (Figure 1). These locations were selected to correspond with the interpreted contamination migration pathway in groundwater Zone 1. Table 1 summarizes information from the ongoing site characterization on well construction, groundwater levels, and contaminant concentrations and also identifies the wells proposed for use in slug testing for groundwater Zone 1.

Slug Testing Methods

The slug test procedures in Section 6.7 of the *Master Work Plan* (Argonne 2002)² will be followed. The test will be repeated a minimum of three times at each location. The two following methods are available for use:

1. *Pneumatic method.* If feasible, the slug tests will be performed by using the pneumatic method, in which gas pressure is used to create a condition equivalent to an instantaneous drop in water level in the well casing. The rise following the initial drop in water level is then recorded, along with the time required for subsequent recovery of the water column in the well to its pre-disturbance level.
2. *Solid rod/water slug method.* At locations where static water levels are within the screened section of the well or where water level responses are very slow, slug tests will have to be conducted by quickly lowering a solid rod or introducing a slug of water into the casing to perturb the static water column. The recovery response in the well will then be observed and recorded.

If the water column in the casing is insufficient for either method, the slug test will not be possible. On the basis of observed water recoveries during recent well purging for groundwater sampling, slow recovery response can be anticipated at nine of the proposed locations (Table 1), where extremely low hydraulic conductivity is projected. At these locations, an initial test will be conducted. The slug test will not be repeated if the response time for complete recovery is more than 24 hr.

Schedule of Field Implementation

Field implementation of the proposed slug tests is tentatively scheduled for middle to late July 2009. The expected time required to complete the 20 slug tests is approximately one week. Prolonged response times may extend the projected testing period.

² Argonne, 2002, *Final Master Work Plan: Environmental Investigations at Former CCC/USDA Facilities in Kansas, 2002 Revision*, ANL/ER/TR-02/004, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, December.

TABLE 1 Summary of well construction, groundwater level, and contaminant data from the ongoing site characterization of Hanover, Kansas, with wells proposed for slug testing in groundwater Zone 1.

Location	Depth (ft BGL)		Concentration ($\mu\text{g/L}$)		Proposed Slug Test	Possible Slow Recovery
	Screen Interval ^a	Water Level ^b	Carbon Tetrachloride	Chloroform		
MW01	30-35	23.16	387	7.6	x	
MW02	31-36	27.80	548	11	x	
MW04	30-35	26.19	10	6.4	x	
MW05	24-29	24.18	488	6.1	x	
MW06	24-29	20.61	99	11	x	x
MW07	30-35	24.93	92	6.7	x	
MW08	30-35	26.44	4.2	0.7		
MW09	18-23	20.11	395	2.9	x	
MW10	26-31	23.54	31	3.9	x	
MW11	15-20	bailer in well	617	13		
MW12	25-35	22.40	111	18	x	x
MW13	15-20	15.29	376	8.7		
MW14	14-19	16.84	45	7.1	x	
MW15	14-19	17.14	0.6	0.3		x
MW16	15-25	16.36	5.8	2.1		x
MW17	13-23	13.18	11	3.3		x
MW18	15-25	16.62	3.4	4.2	x	
MW19	16-26	19.46	21	2.9		x
MW20	18-28	21.11	17	3	x	x
MW21	15-25	17.89	112	8.4	x	x
MW22	18-28	22.11	ND	5.5		x
MW23	19-29	19.89	3.4	0.3		x
MW24	13-18	13.73	0.5	9.5	x	
MW27	20-30	25.14	1	15		
MW28	19-29	22.18	173	8.8	x	
MW29	19-29	23.20	179	10	x	
MW30	9-19	11.24	4.2	2.7		x
MW31	10-20	12.79	0.9	1		
MW34	17-27	17.13	1.3	0.5	x	
MW35	15-25	15.31	ND	11		
MW36	14-24	15.98	ND	0.6		
MW37	15-30	21.60	19	2.5	x	x
MW38	18-28	23.62	37	6.7	x	x
MW39	12-22	20.5	—	—		x
MW40	20-30	23.86	130	14	x	x
MW46	20-30	25.66	ND	ND		
MW47	15-30	24.49	ND	2		

^a Diameter of well screen and casing is 2 in.

^b Water levels measured on April 15, 2009.

