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Final Work Plan: Phase I Investigation of Potential Contamination at the Former CCC/USDA Grain Storage Facility in Savannah, Missouri

Environmental Science Division

USDA United States Department of Agriculture

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

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

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Notation

AGEM	Applied Geosciences and Environmental Management
AMSL	above mean sea level
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
ft	foot (feet)
GC-MS	gas chromatography-mass spectrometry
g	gram(s)
gpm	gallon(s) per minute
hr	hour(s)
in.	inch(es)
MCL	maximum contaminant level
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter
mi	mile(s)
min	minute(s)
MoDNR	Missouri Department of Natural Resources
MoDOT	Missouri Department of Transportation
PID	photoionization detector
PMWP	*Provisional Master Work Plan*
PWSD	Public Water Supply District
SOP	standard operating procedure
USDA	U.S. Department of Agriculture
VOC	volatile organic compound

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1 Introduction

From approximately 1949 until 1970, the Commodity Credit Corporation of the U.S. Department of Agriculture (CCC/USDA) operated a grain storage facility on federally owned property approximately 0.25 mi northwest of Savannah, Missouri. During this time, commercial grain fumigants containing carbon tetrachloride were commonly used by the CCC/USDA and the private grain storage industry to preserve grain in their facilities. In November 1998, carbon tetrachloride was detected in a private well (Morgan) roughly 50 ft south of the former CCC/USDA facility, as a result of state-wide screening of private wells near former CCC/USDA facilities, conducted in Missouri by the U.S. Environmental Protection Agency (EPA 1999).

The 1998 and subsequent investigations by the EPA and the Missouri Department of Natural Resources (MoDNR) confirmed the presence of carbon tetrachloride in the Morgan well, as well as in a second well (on property currently occupied by the Missouri Department of Transportation [MoDOT]), approximately 400 ft east of the former CCC/USDA facility. Carbon tetrachloride concentrations in the Morgan well have ranged from the initial value of 29 µg/L in 1998, up to a maximum of 61 µg/L in 1999, and back down to 22 µg/L in 2005. The carbon tetrachloride concentration in the MoDOT well in 2000 (the only time it was sampled) was 321 µg/L. The concentrations for the two wells are above the EPA maximum contaminant level (MCL) of 5 µg/L for carbon tetrachloride (EPA 1999; MoDNR 2000a,b).

Because the observed contamination in the Morgan and MoDOT wells might be linked to the past use of carbon tetrachloride-based grain fumigants at its former grain storage facility, the CCC/USDA will conduct investigations to (1) characterize the source(s), extent, and factors controlling the subsurface distribution and movement of carbon tetrachloride at Savannah and (2) evaluate the health and environmental threats potentially posed by the contamination. This work will be performed in accord with the Intergovernmental Agreement established between the Farm Service Agency of the USDA and MoDNR, to address carbon tetrachloride contamination potentially associated with a number of former CCC/USDA grain storage facilities in Missouri.

The investigative activities at Savannah will be conducted 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 agreement with the DOE, under which Argonne provides technical assistance to the CCC/USDA with environmental site characterization and remediation at its former grain storage facilities.

The site characterization at Savannah will take place in phases. This approach is recommended by the CCC/USDA and Argonne, so that information obtained and interpretations developed during each incremental stage of the investigation can be used most effectively to guide subsequent phases of the program. This site-specific *Work Plan* outlines the specific technical objectives and scope of work proposed for Phase I of the Savannah investigation. This *Work Plan* also includes the community relations plan to be followed throughout the CCC/USDA program at the Savannah site.

Argonne is developing a *Master Work Plan* specific to operations in the state of Missouri. In the meantime, Argonne will issue a *Provisional Master Work Plan* (*PMWP;* Argonne 2007) that will be submitted to the MoDNR for review and approval. The agency has already reviewed and approved (with minor changes) the present *Master Work Plan* (Argonne 2002) under which Argonne currently operates in Kansas.

The *PMWP* (Argonne 2007) will provide detailed information and guidance on the investigative technologies, analytical methodologies, quality assurance-quality control measures, and general health and safety policies to be employed by Argonne for all investigations at former CCC/USDA grain storage facilities in Missouri. Both the *PMWP* and this site-specific *Work Plan* must therefore be consulted for a complete description of the planned Phase I work at the former CCC/USDA facility at Savannah.

2 Background and History

2.1 Site Background

Savannah, Missouri, population 4,762 (2000 Census), is located in the northwestern corner of the state, approximately 14 mi north of St. Joseph, Missouri. Savannah is the county seat for Andrew County (Figure 2.1). The city is governed by a mayor and a board of aldermen. Savannah hosts numerous businesses, churches, and schools, as well as a public golf course, city and county government offices, a local newspaper, and the Andrew County Historical Museum.

The census of 2000 reported 1,927 households in the city of Savannah. Of these, 32.1% include children under the age of 18, 51.8% include married couples living together, and 17.5% represent a person living alone who is 65 years of age or older. The average household size is 2.38, and the average family size is 2.99.

The age distribution of the city population is as follows: 25.5%, under 18 years; 8.6%, 18-24 years; 26.0%, 25-44 years; 19.4%, 45-64 years; and 20.6%, 65 years or older. The median age is 38 years.

The median household income in the city is $32,996; the median family income is $40,615; and the per capita income is $17,809. Some 11.8% of the population and 10.2% of families are below the poverty line. Individuals living below the poverty line include 17.6% of the population under age 18 and 8.9% of those 65 and older.

Savannah is home to many clubs and organizations. These organizations include the American Legion and Auxiliary; Beta Sigma Phi; Boy Scouts; Girl Scouts; Daughters of the American Revolution; Retired Senior Volunteer Program; Ladies Auxiliary, VFW Post 12053; Lions Club; Main Street, Inc.; Masonic Lodge; Order of the Eastern Star; Royal Neighbors; Semper Fidelis; Knights of Columbus; 4-H Clubs; PEO; Chamber of Commerce; Extension Club; Savannah Optimists Club; and more.

The city government has an Internet web site (http://www.savannahmo.net/) that provides comprehensive information regarding all aspects of the municipal government and community activities.

Residents within the municipal limits of Savannah primarily receive their drinking water from a municipal distribution system. The municipal system presently obtains its water supply from two groundwater wells located approximately 5 mi southwest of the city, as well as from a surface reservoir located approximately 0.83 mi west of the Savannah municipal boundary and 0.75 mi to the southwest and topographically down-slope from the former CCC/USDA facility (Figure 2.2). Residents in the area surrounding the town variously obtain drinking water from the Savannah municipal system, from Andrew County Public Water Supply District (PWSD) #1 or PWSD #3, or from private domestic wells. PWSD #1 obtains its water supply from wells formerly operated as municipal wells by the city of St. Joseph; these wells are now owned and operated by Missouri American Water. PWSD #3 purchases all of its water supply from the city of Savannah.

In March 2007 the city of Savannah started construction of a third groundwater well near the two existing wells. The city is also installing a new pipeline to the city and a treatment plant to accommodate the water from all three wells. When the new well, pipeline, and treatment system are completed in about one year, the city will no longer use the reservoir as a drinking water source (Hatcher 2007a). Under an agreement with the Department of Conservation (Hatcher 2007b), however, the reservoir will be maintained by the city for recreational use by the community for an additional 5-6 years.

In 2000, the MoDNR estimated that approximately 6 private wells were located within a 0.25-mi radius — and 17 wells within a 4-mi radius — of the former CCC/USDA facility (MoDNR 2000a). Further investigation by the MoDNR identified 5 additional private wells within 0.25 mi of the former facility, for a total of 11 wells within the 0.25-mi radius; however, as of 2000, none of these was believed to be used for drinking water supply (MoDNR 2000b). Updating the status of the private wells near the former CCC/USDA facility and determining the residents' drinking water sources is part of the proposed investigation (Section 3.2.1.1).

The former CCC/USDA grain storage facility was located approximately 0.25 mi northwest of the Savannah municipal boundary and 7 mi northeast of the Missouri River, along the southwest side of Business Hwy. 71 (Figure 2.2). The former facility lies along a low topographic rise trending northwest-southeast (elevation approximately 1,150 ft above mean sea level [AMSL]), along which Business Hwy. 71 lies. This rise forms a local surface drainage divide. Surface runoff from the divide is toward the northeast, east, south, and southwest via several natural drainage ways; however, the water flow along these pathways has been somewhat

modified by the construction of numerous small retention ponds and the city reservoir to the northeast, east, and southwest of the former facility, as well as by regrading west of the former CCC/USDA facility associated with the construction of Hwy. 71. The MoDNR determined that surface drainage from the former CCC/USDA facility is now directed, via a culvert beneath the roadway, toward a retention pond northeast of the former facility and Business Hwy. 71 (MoDNR 2000a; Figure 2.2).

Overflow from the retention pond moves overland to the east and then north for approximately 0.5 mi, where it joins an unnamed intermittent stream. The intermittent stream then runs north-northeast for approximately 0.5 mi before it becomes a permanent stream. The stream continues north-northeast approximately 3 mi before it enters the One Hundred and Two River. This river flows generally southward, draining into the Platte River approximately 15 mi southeast of Savannah. The Platte River, in turn, drains into the Missouri River approximately 45 mi south of Savannah.

Available documentation (GSA 1975) indicates that the former CCC/USDA grain storage facility occupied approximately 2.17 acres of land owned by the U.S. Government. Historical aerial photographs depicting conditions at the former Savannah grain storage facility in 1960, 1974, and 1981 have been obtained by the CCC/USDA (Figures 2.3a-c, respectively). A current (2006) aerial view of the former site is in Figure 2.3d. Figure 2.3a shows the maximum known extent of the former CCC/USDA grain storage operation; the photograph shows 2 rectangular and 55 round grain storage structures on the site in 1960.

Figure 2.3b indicates that all of the USDA grain storage structures present in 1960 had been removed by 1974; however, the foundations of the 2 former rectangular storage bins and 3 additional circular bins (or foundations) are visible in the 1974 photograph. The locations of the circular structures (or foundations) seen in the 1974 aerial photograph (Figure 2.3b) do not coincide with any of the CCC/USDA bins identified in the 1960 photograph (Figure 2.3a). The origin of these 3 additional bins is unknown, as is their possible association with either past CCC/USDA operations or other grain storage activities on this property. The 2 rectangular and 3 circular foundations continue to be visible in the 1981 photograph (Figure 2.3c), and they are still present on the former USDA property (Figure 2.3d). The remainder of the former CCC/USDA site is currently level and covered with grass. Trees line the southern, western, and northern margins of the property (Figures 2.3d, 2.4, and 2.5). A perimeter fence surrounds the

former site; access to the property is currently via a gated entrance from Business Hwy. 71, at the southeast corner of the property.

Property records reproduced in Appendix A indicate that in 1975, ownership of the former grain storage facility was transferred from the U.S. Government to Reorganized School District III of Savannah, subject to requirements that the property be used by the school district for educational purposes. Under the terms of the transfer document, these requirements and the provisions allowing the Government to reclaim the property ended 30 years after the date of transfer, in 2005. Representatives of the Savannah school board indicated that the property was previously used by a faculty member of the local high school's agriculture department, but that it is now generally used only for equipment storage (MoDNR 2000a; Caldwell 2006; Mallette 2007).