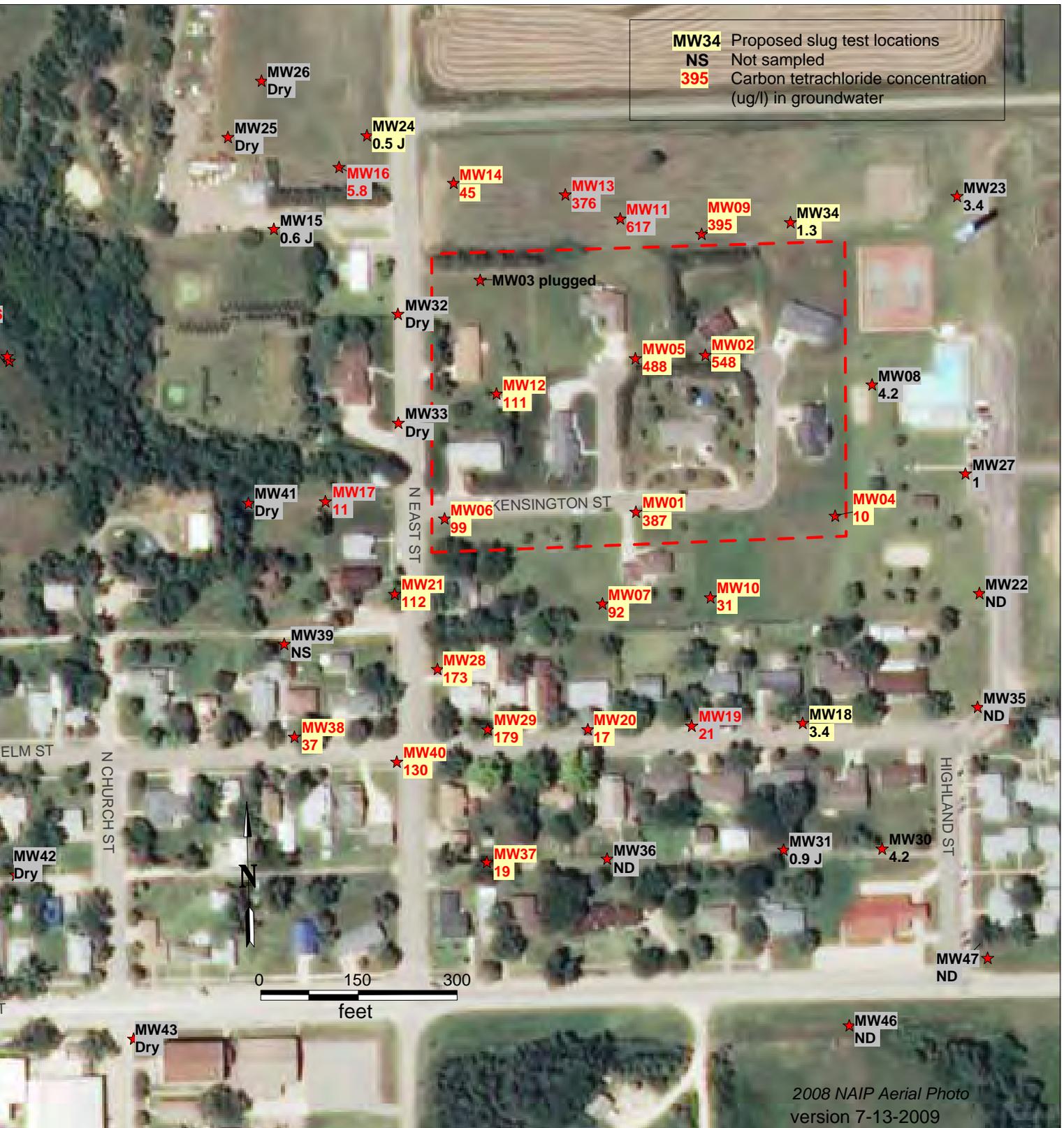


FIGURE 1 Carbon tetrachloride distribution in groundwater Zone 1.



Lorraine M. LaFreniere, Ph.D.
Manager, Applied Geosciences and
Environmental Management Section

Environmental Science Division
Argonne National Laboratory
9700 South Cass Avenue, Bldg. 203
Argonne, IL 60439-4843

1-630-252-7969 phone
1-630-252-5747 fax
lafreniere@anl.gov

September 8, 2009

Ms. Elizabeth Finzer
Kansas Department of Health and Environment
1000 SW Jackson St., Suite 410
Topeka, KS 66612-1367

Subject: Approved Figure 4 (dated 8/25/2009) for Addendum 2 (Revised) to *Final Work Plan: Investigation of Potential Contamination at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas*, for Further Investigation for Groundwater Zone 2 at Hanover, Kansas
ANL/EVS/AGEM/CHRON-1293

Dear Ms. Finzer:

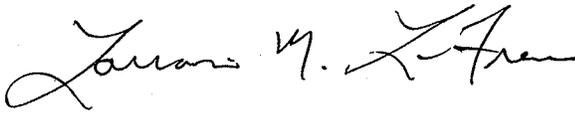
Attached, at the request of Caroline Roe of the Commodity Credit Corporation, U.S. Department of Agriculture, is the approved version (dated 8/25/2009) of Figure 4 in Addendum 2 (Revised) to our document *Final Work Plan: Investigation of Potential Contamination at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas* (ANL/EVS/AGEM/TR-08-10). We received your approval for this version of the figure in a letter dated August 28, 2009.

Please place this approved figure (8/25/2009), with this letter, at the front of the August 11, 2009, version of Addendum 2 (Revised) in the *Final Work Plan* notebook (ANL/EVS/AGEM/TR-08-10) in your possession. This figure differs from the earlier version (dated 8/11/2009) in the addition of one well location on East North Street, south of the former CCC/USDA facility. The change was made in response to your request in a letter dated August 18, 2009. The addition of the new location increases the number of deep borehole (and offset boring) locations in Step 1 of the groundwater investigation from three to four. All other particulars of the August 11, 2009, version of Addendum 2 (Revised) remain the same.

CONFUSION ALERT: The Hanover sub-slab sampling work plan also has addendums. The attached Addendum 2 (Revised) is for the Hanover site characterization work plan (ANL/EVS/AGEM/TR-08-10).

Please direct questions to Ms. Roe. As you know we will be conducting the work described in Addendum 2 (Revised) next week.

Sincerely,



Lorraine M. LaFreniere

LML:rs

Attachment: Figure 4 (8/25/2009) for Addendum 2 (Revised) for ANL/EVS/AGEM/TR-08-10

cc (with attachment):

- C. Carey (KDHE)
- J. Underwood (KDHE)
- C. Roe (CCC/USDA)
- S. Gilmore (CCC/USDA)
- D. Steck (CCC/USDA)
- G. Fremerman (CCC/USDA)
- Chron 1293

HANOVER, KS

Figure 4. Proposed Investigation for Groundwater Zone 2-4



Addendum 2 (Revised) to *Final Work Plan: Investigation of Potential Contamination at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas, for Further Investigation for Groundwater Zones 2-4 at Hanover, Kansas*

Introduction

In January-March 2009, Argonne initiated an investigation in five phases (Phases 1-5) at and near the former CCC/USDA grain storage facility at Hanover, on behalf of the CCC/USDA, according to a site investigation *Work Plan* (Argonne 2008)¹ approved by the KDHE. As proposed, the investigation included (1) site characterization for soil and groundwater (Phases 1-4) and (2) a vapor intrusion investigation including collection of soil vapor and indoor air samples (Phase 5). The preliminary results of the ongoing site characterization to date are summarized as follows:

- Carbon tetrachloride concentrations in soil did not exceed the KDHE Tier 2 risk-based standard (200 µg/kg). Soil sampling was conducted at 30 locations on and near the former CCC/USDA property, which is a potential source area, from the ground surface to the top of the uppermost groundwater zone. The highest carbon tetrachloride concentration found in soil was 35 µg/kg. (The highest chloroform concentration found in soil was 44 µg/kg; the Tier 2 standard for chloroform is 960 µg/kg.)
- Four water-bearing zones (groundwater Zones 1-4) were identified in the Hanover investigation area, in a bedrock unit consisting mainly of limestone, siltstone, and shale. The primary sources of groundwater are zones of limited thickness through the secondary pore spaces developed along bedding planes and fractures in the bedrock unit.
- Groundwater Zone 1 is the uppermost local water-bearing zone in the Permian Chase Group bedrock unit. Carbon tetrachloride concentrations in this zone ranged up to 617 µg/L. Contaminated groundwater Zone 1, a potential source of concern for vapor intrusion and downward leakage to the underlying groundwater zones, was investigated extensively. The extent of contamination in groundwater Zone 1 was delineated, and the zone's qualitative characteristics were identified through coring and groundwater sampling at 45 locations. A quantitative characterization using slug tests has been proposed to generate data for determining the range and distribution of hydraulic properties in groundwater Zone 1. A work plan outlining the proposed slug tests has been prepared and submitted for approval (Addendum 1 to the Hanover site investigation *Work Plan* [Argonne 2008a]).
- Also identified were three additional water-bearing zones observed at two locations (MW44 and MW45) west of the former CCC/USDA facility. Carbon tetrachloride was found at 11-28 µg/L in groundwater Zone 2 at

¹ Argonne, 2008a, *Final Work Plan: Investigation of Potential Contamination at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas*, ANL/EVS/AGEM/TR-08-10, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, November.

MW44 and MW45, but carbon tetrachloride concentrations above the MCL (5.0 µg/L) were not detected in groundwater Zones 3 and 4 at these two locations.

- To obtain further information on groundwater flow, groundwater samples have been collected for tritium analysis from seven monitoring wells believed to cover all four groundwater zones. Samples are currently being analyzed by the analytical laboratory at the University of Miami. The results will be reported as they become available.

The preliminary results of the recent investigation suggest that carbon tetrachloride has migrated from groundwater Zone 1 to Zone 2. This Addendum 2 (Revised) proposes further investigation targeting groundwater Zones 2-4 to determine their contaminant concentrations and to delineate the extent of the contamination.

Preliminary Information on Groundwater Zone 2

In the initial investigation, groundwater Zone 2 was identified within the shale and limestone unit about 30-40 ft below groundwater Zone 1. The results from coring at a few deep wells, groundwater sampling, a survey of private wells, and soil vapor-indoor air sampling suggest the characteristics of groundwater Zone 2 discussed below.

Lithology and Saturated Layers. Groundwater Zone 2 is hosted by a bedrock unit consisting of brownish gray shale with a few limestone layers (Figure 1). The Zone 2 unit underlies a red shale unit (approximately 25 ft thick) and overlies a gray shale unit (also approximately 25 ft thick). Within the Zone 2 unit, three thin, saturated intervals were identified in the course of the preliminary investigation as forming a water-bearing zone that provided immediate water during coring at locations MW44 and MW45.

Vertical Extent and Thickness. Groundwater Zone 2 is vertically located at an elevation of 1,240-1,250 ft AMSL (above mean sea level), as identified in the preliminary investigation. The total thickness of 10 ft is postulated for the stratigraphic interval incorporating Zone 2, although the actual combined thickness of the multiple, thin saturated intervals observed to date in Zone 2 is less than 3 ft.

Lateral Extent. Groundwater Zone 2 was identified by coring at locations MW44 and MW45, west of the former CCC/USDA facility. Comparison of logging records for private wells suggests that Zone 2 extends through the area surrounding the former CCC/USDA facility and that Zone 1 is entirely eroded in many areas of the former facility. Evidence of the unit was found at five Bill's Service monitoring wells ("BSMW" wells) to the east and four private wells to the south and southeast (Figure 2). No immediate water recovery or evidence of saturation was identified, however, during coring at one deep well (MW03) on the former CCC/USDA facility. This well should have encountered potential water-bearing Zones 1 and 2. On the basis of local topography, groundwater Zone 2 is projected to be eroded farther to the east, south, and west, where the ground-surface elevation is near 1,250 ft AMSL.

Groundwater Flow. Water levels measured at MW44S and MW45S (about 260 ft apart and both screened in Zone 2) are at similar elevations, within 0.2 ft. The groundwater flow pattern cannot be determined on the basis of the limited data currently available.

Contamination. Carbon tetrachloride was found in groundwater from monitoring wells MW44S and MW45S at 11 µg/L and 28 µg/L, respectively, as well as at 5.1-7.8 µg/L in two private wells near MW45 (Figure 2). Information on well construction for these two private wells indicates that the gravel packs extend from groundwater Zones 3 and 4 to the overlying Zone 2. No contamination was detected in private wells east and south of the former CCC/USDA facility.

Vapor Intrusion. A limited vapor intrusion investigation (Figure 3) was conducted in the area where the depth to contaminated groundwater Zone 2 is less than 40 ft due to surface erosion resulting in the removal of the overlying sediments, including the identified groundwater Zone 1. This area is located north of W. Elm Street, from N. Hanover Street to the western erosion limit of Zone 2. Indoor air and sub-slab vapor were collected at all accessible residences in the area. Results to date (Figure 3) show no evidence of vapor intrusion from groundwater Zone 2 in this area. Further investigation of vapor intrusion is proposed in Step 4 below.

Objectives

The primary objectives of the groundwater Zone 2 investigation proposed here are as follows:

- Obtain additional data for characterizing groundwater Zone 2, to supplement the results of work already completed at locations MW44 and MW45.
- Delineate the extent of the contamination hosted by Zone 2.
- Determine the groundwater flow pattern in Zone 2.
- Identify and evaluate further the potential for vapor intrusion in the area where contaminated groundwater Zone 2 is shallower than 40 ft.

The objective of the limited investigation of groundwater Zones 3 and 4 proposed here is to obtain information on the groundwater flow pattern and the extent and magnitude of contamination.