The former CCC/USDA facility is presently bordered by small private acreages and residential properties to the south, west, and northwest and by Business Hwy. 71 to the northeast. A small commercial property housing the McPike Rent-All storage facility (Figure 2.6) is directly north of the former CCC/USDA property. The McPike property is owned by Joan Whitlock. Residential properties around the former CCC/USDA facility are owned by Charles P. Morgan (to the south), Jerry Hughes (to the west), and Guy Ring (at the southwest corner). The Missouri Department of Transportation (MoDOT) occupies the property to the east, across Business Hwy. 71. The state purchased this property from a private landowner in 1998.

2.2 Geologic and Hydrogeologic Setting

2.2.1 Regional and Local Geology

The former CCC/USDA grain storage facility is located in the northwestern, formerly glaciated, portion of Missouri, within the Dissected Till Plains region of the Central Lowlands physiographic province (MoDNR 2000a). In this area, pre-Illinoian periglacial and glacial materials (consisting predominantly of clay till) and surficial loess were deposited over a sequence of Pennsylvanian shale and limestone bedrock units more than 1,300 ft thick. These bedrock units dip very gently to the west-northwest (McQueen and Greene 1938). Extensive preglacial erosion of the bedrock surface, combined with subsequent postglacial erosion of the till and loess deposits, have combined to produce widely varying thicknesses of the Pleistocene

sediments and depths to bedrock across much of northwestern Missouri and the local Savannah area. Regional geologic mapping (McQueen and Greene 1938) suggests that the former CCC/USDA facility overlies the southwestern margin of a northeast-plunging buried valley, 5-6 mi wide, that forms a paleotributary to a larger bedrock valley (more than 200 ft deep) trending northwest-southeast and extending across the northwestern portion of Missouri. Relatively coarser-grained sediments — consisting of discontinuous lenses, stingers, or sheets of silt, sand, and gravel — are sparsely distributed within the till and may locally be better developed near the base of the glacial sequence. These sediments likely represent pre- or inter-glacial stream deposits, the distribution of which does not generally mirror present-day drainage patterns (Fuller et al. 1957; Heim et al. 1960).

Geologic descriptions of exposures previously observed in a quarry roughly 5 mi southeast of the former CCC/USDA facility (Howe 1968) suggest the possible characteristics of the bedrock and glacial deposits in the Savannah area. At the quarry location,[1] bedrock units of the Pennsylvanian Shawnee Group, consisting of the Plattsmouth and Kereford limestone members of the Oread Formation (thickness > 20 ft), are overlain by the Jackson Park shale member (thickness approximately 5 ft) of the Kanwaka formation. Individual shale beds within the Shawnee Group may range from < 1 ft to > 75 ft in thickness. Natural outcroppings of the bedrock units are restricted to the bluffs overlooking the Missouri River, approximately 3-4 mi southwest of Savannah.

One, or possibly two, till units were identified at the quarry near Savannah, although no intervening soil horizon (which would confirm a temporal separation between two units) could be identified. The lower portion of the glacial sequence consisted predominantly of medium to dark gray, generally unweathered, clay-rich till containing erratics as 10-40% of the disseminated coarser clasts. The upper portion of the sequence consisted of more pervasively weathered, oxidized, and jointed till. Large blocks of limestone (up to 35 ft) and discontinuous, contorted masses of medium sand to pebbles and cobbles (up to approximately 5 ft in thickness and 50-100 ft in length) were randomly distributed within the till units (Howe 1968).

Little information is available regarding the specific geologic sequence to be expected at the former CCC/USDA grain storage property. Neither geologic logs nor completion records for

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1 See the description of Stop 5 (Gordon Brothers Savannah Quarry) on pages 40-43 of the Howe (1968) document (http://www.missourigeologists.org/EarlierGuidebooks/Guidebook1968.pdf).

wells or other potential borings in the immediate vicinity of the former facility have been identified. Published data (Fuller et al. 1957) indicate reported elevations at the top of bedrock that vary from roughly 980 ft AMSL to 1,070 ft AMSL within 1 mi of the former CCC/USDA facility, suggesting a possible thickness for the Pleistocene and Recent deposits beneath the former CCC/USDA facility of 80-170 ft (at a surface elevation of approximately 1,150 ft AMSL). The MoDNR (2000b) reported that the contaminated (Morgan) well (Figure 2.7) identified 50 ft south of the former CCC/USDA property is 70 ft deep, but that the depth of the screen interval in this well is unknown, as is the stratigraphic interval from which the well draws water. Limited data for an unspecified well owned by the city of Savannah in 1941, approximately 0.5 mi southwest and topographically downslope from the former CCC/USDA facility, indicate that the well reached a depth of 114.5 ft below ground level (BGL) in Pennsylvanian bedrock and that water was sampled from the glacial drift at a depth of 70-80 ft BGL (Fuller et al. 1957).

Estimation from more regional geologic data suggests that the stratigraphic sequence beneath the former CCC/USDA facility could consist of silty-clayey surficial soil (5-10 ft), overlying silty to clayey loess (5-35 ft) and till (35-140 ft) (MoDNR 2000a). A likely thickness in excess of 12 ft is expected for the combined surficial soil and loess units (Langer et al. 2002). Discontinuous, thin deposits of silty to sandy or gravelly materials, erratics, and detached limestone blocks may be present within and/or at the base of the till, but their abundance and distribution cannot be predicted with any confidence.

2.2.2 Regional and Local Hydrogeology

The availability of groundwater for potable use in Andrew County and nearby counties is limited; aquifer intervals are generally restricted to the basal and interbedded glaciofluvial deposits described above or to the more well developed alluvial deposits associated with the modern Missouri and Nodaway Rivers. Wells capable of producing in excess of 100 gpm have been completed in the latter alluvial deposits. The Savannah municipal wells are located approximately 5 mi southwest of the city in the Missouri River alluvium.

In Andrew County and the adjacent counties, quantities of groundwater sufficient for domestic supply can be obtained from the interglacial deposits; however, the productivity and distribution of these sediments is not readily predicted, and the groundwater is frequently high in total iron, total dissolved solids, and sulfate content (Fuller et al. 1957; Heim et al. 1959, 1960).

Only 25% of the total area of Andrew County (primarily along its northern and southeastern margins) is estimated to be located favorably for domestic use of groundwater from the glaciofluvial sediments (Fuller et al. 1957). Wells in these deposits that tap relatively shallow water-bearing intervals (less than 50 ft BGL) may be subject to seasonal variations in water levels, "going dry" during extended periods of drought (Heim et al. 1960).

Small quantities of groundwater may also be available from the uppermost, more weathered Pennsylvanian Shawnee Group shale and limestone bedrock units. The groundwater from this source is generally of poor quality, however, and is unsuitable for consumption and many other purposes because of high concentrations of sodium, chloride, and sulfate. Water quality within the bedrock units is expected to decrease with increasing depth (MoDNR 2000a; Fuller et al. 1957; Heim et al. 1960). Shales deeper in the Pennsylvanian bedrock sequence are believed to act as effective barriers to groundwater movement.

Groundwater production in the vicinity of Savannah and the former CCC/USDA facility is believed to be exclusively from the glaciofluvial deposits, which are collectively referred to by the EPA as the "Pleistocene glacial-drift water-bearing unit." Depths to the shallowest aquifer intervals within this unit generally range from 10 ft to 50 ft BGL, with most wells encountering water at 30-35 ft BGL (MoDNR 2000a). No data are available on the possible direction(s) of groundwater flow near the former CCC/USDA facility. Groundwater movement within the glacial deposits is likely to be highly complex because of the heterogeneous distribution and discontinuity of the more permeable intervals within these sediments, as well as the possible influence of fractures or jointing in the clayey till matrix.

2.3 Previous Investigations

Carbon tetrachloride was first detected in the groundwater at Savannah in 1998, during screening of private wells conducted in Missouri by the EPA (1999). Subsequent studies to confirm and obtain data on the possible extent of the contamination have been performed by the EPA and MoDNR. The sequence and results of these investigations and related activities are summarized in Table 2.1. Estimated sampling locations in November 1998 and August 2000 are shown with analytical results in Figures 2.7 and 2.8.

TABLE 2.1 Summary of analytical results for previous investigations of carbon tetrachloride contamination at Savannah.

Sample Date	Sample Location	Medium	Concentration (µg/L) Carbon Tetrachloride	Chloroform	Comment
November 1998 Sampling for EPA Pre-CERCLIS Site Screening (EPA 1999)					
11/17/1998	CCC/USDA property	Soil gas	ND	ND	4 samples at 4 locations; 1 sample contained hexane at 2,200 µg/m^3 and methylene chloride at 810 µg/m^3.
	CCC/USDA property	Soil	ND	ND	2 samples at 1 location.
	Morgan well[a]	Groundwater	29	5.4	50 ft S of CCC/USDA property. Trace levels of tetrachloroethylene (0.34 µg/L), toluene (0.15 µg/L), and bromodichloromethane (1.1 µg/L) were also detected.
	Hughes well	Groundwater	ND	ND	0.11 mi W of CCC/USDA property.
	McPike well	Groundwater	ND	ND	0.05 mi N of CCC/USDA property; on site of rental business; now owned by J. Whitlock.
	Wilson well	Groundwater	ND	ND	0.43 mi E of CCC/USDA property.
February 1999 EPA Sampling (EPA 1999)					
2/19/1999	Morgan well[a]	Groundwater	61	4.3	50 ft S of CCC/USDA property; untreated sample.
		Groundwater	4.7	0.51	Sample from in-house treatment system.
January 2000 MoDNR Preliminary Assessment (MoDNR 2000a)					
1/12/2000	Morgan well[a]	Groundwater	42.8, 43.3	2.7, 2.8	50 ft S of CCC/USDA property; duplicate samples.
August 2000 MoDNR Site Inspection (MoDNR 2000b)					
8/29/2000	Morgan well[a]	Groundwater	46.3, 49.2	2.4, 2.5	50 ft S of CCC/USDA property; duplicate samples.
	MoDOT well[b]	Groundwater	321	7.1	400 ft E of CCC/USDA property.
	Burks well	Groundwater	ND		On County Rd. 429, 700 ft S of CCC/USDA property.
	Clizer well	Groundwater	ND		On County Rd. 428, 1,000 ft NW of CCC/USDA property.
	Municipal system intake	Groundwater	ND		On city reservoir.
June 2005 MoDNR Sampling (CCC/USDA 2006)					
6/28/2005	Morgan well[a]	Groundwater	22		50 ft S of CCC/USDA property.

[a] Morgan residence was connected to a public water supply on or before 6/30/1999 (MoDNR 2000a).

[b] The MoDOT well is no longer in use (MoDNR 2000b).

2.3.1 EPA Pre-CERCLIS Site Screening Investigation — November 1998 Sampling

In November 1998, three private wells near the former CCC/USDA grain storage facility (Hughes, McPike and Morgan; Figure 2.7) and a fourth well approximately 0.4 mi east of the facility (Wilson; outside the area shown in Figure 2.7) were sampled. This sampling was part of state-wide screening of private wells near former CCC/USDA facilities in Missouri conducted by Project Resources, Inc., on behalf of the EPA. Carbon tetrachloride and chloroform were detected in the Morgan well, located roughly 50 ft south of the former CCC/USDA facility, at concentrations of 29 µg/L and 5.4 µg/L, respectively (Table 2.1). Trace levels of tetrachloroethylene (0.34 µg/L), toluene (0.15 µg/L), and bromodichloromethane (1.1 µg/L) were also detected in the sample from the Morgan well. No volatile organic compounds (VOCs) were detected in the remaining three wells (at an analytical reporting limit of 0.02 µg/L for carbon tetrachloride).