Proposed Investigation for Groundwater Zones 2-4

The number and depths of the boreholes proposed are summarized in Table 1. The proposed work is as follows:

- *Step 1.* At the location along the northern border of the former CCC/USDA facility where the highest carbon tetrachloride concentrations were found in Zone 1, drill a deep borehole (to 145 ft BGL [below ground level]), with continuous coring, to determine whether Zones 2-4 are present and whether these zones have been affected by carbon tetrachloride migrating downward from Zone 1 (Figure 4). In addition, confirm the presence of groundwater Zones 2-4 at the anticipated depths at two locations to the west of the former CCC/USDA facility, and identify potential effects of the contamination delineated in groundwater Zone 1 on the deeper zones. In the area to the west, carbon tetrachloride has been found in Zone 2 monitoring wells MW44 and MW45 and in two deep private wells (Butch Bruna and Don Martin; Figure 2). This step would include a minimum of three deep boreholes

targeting Zone 2 (70-80 ft BGL) at locations along the inferred axis of the contamination in Zone 1 and/or the western edge of the contamination as currently constrained for Zone 1 (Figure 4). Offset from each of these three boreholes would be another deeper borehole (135–145 ft BGL) targeting Zones 3 and 4. Work would be as follows:

- Drill three deep boreholes to depths up to 80 ft BGL, with continuous coring, to identify the Zone 2 unit and individual saturated layers.
- Collect groundwater samples for analyses for volatile organic compounds (VOCs) from the identified Zone 2 unit.
- Install monitoring wells screened exclusively in groundwater Zone 2 at all three locations.
- Install recorders to determine groundwater flow in Zone 2 through measurement of water levels at all three deep borehole locations, plus existing wells MW44 and MW45.
- Drill three offset, deeper boreholes to depths up to 145 ft BGL, with continuous coring, to identify the Zone 3-4 units and individual saturated layers.
- Collect groundwater samples for analyses for VOCs from the identified Zone 3 and Zone 4 units.
- Install monitoring wells screened exclusively in groundwater Zones 3 and 4 at all three locations.
- Install recorders to determine groundwater flow in Zones 3 and 4 through measurement of water levels at all three locations.
- *Step 2.* Constrain the extent of the contamination in groundwater Zone 2 downgradient from MW44-MW45.
 - Drill one borehole downgradient from wells MW45-MW44, as determined on the basis of the groundwater flow direction identified for groundwater Zone 2 in Step 1.
 - Collect groundwater samples for VOCs analyses.
 - Install the monitoring well in groundwater Zone 2.
 - Identify the potential for vapor intrusion issues in the residential area where the depth to the contamination in groundwater Zone 2 is less than 40 ft BGL.
 - If necessary, conduct slug tests to quantitatively characterize the hydraulic properties of groundwater Zone 2. (Slug tests for Zone 1 are discussed in Addendum 1 to the Hanover site investigation *Work Plan* [Argonne 2008a]).
- *Step 3.* As necessary, delineate the extent of the contamination identified in Zone 2.

- Drill one or two deep boreholes at locations to be proposed between the three wells drilled in Step 1 and existing wells MW44 and MW45. Locations will be selected on the basis of the presence of groundwater Zone 2 and the contamination location identified in Step 1.
- Collect groundwater samples for VOCs analyses.
- Install monitoring wells in groundwater Zone 2 at all locations.
- Further confirm groundwater flow directions in groundwater Zone 2 through measurement of water levels at all four or five of the Step 1-Step 2 deeper well locations, plus wells MW44 and MW45.

Table 1 Summary of proposed deep boreholes and anticipated depths.

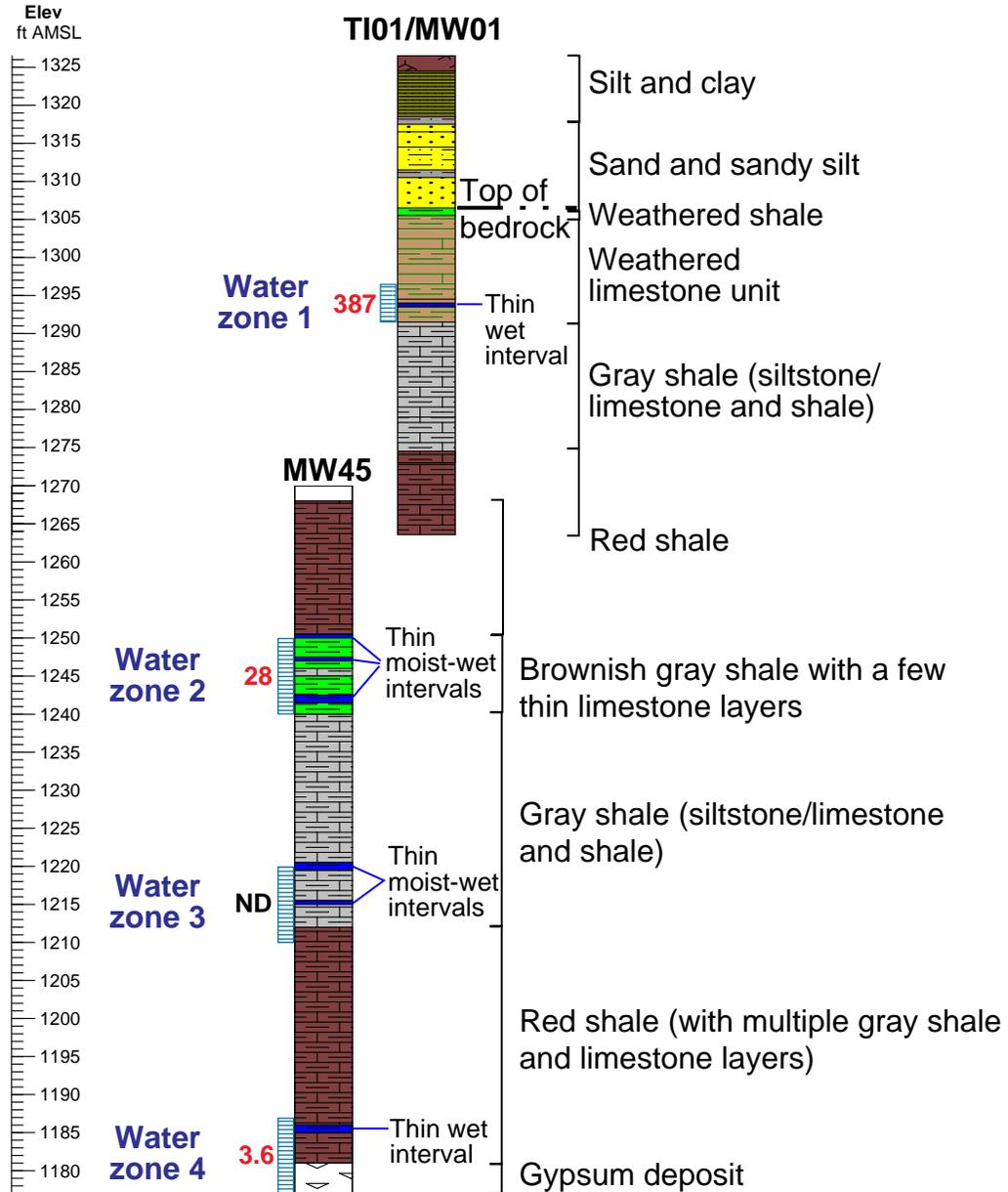
Step	Drilling Tasks	Zones
1	1 borehole (< 80 ft BGL) and offset (< 145 ft BGL)	2-4
	2 boreholes (< 70 ft BGL) and offset (< 135 ft BGL)	2-4
2	1 borehole (< 40 ft BGL)	2
3	1-2 boreholes (< 70 ft BGL)	2

Schedule of Field Work

The field work proposed here will be scheduled upon approval. The proposed work is expected to require two mobilizations of approximately nine days each (including drilling and indoor air and sub-slab sampling). The various elements included in this work plan might not be accomplished consecutively as presented here, depending on the analytical results that will drive the investigation process. Further discussion may be required between the KDHE and the CCC/USDA as the investigation proceeds. In particular, the need for indoor air and sub-slab sampling will need to be determined and agreed upon by the KDHE and CCC/USDA project managers prior to implementation.

Hanover, KS

Figure 1. Stratigraphic Section



387 Carbon tetrachloride concentration in groundwater ($\mu\text{g/L}$)

ND Not detected

HANOVER, KS

Figure 2. Results for carbon tetrachloride (ug/L); chloroform (ug/L) in private and deep monitoring wells.



Note:
(WZ 2) - Water Zone 2 estimated based on well screen interval.
(AA) - Alluvium aquifer in Little Blue River valley.
(NR) - No record available.
(ND) - Not detected at instrument detection limit of 0.1 µg/L.
(J) - Estimated concentration less than method quantitation limit of 1 µg/L.
(Red lettering) - carbon tetrachloride > 5 µg/L.

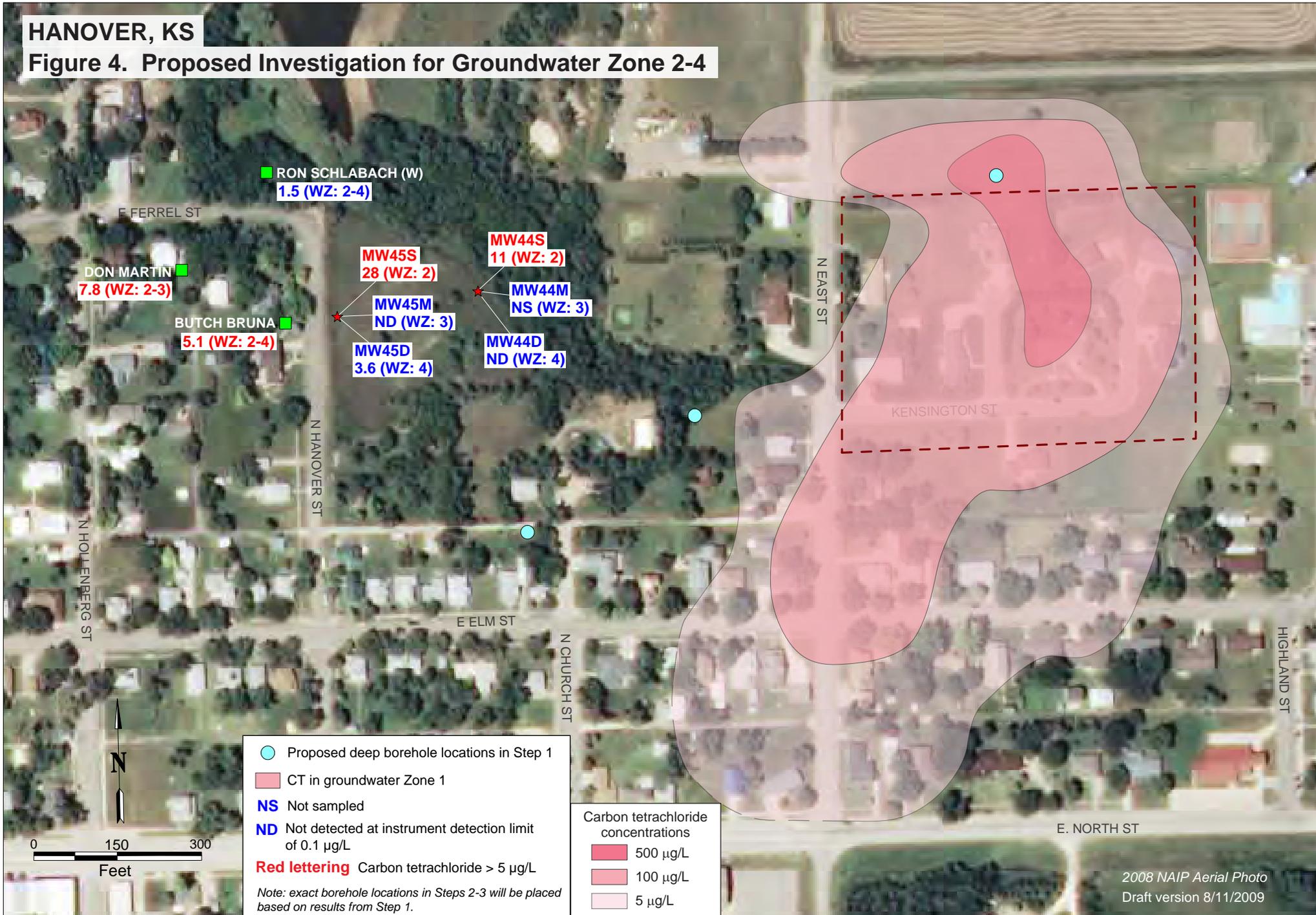
HANOVER, KS

Figure 3. Indoor air results and sub-slab vapor results (ug/cubic meter) in the area where Zone 2 groundwater is within 40 ft of the surface. Results for carbon tetrachloride (ug/L); chloroform (ug/L) in private and deep monitoring wells.