As part of the 1998 site screening investigation, two soil samples (10-12 ft and 20-22 ft BGL) and four soil gas samples (12 ft BGL) were also collected adjacent to the rectangular storage building foundations that remain at the former CCC/USDA facility (Figure 2.7). No carbon tetrachloride was detected in the soil or soil gas samples; however, hexane (2,200 µg/m^3) and methylene chloride (810 µg/m^3) were identified in one soil gas sample, from a location north of the foundations (Table 2.1). The hexane and methylene chloride were not believed to be associated with the former use of grain fumigants by the CCC/USDA (MoDNR 2000a; EPA 1999). The site screening investigation report, issued in January 1999 (as reported by the MoDNR [2000a]), recommended further investigation of the identified contamination.

2.3.2 EPA Sampling of the Morgan Well — February 1999

In February 1999, groundwater from the Morgan private well, at a faucet in the kitchen of the associated residence, was resampled for VOCs analyses. Available data indicate that two samples were collected: one of untreated groundwater and the other of water treated by an in-home activated carbon filtration system. Carbon tetrachloride and chloroform were identified at concentrations of 61 µg/L and 4.3 µg/L in the untreated groundwater and at 4.7 µg/L and 0.51 µg/L in the filtered effluent, respectively (Table 2.1; EPA 1999).

2.3.3 EPA Removal Action — 1999

On the basis of the November 1998 and February 1999 sampling results (Table 2.1), the EPA undertook a removal action on or before June 30, 1999, and connected the Morgan residence to a public water supply uncontaminated by carbon tetrachloride. The Morgan private well remains available for non-potable uses (MoDNR 2000a).

2.3.4 MoDNR Preliminary Assessment Investigation — January 2000 Sampling

The MoDNR conducted a preliminary assessment of the former CCC/USDA facility (MOSFN0703496) from October 1999 to March 2000 (MoDNR 2000a). The activities included (1) a review of previous findings, (2) a hydrogeologic assessment of the site, (3) an evaluation of potential receptors at risk from the contaminated groundwater, (4) a reconnaissance visit to the site, and (5) resampling of the Morgan private well. The preliminary assessment determined that approximately 45 people might obtain drinking water from an estimated 6 private wells within an estimated 0.25-mi radius — and 17 private wells within an estimated 4-mi radius — of the former CCC/USDA facility.

Carbon tetrachloride was detected in two samples of (untreated) water from the Morgan well at concentrations of 42.8 µg/L and 43.3 µg/L; chloroform was detected in these samples at 2.7 µg/L and 2.8 µg/L (Table 2.1). The MoDNR concluded that (1) no fumigant-related compounds were expected to be found in the surface soils at the former CCC/USDA facility and (2) the surface water exposure pathway was unlikely to be affected. The investigation report recommended the identification and sampling of additional private wells in the vicinity of the former grain storage facility (MoDNR 2000a).

2.3.5 MoDNR Site Inspection Investigation — August 2000 Sampling

The MoDNR conducted a site inspection investigation of the former CCC/USDA facility in August and September 2000. During this investigation, five additional private wells were discovered within an estimated 0.25-mi radius of the former facility. The MoDNR determined that — as of August-September 2000 — 3 of the 11 total private wells now identified within this distance might be in use for drinking water supply. One well was *confirmed* as a source of drinking water; however, the associated residence also had a connection to a public water supply.

Two wells of undetermined status were *presumed* to be available for possible drinking water use. The MoDNR also determined that one (Hughes) of the four wells originally sampled by the EPA in 1998 had been "closed" by the time of the site inspection.

Groundwater samples for VOCs analyses were collected in August 2000 from four private wells (Morgan, Burks, MoDOT, and Clizer). Also analyzed for VOCs were samples of raw and treated water were collected from the Savannah public system at the city reservoir (Figure 2.8; MoDNR 2000b).

Carbon tetrachloride at concentrations of 46.3 µg/L and 49.2 µg/L and chloroform at 2.4 µg/L and 2.5 µg/L were detected in two samples of (untreated) water from the Morgan well (Table 2.1). Carbon tetrachloride and chloroform were also identified at concentrations of 321 µg/L and 7.1 µg/L, respectively, in a well approximately 400 ft east of the former CCC/USDA facility, on property owned by the MoDOT (Figure 2.8). At the time of the August 2000 sampling, this well was being used only for water supply to a lavatory (not for drinking purposes); the MoDOT facility received its drinking water supply from a public system. By the time of completion of the site inspection report, the MoDOT well had been removed from service (MoDNR 2000b).

No VOCs contaminants were detected in the August 2000 sampling in the Burks or Clizer private well samples, or in the samples obtained from the Savannah public water supply (Table 2.1 and Figure 2.8). The MoDNR reported that the origin of the Clizer "well" sample was questionable, however, as piping observed in the well housing suggested that the water might be derived from a source other than the well itself. Concentrations of several chlorinated methane and bromochloromethane species detected in this sample, at levels comparable to those in treated (chlorinated) water from the Savannah municipal system, suggested that the Clizer sample was in fact obtained from a connection to the Savannah municipal system at the well house (MoDNR 2000b).

2.3.6 Sampling of the Morgan Private Well by the Missouri Department of Health — June 2005

The MoDNR reported to the CCC/USDA that the contaminated Morgan private well was resampled for VOCs analyses in June 2005. Carbon tetrachloride was detected at a concentration of 22 µg/L, at a lower level than in previous sampling events (Table 2.1); however, no other

information was provided (CCC/USDA 2006). The MoDNR indicated that the sampling was probably performed by the Missouri Department of Health and Senior Services, which tracks contaminant levels in private wells linked to possible Superfund sites as a service to well owners (Erickson 2006).

2.4 Summary

The findings of investigations performed at Savannah from 1998 to 2005 are summarized in Table 2.1 and Figures 2.7 and 2.8. The findings are as follows:

- The presence of carbon tetrachloride contamination was confirmed at levels exceeding the EPA-promulgated MCL of 5 µg/L, as well as the Missouri quality standards for drinking water and groundwater (10 CSR 20-7.031, Table A). The contaminant was reported at two locations, as follows:

  - Carbon tetrachloride was found in groundwater at a private (Morgan) well approximately 50 ft directly south of the former CCC/USDA grain storage facility, at reported concentrations ranging from a maximum of 61 µg/L (in 1999) to a minimum of 22 µg/L (in 2005). The contamination in the Morgan well was confirmed in five sampling events.

  - A single sampling event conducted in 2000 also identified carbon tetrachloride contamination at a reported concentration of 321 µg/L in groundwater from a private (MoDOT) well located approximately 400 ft directly east of the former CCC/USDA facility.

- Approximately 11 private wells were estimated to be present within an estimated 0.25-mi radius of the former CCC/USDA facility as of August-September 2000; 3 of these wells were confirmed or presumed to be available for drinking purposes at that time.

- The identification of carbon tetrachloride in groundwater at the Morgan and MoDOT wells suggests a link to the possible historic use of grain fumigants containing carbon tetrachloride at the former CCC/USDA grain storage

facility. Limited sampling at the former facility did not detect carbon tetrachloride contamination in soil or soil gas samples collected at depths ranging from 10 ft to 22 ft BGL. Deeper soils and groundwater beneath the former facility have not been sampled.

- The geologic sequence that forms the principal potable-water-bearing unit at Savannah is expected to be lithologically complex, consisting of thin, irregular, and discontinuous glaciofluvial bodies of silty to gravelly materials and boulders imbedded within clayey tills that may be variably fractured and jointed. The tills are expected to be overlain by silty-clayey loess and to rest unconformably on Pennsylvanian shale and limestone bedrock.

- No site-specific information is presently available on the detailed hydrogeologic sequence at and near the former CCC/USDA facility, or on the possible direction(s) of groundwater movement that might affect vertical and lateral contaminant migration. The direction(s) of groundwater movement will have profound implications in the identification of a source area for the contaminant.

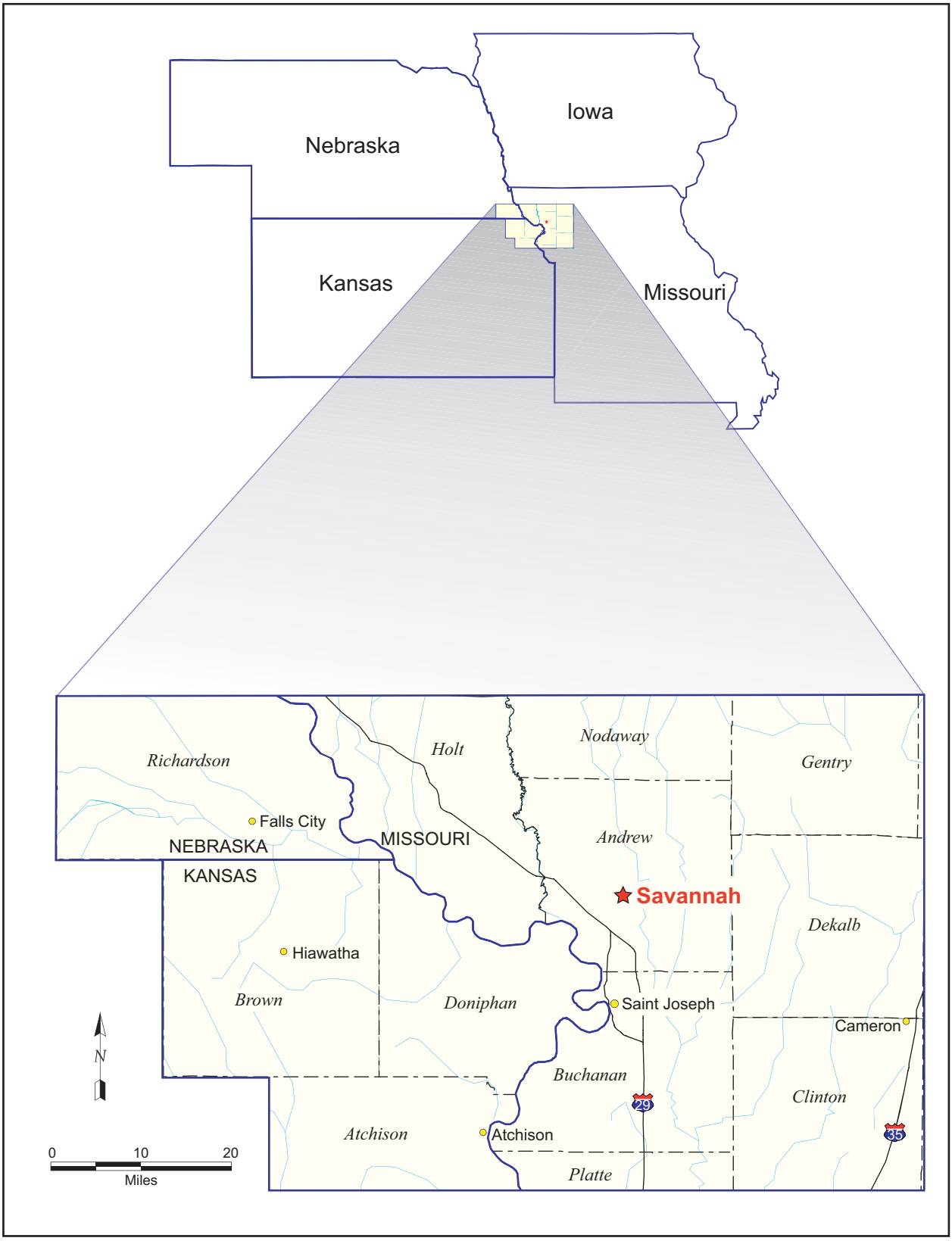
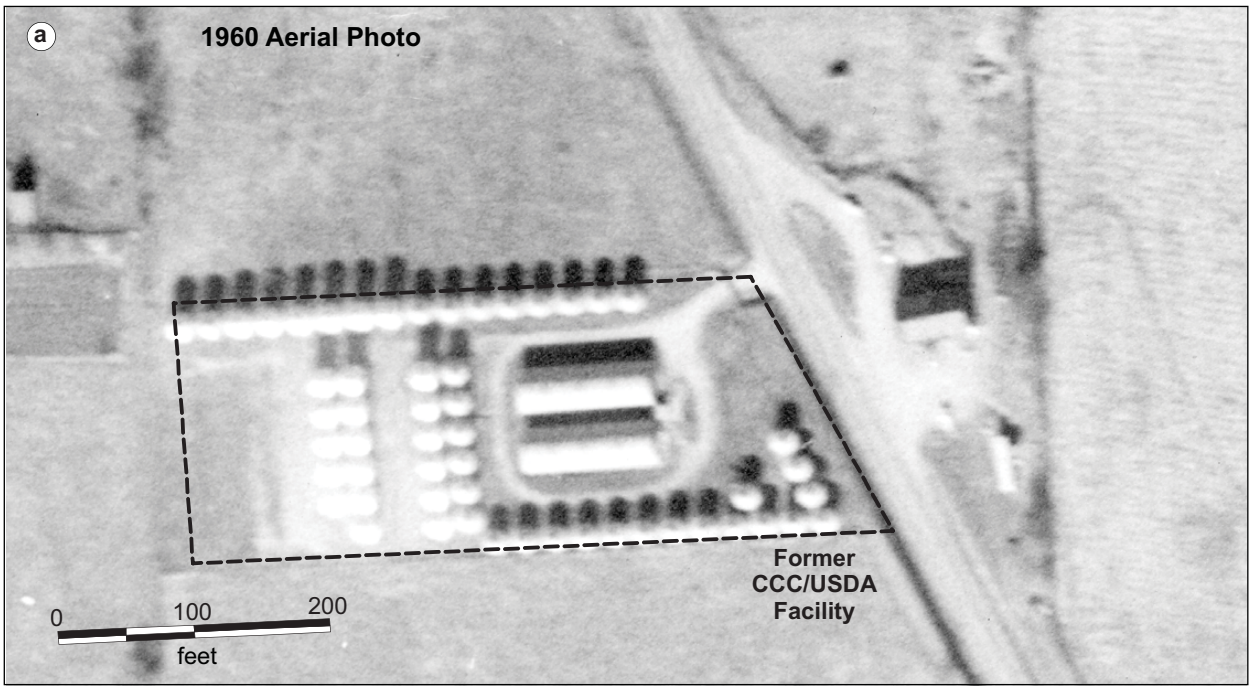