HANOVER, KS

Figure 4. Proposed Investigation for Groundwater Zone 2-4



**Final Addendum 3 to Final Work Plan: Investigation of Potential Contamination
at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas,
for Performance Testing of Selected Zone 1 Monitoring Wells**

1 Introduction

On behalf of the Commodity Credit Corporation of the U.S. Department of Agriculture (CCC/USDA), Argonne National Laboratory recently conducted site characterization and vapor intrusion studies at Hanover, Kansas, as specified in two independent work plans (Argonne 2008a,b) approved by the Kansas Department of Health and Environment (KDHE 2008a,b). On the basis of preliminary information obtained from these studies, groundwater Zone 1 was identified as a critical water-bearing unit with the potential to provide a migration pathway for both upward vapor intrusion and downward leakage of carbon tetrachloride contamination to underlying groundwater Zone 2.

During sampling and well purging, groundwater Zone 1 displayed slow recharge rates, particularly along the western erosional limit of the zone, implying poor transmissivity at many locations. Further hydrologic characterization of the Zone 1 interval was therefore considered necessary to identify the critical factors that govern groundwater flow and contaminant migration in this unit. Consequently, Addendum 1 (Argonne 2009a) to the site investigation *Work Plan* (Argonne 2008a) was issued, proposing aquifer slug testing at selected Zone 1 monitoring wells. The slug testing plan was approved by the KDHE (2009a).

The primary technical objectives of the slug tests outlined in Addendum 1 (Argonne 2009a) were as follows:

- Determine the hydraulic properties of groundwater Zone 1 along and near the apparent contaminant migration pathways defined previously in the ongoing investigation.
- Determine the lateral distribution of hydraulic properties in groundwater Zone 1.
- Provide quantitative information for evaluation of potential options to be considered in a Corrective Action Study (CAS).

With the approval of the CCC/USDA and the KDHE, Argonne conducted slug testing at the Hanover site on August 10-14, 2009 (Argonne 2009b).

The results of the Zone 1 slug tests are summarized in Table 1. The estimated hydraulic conductivity (K_h) values for the Zone 1 water-bearing materials at Hanover ranged over five orders of magnitude, from approximately 0.001 ft/day (at MW06) to approximately 100 ft/day (at MW09). The areal distribution of the calculated *average* K_h values (averaged for all of the individual tests and both calculation methods at each location; last column in Table 1) is illustrated in Figure 1.

Table 1 and Figure 1 indicate that the estimated hydraulic conductivities of the Zone 1 water-bearing interval are generally highest in the area corresponding to the main body of the identified carbon tetrachloride contamination in groundwater. The highest K_h values, ranging

from approximately 40 ft/day to 100 ft/day, were calculated for wells MW05, MW09, MW11, and MW13, which are located near the north central margin of the former CCC/USDA facility. Hydraulic conductivity values ranging from approximately 2 ft/day to 8 ft/day were identified within and near the eastern portion of the former facility (at wells MW02 and MW10), as well as near the intersection of N. East Street and Elm Street (wells MW28 and MW29; Figure 1). At all other tested locations, estimated K_h values that were consistently < 1 ft/day (and in most cases < 0.1 ft/day) were observed.

The CCC/USDA and Argonne have concluded that the expected capacity of the Zone 1 water-bearing interval to produce groundwater to wells is limited, even at the identified locations having higher K_h values. The factors upon which this interpretation is based include the following:

- The thickness of the Zone 1 water-bearing interval ranges only from 1 ft to 3 ft, resulting in limited transmissivity for the unit at even the most permeable locations tested.
- The observed K_h value for the unit decreases rapidly in all directions toward the margins of the contaminant distribution, thus restricting the lateral movement of groundwater into and out of the more permeable intervals.
- The low groundwater head levels (generally < 4-8 ft above total well depth) identified in wells in the portions of the study area having higher estimated K_h values physically constrain the drawdown conditions under which groundwater pumping would be logistically viable in these areas.

The K_h values obtained from the slug testing and the measured groundwater levels determined at Hanover at the time of the tests were used by Argonne to calculate pumping estimates for hypothetical groundwater extraction wells located at monitoring well locations MW09, MW10, and MW29, in the more permeable regions of Zone 1 (Figure 1). The calculations were based on the Theis equation for transient flow in a confined aquifer (Theis 1935; Kruseman and deRidder 1991). The results of the calculations (Argonne 2009b) indicate expected sustainable flow rates from wells in these areas in the range from < 0.2 gpm (at MW10 and MW29) to a maximum of < 1.5 gpm (at MW09). Argonne's previous experience in slug testing — with subsequent actual pump testing (at the KDHE's request) — at the former CCC/USDA facility in Everest, Kansas (Argonne 2006a,b), supports the interpretation that pumping estimates generated by using the Theis (1935) approach represent "best-case" approximations that are unlikely to be achieved by actual wells.

The results of the slug test analyses (Argonne 2009b) were reviewed and discussed with representatives of the CCC/USDA and the KDHE in a teleconference on October 1, 2009, as well as in a meeting held at the KDHE office in Topeka, Kansas, on October 13, 2009. On the basis of the findings presented, the CCC/USDA and Argonne proposed that the potential for use of pumping (or injection) as an effective mechanism for hydraulic control or restoration of the contaminated Zone 1 groundwater at Hanover is highly questionable. The KDHE expressed reservations regarding this interpretation, however, and requested that additional on-site testing be performed to evaluate the groundwater-producing capacity of the Zone 1 water-bearing interval. Specifically, the KDHE recommended that single-well specific-capacity testing, or

possibly constant-rate aquifer testing, be performed at one (or more) location(s) to investigate the viability of groundwater pumping from the Zone 1 unit.

2 Proposed Testing Program

To address the KDHE's concerns regarding the producing capacity of the Zone 1 water-bearing unit, the CCC/USDA proposes a phased program of investigation that will directly assess the technical and logistic feasibility of groundwater pumping from this interval. In keeping with the recent CCC/USDA-KDHE discussions in Topeka (Section 1), the program recommended in this section is designed to utilize the extensive network of Zone 1 monitoring wells that has already been installed at Hanover. The proposed elements of this program are, in sequential order, as follows:

1. Conduct single-well performance (step-drawdown) tests to determine the specific capacity of monitoring wells MW09 and MW05.
2. Conduct a step-drawdown test to determine the specific capacity of monitoring well MW10.
3. On the basis of the results of these tests, determine whether more rigorous constant-rate aquifer testing is technically warranted at one (or more) locations.
4. If warranted, conduct one (or more) constant-rate aquifer tests at location(s) to be approved by the CCC/USDA and KDHE project managers.