FIGURE 2.1 Location of Savannah, Missouri.

FIGURE 2.2 Locations of U.S. Business Highway 71, the former CCC/USDA grain storage facility northwest of Savannah, and the Savannah municipal water supply reservoir west of the city. Source of photograph: NAIP (2006).



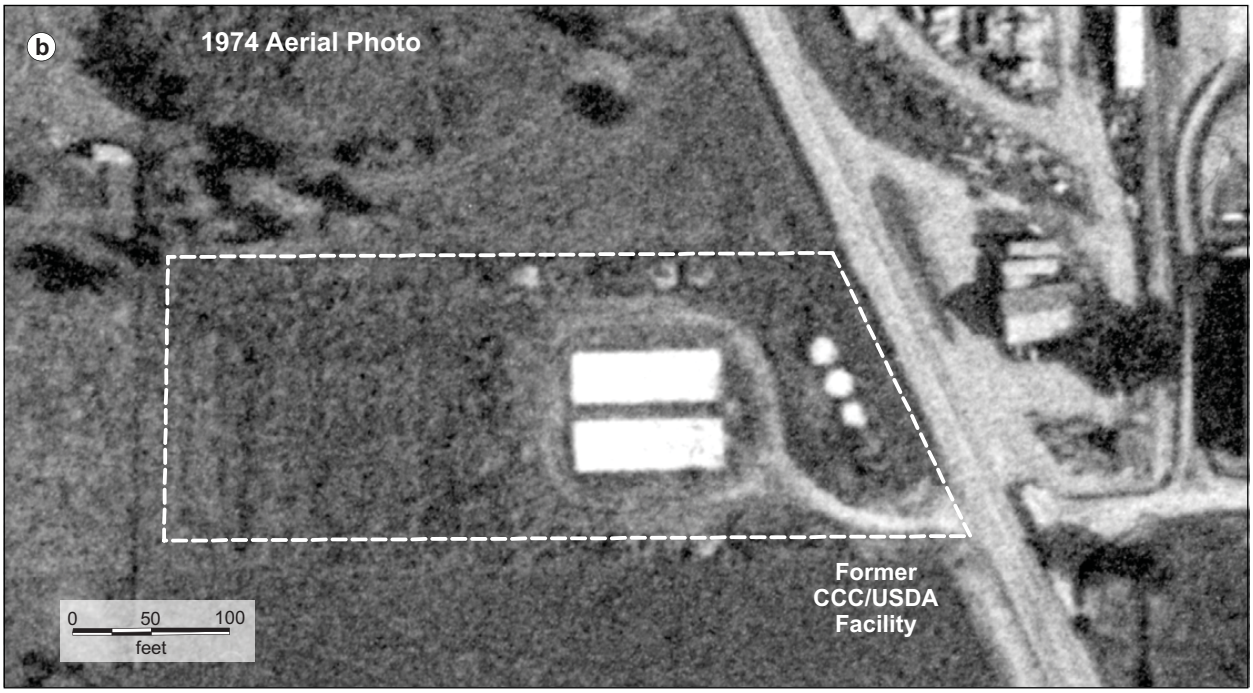


FIGURE 2.3 Aerial photographs of the former CCC/USDA grain storage facility at Savannah, taken in 1960 (a), 1974 (b), 1981 (c), and 2006 (d). Sources of photographs: USDA (1960, 1974, 1981); NAIP (2006).

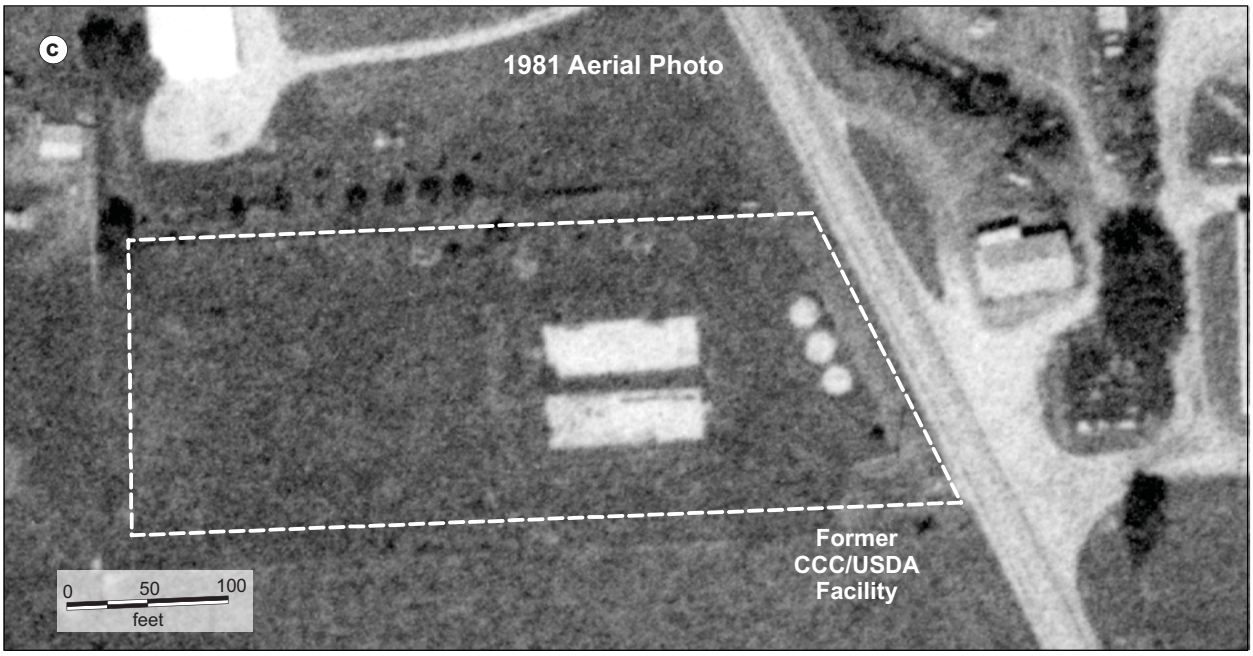


FIGURE 2.3 (Cont.)

FIGURE 2.4 Recent view from the southeast corner of the property formerly occupied by the CCC/USDA grain storage facility, looking northwest toward the two rectangular grain bin foundations that remain at the site. The sheds and equipment visible are located on the more northern foundation; the horse trailer is on the southern foundation.

FIGURE 2.5 Recent view from near the center of the property formerly occupied by the CCC/USDA grain storage facility, looking west-northwest across the western half of the property.

FIGURE 2.6 Recent view from the former CCC/USDA grain storage facility, looking west-northwest toward the McPike Rent-All storage facility directly to the north.

FIGURE 2.7 Results of analyses for volatile organic compounds on soil and soil gas samples from the former CCC/USDA grain storage facility, as well as groundwater samples from private wells near the former CCC/USDA facility, collected in November 1998. Sampling locations are estimated. Source of photograph: NAIP (2006). Source of data: EPA (1999).

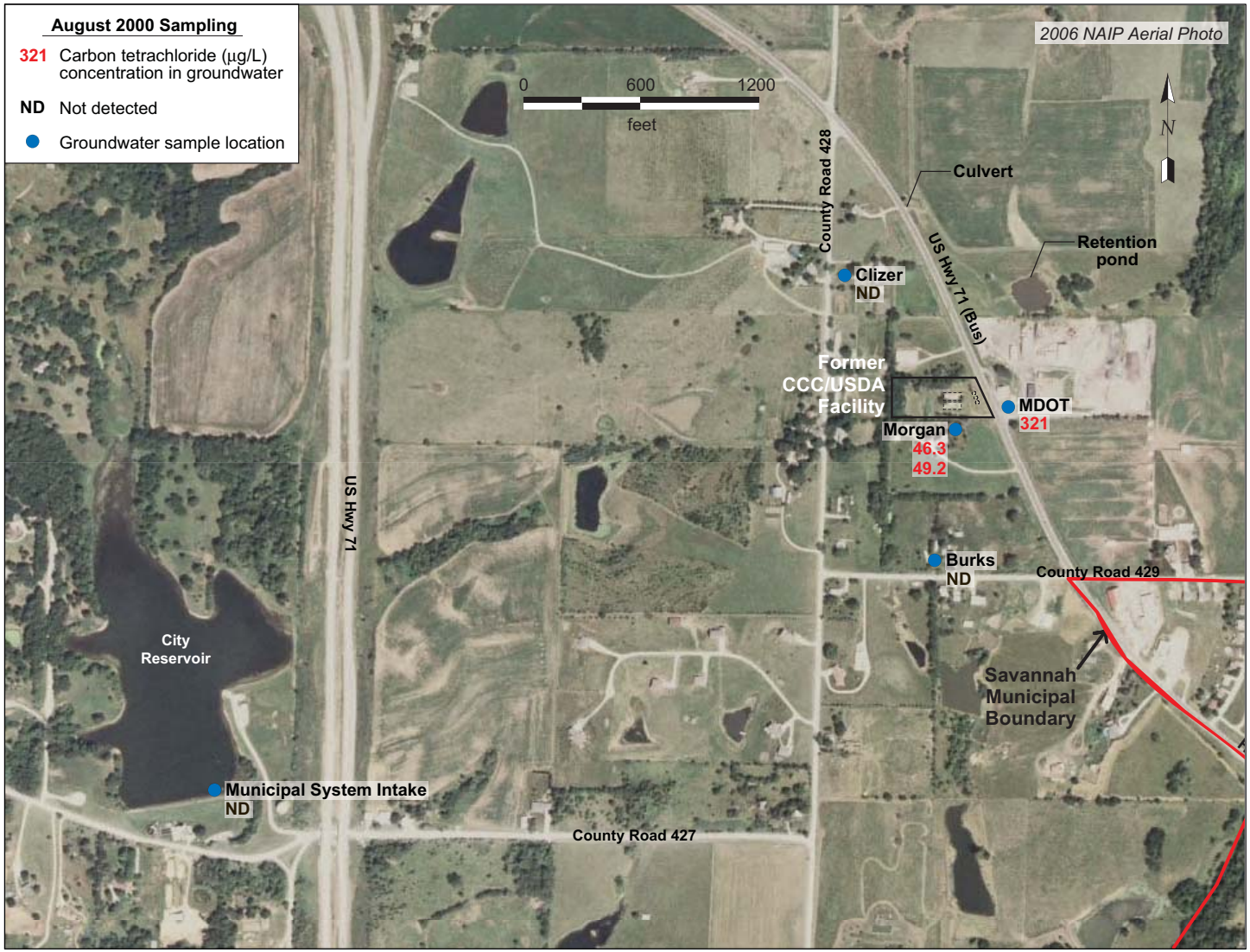


FIGURE 2.8 Results of carbon tetrachloride analyses on groundwater samples collected from private wells near the former CCC/USDA facility and a surface water sample collected from the water intake at the Savannah municipal water supply reservoir in August 2000. Sampling locations are estimated. Source of photograph: NAIP (2006). Source of data: MoDNR (2000b).

3 Investigation Objectives and Tasks

3.1 Technical Objectives of the Phase I Studies

Phase I of the CCC/USDA investigations at Savannah will focus on four primary technical objectives that are designed to increase understanding of the former CCC/USDA facility and to augment the existing analytical database for the site, as summarized in Section 2. The proposed technical objectives for the Phase I program are as follows:

- Update the previous (MoDNR 2000a,b) inventory and status of private wells in the immediate vicinity of the former CCC/USDA grain storage facility, and sample the identified wells for VOCs and geochemical analyses.

- Investigate for possible evidence of a soil source of carbon tetrachloride contamination to groundwater beneath the former CCC/USDA facility.

- Obtain preliminary information on the site-specific lithologies and hydrostratigraphy at the former CCC/USDA grain storage location.

- Establish preliminary groundwater monitoring points, to investigate the patterns of groundwater movement affecting possible contaminant migration near the former CCC/USDA facility.

3.2 Phase I Investigation Tasks

To address the technical objectives proposed in Section 3.1, the following investigative activities are recommended. Site-specific elements of the investigative approach and methods that will be used to implement the proposed Phase I program at Savannah are discussed in Section 4. Detailed information on the investigative technologies, field procedures, and analysis procedures that are pertinent to the CCC/USDA's planned characterization efforts at this site, as well as elsewhere in Missouri, are in the *PMWP* (Argonne 2007).

3.2.1 Update the Previous Inventory and Status of Private Wells in the Immediate Vicinity of the Former CCC/USDA Grain Storage Facility, and Sample the Identified Wells for VOCs and Geochemical Analyses

Argonne has contacted the MoDNR Public Drinking Water Branch, Wellhead Protection Section, Water Resources Center, for information on possible private wells in the vicinity of the former CCC/USDA facility. Available records pertaining to this area are very limited, however, and provide little information regarding the existence or status of private wells that might be available for potential drinking water use. Previous investigations (MoDNR 2000a,b) indicated that, as of 2000, the status of private wells in the immediate vicinity of the former CCC/USDA facility at Savannah was as follows:

- Approximately 11 private wells had been identified within an estimated 0.25-mi radius of the former CCC/USDA grain storage facility. These 11 wells include two with identified carbon tetrachloride contamination (the Morgan well and the MoDOT well).

- Of the 11 wells within approximately 0.25 mi of the former CCC/USDA facility, 3 might have been available (or in use) for drinking water supply in 2000; however, neither contaminated well (Morgan or MoDOT) was in use for drinking water supply when the MoDNR investigations ended (MoDNR 2000b).

- An estimated 3 additional private wells were located within a 1-mi radius of the former CCC/USDA facility.

- One private well sampled by the EPA in 1998 for VOCs analyses (Hughes) had been “closed” before the 2000 investigation (MoDNR 2000b).

3.2.1.1 Updating the Status of Private Wells

As part of the Phase I studies, the locations, present status, and current ownership of all identifiable wells within approximately 0.5 mi of the former CCC/USDA facility (Figure 3.1) will be determined and documented. In conjunction with this exercise, the present source(s) of drinking water used by all residents within the proposed area will be determined.

To address this technical objective, the following activities will be carried out:

- Any additional well information obtained during the preliminary assessment and site inspection studies, but not included in the respective summary reports (MoDNR 2000a,b), will be requested from the MoDNR.

- Current ownership data for all properties in the targeted area will be obtained from the Andrew County assessor's office. These records will be cross-checked against billing and water use records for the Savannah municipal water system and the local rural water district (if available), to identify any occupied properties that are not served by a public water source.

- Individual property owners and residents will be contacted by Argonne staff as necessary for direct determination of the present source(s) of drinking water and to confirm the status of the identified private wells.

3.2.1.2 Well Sampling

In additional Phase I work, existing wells will be sampled, as follows:

- Water samples will be collected from all of the identified private wells to which access can be obtained, for analyses for VOCs and selected additional parameters that will help to determine the geochemical characteristics and quality of the groundwater at Savannah (Section 4.6). If feasible, the total depth and static water level will be measured for each well.

- Samples of untreated water from the city reservoir (at the surface water intake for the Savannah municipal water system) and the effluent water (provided to residents) from the local water treatment plant will also be collected for VOCs and geochemical analyses (Section 4.6).

3.2.2 Investigate for Possible Evidence of a Soil Source of Carbon Tetrachloride Contamination to Groundwater beneath the Former CCC/USDA Facility

During the EPA's site screening sampling in 1998, no carbon tetrachloride contamination was detected in two soil samples collected at one location near the rectangular grain bin foundations that remain at the former CCC/USDA facility, or in soil gas samples collected at four locations near these foundations (EPA 1999; Figure 2.7). No other analyses of soil, soil gas, or groundwater samples collected on the former CCC/USDA property have been performed.

Carbon tetrachloride contamination at levels exceeding the MCL was consistently demonstrated in the Morgan private well (located approximately 50 ft south of the former CCC/USDA facility and no longer used as a drinking water source) in sampling events conducted by the EPA and MoDNR from 1998 to 2005 (Table 2.1; EPA 1999; MoDNR 2000a,b; CCC/USDA 2006). Carbon tetrachloride was also identified in 2000 (MoDNR 2000b) in a well (no longer in use) at the MoDOT facility approximately 400 ft east of the former CCC/USDA property, at a reported concentration of 321 µg/L (Table 2.1). These detections suggest that a source of carbon tetrachloride contamination to groundwater might exist in the vadose zone soils beneath the former facility.

To investigate for possible evidence of a soil source of carbon tetrachloride, two sampling activities are recommended: (1) initial sampling of the surficial and shallow subsurface soils for VOCs analysis, followed by (2) targeted sampling and analysis of the deeper vadose zone soils, if warranted, at locations to be selected on the basis of the findings for surficial and shallow subsurface soils.

3.2.2.1 Sampling and Analysis of Surficial and Shallow Subsurface Soils

Previous Argonne investigations (Alvarado and Rose 2004) demonstrated that the analysis of surficial and shallow subsurface (vadose zone) soils for carbon tetrachloride by a headspace method can serve as a sensitive indicator of possible soil contamination in the deeper vadose zone. 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 surficial and shallow subsurface soils will also be subjected to purge-and-trap sample preparation with analysis by gas chromatography-mass spectrometry (GC-MS) to provide a quantitative basis for the evaluation of potential health risks

associated with exposure to these soils. Sampling and analysis methods for these soils, to be collected at approximate depths of 1 ft, 4 ft, 8 ft, and 12 ft BGL, are discussed in Section 4.2.

Sampling and analysis of the surficial and shallow subsurface soils for VOCs are recommended as a precursor to the remaining Phase I field activities outlined below, so that the results of the analyses can be reviewed by Argonne, the CCC/USDA, and the MoDNR prior to finalization of the subsurface soil investigation program (Section 3.2.2.2). The surficial and shallow subsurface soil sampling will be targeted to test for contamination associated with the identified locations of the former grain storage structures and other structures (including the foundations) at the site (Figure 3.2), as well as in previously unoccupied areas that might have been used for movement, storage, or handling of fumigant containers or related equipment.

Sampling will be performed at proposed locations within the footprints of the former Quonset buildings (Figure 3.2), subject to the approval of the property owner (the Reorganized School District III of Savannah), by boring through the existing concrete foundations. At the request of the MoDNR, a handheld photoionization detector (PID) will be used to take readings of possible soil gas levels beneath the foundations immediately after the concrete is breached at each boring location.

3.2.2.2 Sampling and Analysis of Deeper Subsurface Soils

On the basis of the results of the surficial and shallow subsurface soil investigation, up to five locations (as necessary) will be recommended for potential sampling and analysis of the deeper vadose zone soils in a vertical profile, from 12 ft BGL to the top of the first identified groundwater-bearing unit, during Phase I of the Savannah investigation. Recommendations for these sampling locations will be submitted for the approval of the CCC/USDA and the MoDNR before the sampling effort begins, to ensure that the proposed subsurface sampling program is mutually acceptable to both agencies. If consultation with the CCC/USDA and MoDNR project managers indicates that subsurface soil sampling at more than the five locations proposed for Phase I is technically warranted, additional work of this type will be included in recommendations for possible Phase II studies. If feasible, one or more of these five subsurface soil sampling locations will coincide with the locations of the four deep boring locations discussed in Section 3.2.3.

The subsurface soil samples will be analyzed for VOCs by using purge-and-trap sample preparation with analysis by GC-MS. At selected locations and depth intervals, soil materials might also be collected for the measurement of soil properties including moisture content, porosity, bulk density, and total organic carbon. These parameters would facilitate subsequent quantitative estimation of vertical contaminant migration to groundwater through the vadose zone, if carbon tetrachloride concentrations warranting such investigation are identified in the soils at the former CCC/USDA facility. Sampling and analysis methods for vadose zone soils are discussed in Section 4.5.

In conjunction with the subsurface soil sampling, groundwater will be collected for VOCs and selected geochemical analyses from the groundwater-bearing zone penetrated at the base of each vertical-profile soil boring. Methods for collecting and analyzing water samples are discussed in Section 4.6.