After each segment of the program, the CCC/USDA and KDHE will have the opportunity to evaluate whether the results merit progression to the next segment of the investigation. The CCC/USDA and KDHE project managers will be kept informed about all results and will participate in all decisions. The CCC/USDA anticipates that this investigation, in conjunction with the results of the slug testing previously undertaken (Argonne 2009b) will together serve as a conclusive indication of whether strategies requiring groundwater pumping from the Zone 1 water-bearing unit represent viable remedial alternatives for evaluation in the development of a CAS for the Hanover site.

2.1 Recommended Locations for Step-Drawdown Testing

Wells MW09 and MW05 are recommended as the initial locations for step-drawdown testing to determine the specific capacity of each well. Wells MW09 and MW05 are located near the north central boundary of the former CCC/USDA facility. They lie in the portion of the Zone 1 water-bearing unit exhibiting both the highest observed carbon tetrachloride concentrations in groundwater and the highest estimated hydraulic conductivity values determined by slug testing (Figures 2 and 3). The available data suggest that wells in this area (including MW09 and MW05) might have the greatest probability of sustaining pumping rates that are sufficient to induce significant groundwater drawdown in other nearby monitoring wells and hence might facilitate potential "hot-spot" groundwater extraction in this area as a remedial alternative.

Well MW10 is located near the southern boundary of the former CCC/USDA facility, as well as near the southern, downgradient limit of the highest carbon tetrachloride concentrations identified in the Zone 1 groundwater (Figure 3). Table 1 and Figure 2 indicate that slug testing at this location, as well as at more downgradient locations MW28 and MW29, identified relatively moderate hydraulic conductivity values; however, a substantially greater static water column was observed at MW10. Specific capacity testing at MW10 is therefore recommended to assess the potential for groundwater pumping in this area, as a possible means of hydraulically constraining further downgradient migration of the carbon tetrachloride in groundwater Zone 1.

2.2 Step-Drawdown Testing to Estimate Sustainable Pumping Rates

Calculations performed by Argonne on the basis of the slug testing data discussed in Section 1 (Argonne 2009b) suggest that the potential sustainable flow rates for wells completed in the Zone 1 water-bearing unit might be low. Step-drawdown testing of wells MW09, MW05, and MW10 is therefore recommended to estimate the wells' long-term production capacities. The step-drawdown tests will be performed in keeping with the procedures in the *Master Work Plan* (Argonne 2002), as well as with the KDHE's standard operating procedure for step-drawdown tests (KDHE 2000a).

At each well, pumping at an initial low rate (to be determined in the field) will be performed for approximately 30-60 min, or until the observed water level stabilizes at this rate. At intervals, the water level in the well will be measured manually. The water level will also be recorded continuously by using an automatic, downhole pressure transducer and data logger (Instrumentation Northwest, Inc., Model PT2X) programmed for a suitable measurement interval (approximately 1-5 sec between readings). The pumping rate will then be increased progressively in a series of at least two additional similar time steps, if possible, and the resulting changes in water level will be recorded. The exact number of steps to be performed, the length of the steps, and the incremental increase in flow rate to be used for each step will be determined in the field on the basis of the observed response of each well. At the end of the last time step, the pumping will be terminated, and the recovery of the water level will be monitored to estimate the approximate rate of groundwater recharge to the well bore.

The results of the step-drawdown tests will be interpreted through the use of standard procedures (Kruseman and deRidder 1991) to estimate the specific capacity and hence a potential sustainable flow rate for each well location.

If the water level does not stabilize at the initial pumping rate but instead appears to fall continuously, pumping will be maintained at this rate, and monitoring will continue until the water level reaches the minimum depth acceptable for operation of the pump. The pump will then be stopped, and the recovery of water levels will be monitored to estimate the approximate rate of groundwater recharge to the well.

During each of the step-drawdown tests proposed above, groundwater levels will also be recorded automatically in all existing monitoring wells adjacent to the well being pumped, to monitor for any possible indications of drawdown at these locations. The wells to be monitored for each proposed test are as follows:

<u>Pumping Well</u>	<u>Monitored Wells</u>
MW09	MW02, MW05, MW11, MW13, MW34
MW05	MW01, MW02, MW09, MW11, MW12
MW10	MW01, MW04, MW07, MW18, MW20

2.3 Constant-Discharge Pump Testing

The results of the proposed step-drawdown tests will be reviewed with the CCC/USDA and KDHE project managers to determine whether additional step-drawdown or constant-rate well testing is warranted at any of the proposed, or other, well locations. If constant-rate well testing is considered necessary, the following procedures will be employed:

- Pumping of the selected producing well will occur for a maximum period of 24 hr, at a constant target rate to be determined as described in Section 2.2. The aquifer testing will be performed in keeping with the procedures documented for this activity in the *Master Work Plan* (Argonne 2002), as well as the KDHE's standard operating procedure for constant-rate tests (KDHE 2000b).
- Changes in water levels at the pumping well and in all adjacent existing monitoring wells will be measured automatically by using individual pressure transducer and data logger units. Drawdown will be monitored at each location during the pumping, and water level recoveries will be recorded for an equivalent period after pumping ends.
- Barometric pressure readings will be recorded on-site during the water level measurements, to facilitate correction of the water level data for atmospheric pressure variations that might occur during the pumping and recovery periods. Barometric efficiencies required for these corrections will be calculated on the basis of atmospheric pressure data and water level measurements recorded automatically (every hour) in the pumping well and at each observation well for approximately two weeks following the testing period.
- Water levels will be monitored continuously, both before and after the testing period, in the pumping and observation wells. This will permit the identification of any extended rising or falling trends in water levels across the test area that might affect the drawdown and recovery results.

The Zone 1 water-bearing unit is expected to respond as a confined, or possibly a locally unconfined, interval. Under the proposed test conditions, boundary effects associated with the lateral variations in hydraulic conductivity indicated by the slug testing results might affect the observed drawdown levels at the pumping or observation wells. All of the Zone 1 monitoring wells that might be employed for either pumping or water level observation during the testing are constructed to fully penetrate the Zone 1 water bearing interval, so that corrections to the observed drawdown responses for partial penetration should not be required.