3.2.3 Obtain Preliminary Information on the Site-Specific Lithologies and Hydrostratigraphy at the Former CCC/USDA Grain Storage Location

The regional geologic and hydrogeologic setting of the Savannah area (summarized in Section 2.2) suggests that a complex and highly variable lithologic sequence might in part determine the potential distribution of water-bearing zones and the movement of groundwater (and possible carbon tetrachloride contamination) in the vicinity of the former CCC/USDA grain storage facility. To gain a preliminary understanding of the site-specific stratigraphy and hydrostratigraphy, four deep investigative borings (through the vadose zone and water-bearing units above bedrock) are proposed at the former CCC/USDA facility. Candidate locations for these borings, based on the information currently available for this site, are suggested in Figure 3.3. The specific boring locations for this element of the Phase I study will be selected in consultation with the CCC/USDA and MoDNR project managers after completion of the surficial and shallow subsurface soil sampling and analyses described in Section 3.2.2.1. The intent is that one or more of the suggested deep boring locations can coincide with the subsurface soil sampling locations proposed in Section 3.2.2.2.

At a minimum of two locations, a boring will be advanced by coring from the ground surface to bedrock (or refusal of the selected direct-push [cone penetrometer (CPT)] or conventional drilling technology) to obtain a continuous record of the subsurface geology and hydrogeology present at those respective sites. The hydrogeologic sequence will be characterized

in detail, to determine the range of lithologies and types of sedimentary units present and to identify potential water-bearing and confining intervals. The sequences observed in these two borings will also be compared, to obtain an initial indication of the potential vertical and lateral continuity of the hydrogeologic units beneath and near the former CCC/USDA facility. The evaluation and selection of boring methods and the coring and logging of soil samples are discussed in Sections 4.3 and 4.4, respectively.

On the basis of the results for the initial two deep borings, two additional deep borings will be advanced. If little geologic continuity is anticipated among the individual direct-push/drilling locations, continuous coring will be used; otherwise, selective coring will be employed across depth intervals considered most critical for understanding the distribution and movement of groundwater (and potentially carbon tetrachloride) at and near the former facility.

Groundwater will be collected for VOCs and selected geochemical analyses (Section 4.6) at each deep boring from the identified water-bearing zones that produce sufficient groundwater for sampling. The results will assist in identifying the potential contaminant distribution and the potential for vertical and lateral hydraulic communication among these zones. At selected locations and depth intervals, soil samples might also be collected for the measurement of physical properties including moisture content, porosity, bulk density, and total organic carbon, to facilitate the possible future quantitative estimation of groundwater and carbon tetrachloride migration rates within the saturated zone.

3.2.4 Establish Preliminary Groundwater Monitoring Points, to Investigate the Patterns of Groundwater Movement Affecting Possible Contaminant Migration near the Former CCC/USDA Facility

At present, no hydrologic data are available regarding (1) the magnitude(s) or direction(s) of the hydraulic gradients driving groundwater flow (or potential carbon tetrachloride migration) in the vicinity of the former CCC/USDA facility or (2) the potential effect on these parameters of seasonal and longer-term variations in site conditions. Argonne therefore proposes to establish a preliminary network of four or more permanent new monitoring points (piezometers or wells, depending on whether installation is accomplished with the CPT unit or requires conventional drilling) at the former CCC/USDA facility to facilitate the measurement of groundwater levels. On the basis of the limited information presently available for the site, tentative locations for these piezometers/wells are suggested to coincide with the four tentative deep boring locations

shown in Figure 3.3. As part of this activity, Argonne will also evaluate the technical and logistic feasibility of monitoring one or more existing private wells in the vicinity of the former CCC/USDA facility. The intent would be to expand the areal coverage of the proposed preliminary network.

Argonne further recommends, however, that the specific piezometer/well locations be selected in consultation with the CCC/USDA and MoDNR project managers as the findings of the characterization activities outlined in Sections 3.2.1, 3.2.2, and 3.2.3 become available and yield a more detailed picture of the site-specific hydrogeologic conditions at the investigation site. Argonne will present recommendations to the CCC/USDA and MoDNR project managers for the installation of either single piezometers/wells or clustered piezometers/wells (screened to intercept several discrete depth intervals, as described in Section 4.7), as needed, to permit the examination of possible lateral and vertical groundwater movement.

At each selected monitoring point, Argonne proposes the use of automatic water level sensors and data loggers to acquire continuous records of the water level fluctuations over a minimum period of one year (see Section 4.8). The preliminary monitoring network established during the proposed Phase I investigation will be maintained throughout the CCC/USDA's characterization activities and will be expanded or augmented as necessary in subsequent phases of the Savannah studies.

FIGURE 3.1 Proposed area within approximately 0.5 mi of the former CCC/USDA grain storage facility to be investigated to determine the locations, ownership, and status of identifiable private wells, as well as the source(s) of drinking water being used by residents. Source of photograph: NAIP (2006).

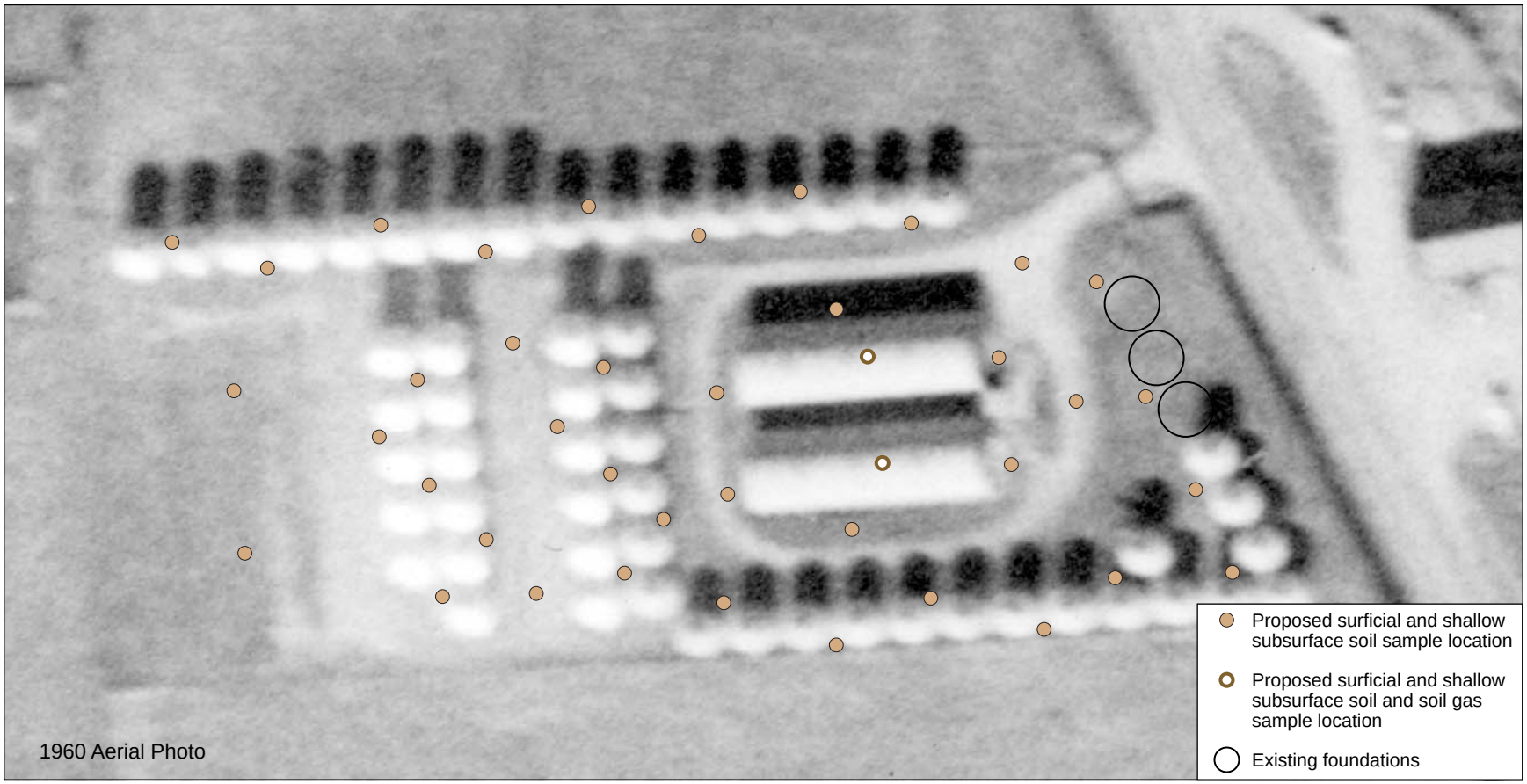


FIGURE 3.2 Proposed locations for sampling of surficial and shallow subsurface soils and for soil sampling and measurement of possible soil gas beneath the existing Quonset building foundations at the former CCC/USDA grain storage facility. Source of photograph: USDA (1960).

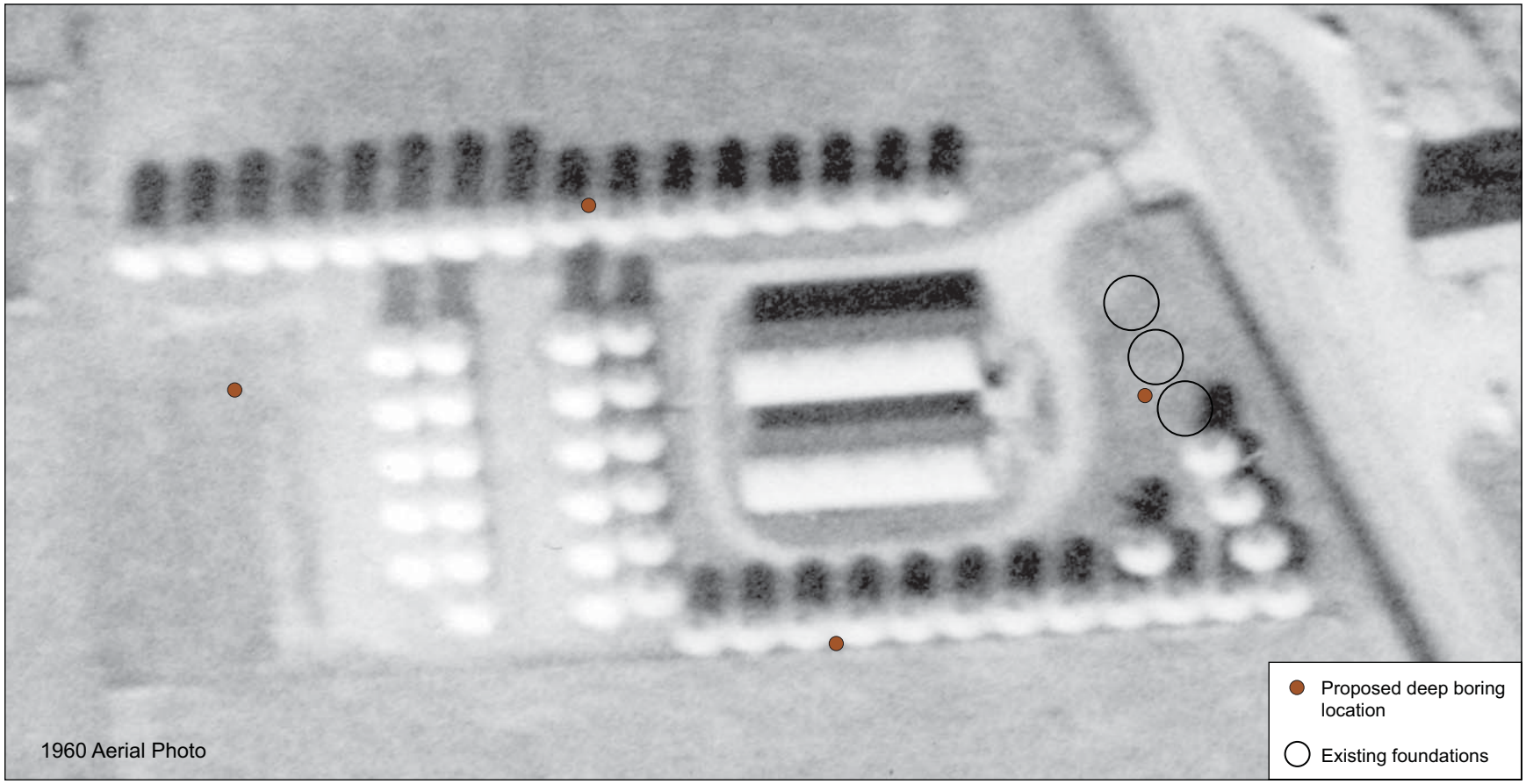


FIGURE 3.3 Candidate locations for possible deep investigative borings at the former CCC/USDA grain storage facility. Source of photograph: USDA (1960).

4 Investigation Methods

The *PMWP* (Argonne 2007) summarizes the anticipated range of investigative technologies, field procedures, and analytical methods that might be employed by Argonne in the characterization of former CCC/USDA grain storage facilities in Missouri. During each phase of the characterization process at a site, specific technologies and methodologies are recommended (for the approval by the CCC/USDA and MoDNR project managers) to address the identified technical objectives of the investigation program. The approved elements will then be implemented in accord with the standard operating procedures, quality assurance-quality control measures, and general health and safety policies outlined in the *PMWP*.

The technical objectives and investigation tasks for Phase I of the site characterization at Savannah are in Section 3. This section summarizes the site-specific approach, technologies, and methods proposed for the Phase I program. The site-specific community relations procedures to be followed throughout the CCC/USDA and Argonne program at Savannah are described in Section 5, and health and safety information for this site is in Section 6.

4.1 Proposed Field Sessions and Scheduling

The Phase I investigation at Savannah will be conducted in two field sessions. The initial field session will consist of (1) the data-gathering efforts for private wells and the public water system (Section 3.2.1.1) and (2) surficial and shallow subsurface soil sampling and analyses (Section 3.2.2.1). Argonne will establish a temporary field office at or near the former CCC/USDA facility (subject to property access) during this mobilization. The field office will be maintained throughout the Phase I program. The initial field session is expected to require 5-7 days to complete.

The remainder of the proposed Phase I program, including the private well sampling outlined in Section 3.2.1.2, will be conducted during the second field session. This field session will commence after the surficial and shallow subsurface soil analyses (Section 3.2.2.1) and the private well survey (Section 3.2.1.1) have been completed and reviewed by Argonne, the CCC/USDA, and the MoDNR. This approach is recommended to facilitate agreement among the agencies on the locations to be investigated by the deeper subsurface borings, as well as the well sampling and related activities outlined in Sections 3.2.1.2, 3.2.3, and 3.2.4. The expected duration of the second field session cannot be readily estimated because of present uncertainty

regarding the nature of the geologic sequence beneath the former CCC/USDA facility, and hence the difficulties that might be encountered in achieving sufficient depth penetration to address the Phase I technical objectives. (See also Section 4.3.) Field work during this session will be conducted on a 10-days-on, 4-days-off cycle, until the required tasks are completed.

4.2 Sampling and Analysis Methods for Surficial and Shallow Subsurface Soils and Soil Gas

Samples of the surficial and shallow subsurface native soils will be collected at each targeted location (Figure 3.2), at anticipated depths of 1 ft, 4 ft, 8 ft, and 12 ft BGL, from sleeved cores recovered by using the Argonne 22-ton, track-mounted crawler CPT vehicle. Sampling will be performed at proposed locations within the footprints of the former Quonset buildings (Figure 3.2), subject to the approval of the property owner (the Reorganized School District III of Savannah), by boring through the existing concrete foundations. The procedure to be used is in Appendix B.

At the request of the MoDNR, possible soil gas levels beneath the existing Quonset foundations will be determined by taking soil gas readings immediately after the concrete is breached at each proposed soil sampling location under the foundations. The soil gas measurements will be made by using a calibrated, hand-held PID, as described in Appendix B.

The recommended target depths will be adjusted at individual sampling locations, if necessary, to avoid any obviously recently deposited fill materials. The soil samples will be placed immediately in jars, sealed, preserved on dry ice, and shipped by overnight service to the Applied Geosciences and Environmental Management (AGEM) Laboratory at Argonne National Laboratory for rapid turnaround (typically 24-hr) analysis, so that interim results can be evaluated in the field as the sampling progresses. These soil samples will be analyzed by (1) a headspace method with a gas chromatograph and electron capture detector (modified EPA Method 5021) and (2) a purge-and-trap sample preparation method with analysis by GC-MS (EPA Methods 5030B and 8260B; *PMWP*, Argonne 2007, Sections 6.1.1, 6.2, and 6.3.1).

At the request of the MoDNR, corresponding aliquots of approximately 10-20% of the surficial and shallow subsurface soil samples will also be collected by using (25-g) EnCore™ sampling devices. These samples will be preserved on ice at 4°C and shipped by overnight

service to the AGEM Laboratory for purge-and-trap sample preparation with analysis by GC-MS (EPA Methods 5030B and 8260B; *PMWP,* Argonne 2007, Sections 6.1.1, 6.2, and 6.3.1).

4.3 Evaluation and Selection of Boring Methods

Argonne will attempt to conduct the vadose zone and deeper boring, sampling, and monitoring point installation tasks outlined in Sections 3.2.2.2, 3.2.3, and 3.2.4 by using the direct-push capabilities of the 22-ton, track-mounted crawler and 40-ton, truck-mounted CPT vehicles operated by Argonne. Argonne will also provisionally contract for the services of a sonic drilling rig and crew (licensed for operation in Missouri per state requirements) for possible use during the second field session, should conventional drilling prove necessary.

At each of the proposed deep investigation locations, an initial push to refusal depth will be made by using the instrumented electronic CPT cone to acquire continuous geomechanical measurements of tip pressure, sleeve friction, conductivity (if possible), borehole inclination, and tip-versus-sleeve ratio (*PMWP*, Argonne 2007, Section 6.5). The resulting logs will document sensor responses to the vertical sequence of materials penetrated, for possible correlation with the site-specific lithologies and stratigraphy identified by examination of corresponding core materials (*PMWP*, Argonne 2007, Section 4.3.1.2; and Section 4.4 below). At one or more initial locations, attempts will be made to recover soil cores for correlation with the electronic CPT data acquired in the initial stages of the investigation. The CPT will recover the core through fitting of the push rods with a 4-ft-long soil coring barrel (*PMWP*, Argonne 2007, Sections 6.1.1 and 6.5).

The success of the initial direct-push operations will be evaluated in the context of the anticipated lithologies and possible depth(s) to bedrock in the study area, to determine whether CPT technology can be used effectively to accomplish some or all of the Phase I investigation tasks. On the basis of this evaluation, Argonne will review the scope of the required subsurface investigation program with the CCC/USDA and MoDNR project managers and will request approval for the use of conventional drilling to complete the tasks that cannot be performed by using the CPT.

4.4 Collection and Logging of Soil Core Samples

At each boring location identified in Sections 3.2.2.2 and 3.2.3, core samples will be obtained to the extent possible for determination of the lithologies present and their stratigraphic distribution, the identification of potential hydrostratigraphic zones, and possible sampling for VOCs or physical property analyses. The required cores will be collected either continuously or selectively with depth, by using the CPT or conventional drilling equipment (Section 4.3) fitted with appropriate coring devices (*PMWP*, Argonne 2007, Sections 6.1.1 and 6.4.1). All cores will be logged in accord with the *PMWP* (Argonne 2007, Sections 4.3.1.3 and 6.4.1.5) and will be archived upon completion of the Phase I field program at an Argonne facility for future reference.

4.5 Sampling and Analysis Methods for Deeper Subsurface Soils

At each boring location selected in Section 3.2.2.2, deeper subsurface soils will be sampled for VOCs analyses at 4-ft depth intervals, in a vertical profile from an initial depth of 12 ft BGL to the top of the first saturated zone identified. Samples from additional depths within the cored interval at each boring location will be collected, if necessary, to adequately represent any significant variations observed in the lithologies penetrated.

Soil samples for the determination of VOCs will be placed immediately in jars, sealed, preserved on dry ice, and shipped by overnight service to the AGEM Laboratory at Argonne for analysis by the purge-and-trap sample preparation method with analysis by GC-MS (EPA Methods 5030B and 8260B; *PMWP*, Argonne 2007, Sections 6.1.1, 6.2, and 6.3.1).

At the request of the MoDNR, corresponding aliquots of approximately 10-20% of the surficial and shallow subsurface soil samples will also be collected by using (25-g) EnCore™ sampling devices. These samples will be preserved on ice at 4°C and shipped by overnight service to the AGEM Laboratory for purge-and-trap sample preparation with analysis by GC-MS (EPA Methods 5030B and 8260B; *PMWP*, Argonne 2007, Sections 6.1.1, 6.2, and 6.3.1).

At selected locations and depth intervals to be determined in the field, soil materials might also be collected from the cores for the measurement of soil properties including moisture content, porosity, bulk density, and total organic carbon (*PMWP*, Argonne 2007, Sections 6.1.2 and 6.3.1).

4.6 Sampling and Analysis Methods for Groundwater and Surface Water

Samples of groundwater from the private wells and investigative borings discussed in Sections 3.2.1.2, and 3.2.3 and samples of surface water and treated water from the Savannah city reservoir (Section 3.2.1.2) will be collected for analysis for VOCs and selected geochemical parameters, including the concentrations of common anions (chloride, sulfate, nitrate, and phosphate) and metals (aluminum, calcium, iron, magnesium, manganese, potassium, sodium, silicon, and zinc). The water samples from each of these sources will be collected in accord with the procedures in the *PMWP* (Argonne 2007, Sections 6.1.2, 6.1.3, and 6.3.2).

Samples for the determination of VOCs will be preserved and shipped (on ice at 4°C) by overnight service to the AGEM Laboratory at Argonne, for analysis by the purge-and-trap sample preparation method with analysis by GC-MS (EPA Methods 5030B and 8260B; *PMWP*, Argonne 2007, Section 6.3.2). To ensure reproducibility, a minimum of 10% of the water samples will also be selected for verification analysis by a second laboratory (Envirosystems, Inc., Columbia, Maryland) with the EPA's Contract Laboratory Program methods. An index of the EPA methods is online (http://www.epa.gov/epahome/index/).

Samples for inorganic geochemical analyses will be preserved and shipped (on ice at 4°C) by overnight service to Severn-Trent Laboratories (South Burlington, Vermont) for analysis.

4.7 Construction of Piezometers and Abandonment of Boreholes

Monitoring wells (piezometers) will be constructed at Savannah in accord with MoDNR requirements, as either flush-mount or aboveground completions, as requested by individual property owners. The wells/piezometers will be installed either individually or in clusters (screened across discrete depth intervals) at locations and depths approved by the CCC/USDA and MoDNR project managers. At location(s) where it is logistically possible, Argonne will request a variance from MoDNR (MoDNR Form MO 780-1422) to permit the installation of 1-in.-diameter piezometers by using direct-push methods (MoDNR 2005; *PMWP*, Argonne 2007, Sections 6.4.3-6.4.6).

All boreholes advanced during the Phase I investigation that are not selected for completion as monitoring points will be abandoned in accord with MoDNR requirements (MoDNR 2005; *PMWP*, Argonne 2007, Section 6.4.7).