Under these conditions, Argonne anticipates that the drawdown data from any constant-rate tests will be interpreted by using standard methods (Kruseman and deRitter 1991). The final selection of the appropriate interpretation technique(s) must be based on the observed

characteristics of the drawdown profiles recorded, as well as the analysis of the pre- and post-test groundwater level trends. Recovery data will also be recorded and interpreted, if the water level responses indicate that such an analysis is appropriate for the Zone 1 unit.

2.4 Disposal of Produced Water

Groundwater withdrawn during the field program will be retained temporarily in one or more barrels or portable storage tanks and sampled for analyses of volatile organic compounds and nitrate. On the basis of the results, disposal of the wastewater will be conducted in accord with U.S. Environmental Protection Agency guidance (EPA 1992) provided by the KDHE (2009b).

3 References

Argonne, 2002, *Final Master Work Plan: Environmental Investigations at Former CCC/USDA Facilities in Kansas, 2002 Revision*, ANL/ER/TR-02/004, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, December.

Argonne, 2006a, *Plan for Proposed Aquifer Hydraulic Testing and Groundwater Sampling at Everest, Kansas, in January-February 2006*, ANL/EVS/AGEM/TR-06-01, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, January.

Argonne, 2006b, *Final Report: Results of Aquifer Pumping and Groundwater Sampling at Everest, Kansas, in January-March 2006*, ANL/EVS/AGEM/TR-06-05, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, September.

Argonne, 2008a, *Final Work Plan: Investigation of Potential Contamination at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas*, ANL/EVS/AGEM/TR-08-10, prepared for the commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, November.

Argonne, 2008b, *Final Work Plan: Supplemental Upward Vapor Intrusion Investigation at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas*, ANL/EVS/AGEM/TR-08-14, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, December.

Argonne, 2009a, "Addendum 1 to *Final Work Plan: Investigation of Potential Contamination at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas*, for Slug Testing for Groundwater Zone 1 at Hanover, Kansas," ANL/EVS/AGEM/CHRON-1277, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, July 14.

Argonne, 2009b, *Slug testing of Zone 1 Monitoring Wells at Hanover, Kansas, in August 2009*, ANL/EVS/AGEM/CHRON-1297, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, October.

KDHE, 2000a, *Conducting a Step-Drawdown Test*, Standard Operating Procedure BER-09, Rev. 1, Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas, September.

KDHE, 2000b, *Conducting a Constant-Rate Aquifer Test and Recovery Test*, Standard Operating Procedure BER-10, Rev. 1, Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas, August.

EPA, 1992, *Guide to Management of Investigation-Derived Wastes*, publication 9345.3-03FS, Office of Solid Waste and Emergency Response, U.S. Environmental Protection Agency, Washington, D.C., January.

KDHE, 2008a, letter from E. McWilliams (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding work plan for vapor intrusion investigation at Hanover, July 17.

KDHE, 2008b, letter from E. Finzer (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding work plan for site investigation at Hanover, November 18.

KDHE, 2009a, letter from E. Finzer (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding addendums to work plan for site investigation at Hanover, July 22.

KDHE, 2009b, electronic mail message from E. Finzer (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding disposal of investigation-derived liquid waste, October 29.

Kruseman, G. and N. deRidder, 1991, *Analysis and Evaluation of Pumping Test Data, Second Edition*, Publication 47, International Institute for Land Reclamation and Improvement, Wageningen, the Netherlands.

Theis, C., 1935, "The Relation between the Lowering of the Piezometric Surface and the Rate and Duration of a Well Using Groundwater Storage," *Transactions of the American Geophysical Union* 16:519-524.

TABLE 1 Summary of interpreted results for slug tests in Zone 1 monitoring wells in August 2009.

Well	Calculated Hydraulic Conductivity ^a (ft/day)								Average ^b
	Bouwer and Rice Method Result for Each Test				Hvorslev Method Result for Each Test				
MW01	0.71	0.48	0.60	0.46	0.98	0.66	0.83	0.63	0.67
MW02	2.9	2.2	3.0	2.4	4.0	3.0	4.1	3.3	3.1
MW04	0.67	0.49	0.64	0.43	0.92	0.67	0.89	0.59	0.66
MW05	45	47	42	42	62	65	59	59	53
MW06	0.001	–	–	–	0.001	–	–	–	0.001
MW07	0.017	0.012	–	–	0.024	0.017	–	–	0.018
MW09	69	73	40	67	97	102	55	93	75
MW10	2.8	2.7	3.0	2.8	3.9	3.7	4.1	3.9	3.4
MW11	56	39	55	56	78	53	78	77	62
MW12	0.005	–	–	–	0.007	–	–	–	0.006
MW13	55	48	51	46	75	66	70	63	59
MW16	0.043	0.025	–	–	0.059	0.034	–	–	0.040
MW18	0.25	0.22	0.28	–	0.34	0.30	0.40	–	0.30
MW20	0.011	–	–	–	0.015	–	–	–	0.013
MW21	0.002	–	–	–	0.003	–	–	–	0.003
MW28	2.6	5.9	2.8	4.1	3.6	8.3	3.9	5.7	4.6
MW29	3.0	4.5	3.4	4.8	4.1	6.3	4.8	6.6	4.7
MW34	0.24	0.07	0.21	–	0.33	0.09	0.29	–	0.20
MW37	0.003	–	–	–	0.004	–	–	–	0.004
MW38	0.017	–	–	–	0.024	–	–	–	0.021

^a Calculated with the assumption of a thickness of 2 ft for the water-bearing interval.

^b Averaged for all tests and both calculation methods.



FIGURE 1 Areal distribution of average estimated hydraulic conductivity values for groundwater Zone 1, as determined by analysis of the data generated by the August 2009 slug testing.



FIGURE 2 Wells proposed for step-drawdown testing, with areal distribution of average estimated hydraulic conductivity values for groundwater Zone 1 as determined by analysis of the data generated by the August 2009 slug testing.



FIGURE 3 Wells proposed for step-drawdown testing, with carbon tetrachloride distribution in groundwater Zone 1 and locations of wells used for slug testing in August 2009.



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