4.8 Water Level Monitoring

Groundwater levels will be continuously monitored in the piezometers by using programmable downhole pressure sensor and data logging units (In-Situ, Inc., MiniTroll™, or Instrumentation Northwest PT2X™ devices). Subject to access and the approval of the CCC/USDA and MoDNR project managers, automated monitoring might also be conducted at one or more private wells. The data loggers at each location will be programmed initially to record one measurement every 10 min. The loggers will be downloaded after approximately one month of operation, and the resulting hydrographs will be examined for possible evidence of pumping or other short-term influences on the local groundwater levels. On the basis of these results, monitoring will either continue at the original measurement frequency, or the loggers will be reprogrammed to a recording interval (typically one reading every 1 hr to 4 hr) suitable for extended observation at the site. Automated monitoring is recommended in the network of Phase I monitoring points for a minimum of one year, to document possible seasonal variations in water levels (*PMWP*, Argonne 2007, Section 6.4.6.3).

5 Community Relations Plan

This community relations plan identifies issues of community concern regarding the Savannah, Missouri, groundwater contamination site and outlines community relations activities to be conducted during all phases of the investigation at Savannah.

The CCC/USDA formerly operated a grain storage facility approximately 0.25 mi northwest of the Savannah city limits from approximately 1949 until 1970. The CCC/USDA has assumed lead responsibility for all technical and community relations activities at Savannah. Argonne will conduct these activities for the CCC/USDA. These efforts will be closely coordinated with the MoDNR, which will oversee the work performed at the site. The EPA might also be involved in the activities.

Community concern is likely to increase when field work begins and Argonne's presence becomes apparent. Effective community relations will require close contact with residents both within and outside the city limits. In addition, as discussed below, information will be made available, as appropriate, in the local area to ensure that interested residents are adequately informed.

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

5.1 Site Description

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

5.2 Community Background

5.2.1 Community Profile

The incorporated city of Savannah is governed by a mayor and a board of aldermen. In addition to public works and other city responsibilities, the mayor and board have authority to

provide and maintain the municipal water supply system. The city operates a full-time office that is staffed by the city clerk/administrator and the deputy clerk/administrator.

Savannah is the governmental seat for Andrew County. The city is home to numerous businesses, churches, schools, a public golf course, city and county government offices, a local newspaper, and the Andrew County Historical Museum.

Residents within the Savannah municipal limits primarily receive their drinking water from a municipal distribution system. The municipal system obtains its water supply from two groundwater wells approximately 5 mi southwest of the city, as well as from a surface reservoir approximately 0.83 mi west of the city and 0.75 mi southwest and topographically down-slope from the former CCC/USDA facility (Figure 2.2). In March 2007 the city began construction of a third groundwater well near the two existing wells. The city is also constructing a new pipeline to transport water from all three wells to the city. In addition, a new water treatment plant is being constructed approximately midway between the public wells and the city. The new well, pipeline, and treatment system are to be completed in about one year. At that time, the city will discontinue use of the reservoir as a drinking water source.

Residents in the area surrounding Savannah variously obtain drinking water from the Savannah municipal system, from a rural water system, or from private domestic wells.

Area residents indicate that they rely on information from credible sources such as city officials; the weekly local newspaper, *The Savannah Reporter*; and the regional daily newspaper, *The St. Joseph News-Press.*

5.2.2 History of Community Involvement

Carbon tetrachloride was first detected in the groundwater north of Savannah in 1998, during screening of private wells by the EPA (1999). Investigations performed by the EPA and the MoDNR from 1998 to 2005 confirmed carbon tetrachloride contamination in groundwater at a private (Morgan) well approximately 50 ft directly south of the former CCC/USDA grain storage facility. A single sampling event in 2000 also detected carbon tetrachloride contamination in groundwater in a private (MoDOT) well approximately 400 ft directly east of

the former CCC/USDA facility. City officials were not aware of these detections until they were informed of the results by Argonne personnel during a site visit in March 2006.

5.2.3 Key Community Concerns

Currently, community concern about the groundwater contamination is low, because all city residences are connected to the city public water supply system and are unaffected by the contamination identified north of the town (Hatcher 2007a). In addition, residents living north of the city limits, in the area where the groundwater contamination has been detected, are connected to the Andrew County PWSD #1.

Once the proposed investigation begins and the presence of Argonne staff and contractors becomes apparent, nearby residents are likely to become more curious. This community relations plan is being developed in anticipation of the potential for greater community interest.

5.3 Community Relations Objectives

This Savannah community relations plan has the following major objectives:

1. Explain the investigative plans of the MoDNR and the CCC/USDA and provide general information about the program, to gain community acceptance.

2. Inform the local community of the investigation's findings and developments, as appropriate.

3. In coordination with the MoDNR, respond to citizens' inquiries about site activities and address their concerns regarding the presence of possible health and/or environmental hazards (if any are identified).

4. Ensure that the public has appropriate opportunities for involvement in site-related decisions.

5. Determine, on the basis of discussions with city officials and the site property owner (the school district), appropriate activities to ensure suitable public involvement.

6. Provide appropriate opportunities for the community to learn about the investigation and its potential effects on the community.

5.4 Timing of Community Relations Activities

This section describes the activities proposed to meet the community relations objectives identified in Section 5.3. Many of these activities will predate the field work.

5.4.1 Activities before Field Work Begins

In coordination with the MoDNR and the CCC/USDA and with the approval of the two agencies, Argonne will provide for the conduct of the following community relations activities, to the extent practicable, before field work begins:

- Designate an Argonne point of contact. This individual will be Argonne's liaison with the community and will be responsible for implementation of this community relations plan.

- Arrange for an initial informational contact with officials of the city government to explain proposed activities and schedules.

- Arrange for discussions (by telephone and in person) with interested residents and other interested or affected parties, as appropriate, to understand their concerns and information needs and to learn how and when citizens would like to be involved in the investigation process. This activity includes the following specific tasks:

    - Develop a list of names, addresses, and telephone numbers of local officials and interested citizens.

- With the assistance of city officials, identify a location for an information repository and administrative record file that will give residents easy access to investigation reports and other information. The repository will be available for public inspection and copying.

- Identify existing wells near the site that could be used for sampling.

- Identify access issues, discuss the issues with landowners, and resolve any concerns.

- Identify any physical and legal constraints or barriers to implementation of investigative plans.

- Send a copy of the approved site-specific *Work Plan* to the city. When community officials have had an opportunity to review the *Work Plan*, offer to meet with local community leaders and residents and brief them regarding the planned work. Such a meeting would be attended by MoDNR and CCC/USDA officials, Argonne staff, and others as appropriate. The purpose would be to accomplish the following:

  - Describe the site location and problem.

  - Explain why action is required (state regulations and legal, health, and other concerns).

  - Explain the objectives of the investigation.

  - Describe the site-specific *Work Plan* and its schedule in detail, including staff, contractors, and equipment to be on the site.

  - Introduce key personnel, including points of contact (with telephone numbers and addresses).

  - Present a strategy for communications with the public.

  - Seek input and answer questions from the community regarding the investigation and the communications strategy.

  - Discuss any access issues/problems that still might need to be addressed.

  - Announce the location of the community information repository.

- Fact sheets describing the site work will be provided to the city, the school district, and the owners of property adjacent to the former CCC/USDA property who will be canvassed during site work.

- Work with city officials to ensure that affected individuals living outside the city limits receive information about the investigation. This is an important issue, because the site itself is outside the city limits, and most of the parties likely to be affected by the investigation reside outside the city.

- Place materials in the information repository, and update the information as needed. Included in the repository will be the contact list of key officials, a copy of this site-specific *Work Plan*, relevant correspondence, investigation results, and guidance documents.

5.4.2 Activities during Field Work

In coordination with the MoDNR and the CCC/USDA, Argonne will provide for the following community relations activities during field work, to the extent practicable:

- Hold meetings with public officials and interested citizens as needed.

- Continue updating the information repository and the contact list.

- Continue telephone contact with state and local officials and with interested residents, if necessary.

- Arrange for site visits by interested parties, as permitted by site activities and safety limitations.

5.4.3 Activities upon Completion of Field Work

In coordination with the MoDNR and the CCC/USDA, Argonne will provide for the following community relations activities upon completion of the field work, to the extent practicable:

- Offer to meet with public officials and interested citizens to present and discuss the investigation's findings, results, recommendations, and any future activities at the site.

- Update the information repository with the investigation's results and proposed future activities at the site.

5.5 Contact List of Key Officials

The contact list below includes key officials includes federal, state, and local officials; interest groups; interested citizens; media representatives; and individuals living or working near the investigation site.

5.5.1 Federal Elected Officials

Senator Kit Bond
Washington, D.C., Office
274 Russell Senate Office Building
Washington, DC 20510
202-224-5721

Senator Kit Bond
Kansas City Office
911 Main St., Suite 2224
Kansas City, MO 64105
816-471-7141

Senator Claire McCaskill
Washington, D.C., Office
717 Senate Hart Office Building
Washington, DC 20510
202-224-6154

Senator Claire McCaskill
Kansas City Office
Whitaker Federal Office Building
400 E. 9th Street, Suite 400
Kansas City, MO 64106
816-421-1639

Congressman Sam Graves
Washington, D.C., Office
1415 Longworth House Office Building
Washington, DC 20515
202-225-7041
202-225-8221 (fax)

Congressman Sam Graves
St. Joseph District Office
201 S. 8th Street, Room 330
St. Joseph, MO 64501
816-233-9818
816-233-9848 (fax)

5.5.2 State Elected Officials

Governor Matt Blunt
Office of the Governor
Room 216, State Capitol Building
Jefferson City, MO 65101
573-751-3222

State Senator Brad Lager
State Senate, District 12
Room 429, State Capitol Building
Jefferson City, MO 65101
573-751-1415

State Representative Robert Schaaf
State House of Representatives, District 28
201 West Capitol Avenue
Room 304B
Jefferson City, MO 65101
573-751-2183

5.5.3 Local Officials

Elected Savannah Officials:

City of Savannah
City Hall, 402 Court Street
Savannah, MO 64485
816-324-3315
816-324-5997 (fax)
http://www.savannahmo.net/
Hours: Monday-Thursday, 8 a.m. to 5 p.m.
Friday 8 a.m. to 4 p.m.

Mayor: Billy Kretzer
Email: bksav@savannahmo.net
816-324-3315
West Ward Alderman: Ellen Bolger
West Ward Alderman: Troy Graham
East Ward Alderman: Greg Gabler
East Ward Alderman: Connie George

Savannah City Administration:

City Clerk/Administrator: Janice Hatcher
jhatcher@savannahmo.net
816-324-7503

Directory of Utility Accounts: Roxie Dunn
roxie@ponyexpress.net
816-324-3315

Deputy City Clerk/Treasurer: Beth Kar
Email: savannah@ponyexpress.net
816-324-7501

Street Department:
Director of Public Works: Kenny Lance
816-324-7528

Water Department:
Superintendent Dale Watson
816-324-7529

Wastewater Department:
Superintendent Jason Long
wasteh2o@ponyexpress.net
816-324-7530

Andrew County Administration:

Andrew County Clerk	816-324-3624
Andrew County Commissioner	816-324-5716
Andrew County Health Department	816-324-3139

5.5.4 Federal Agency Officials

Steve Gilmore
Conservation and Environmental Protection Division
Farm Service Agency
Commodity Credit Corporation
U.S. Department of Agriculture
Room 4725, Stop 0513, South Agriculture Building
1400 Independence Avenue, SW
Washington, DC 20250-0513
202-720-5104
Steve.Gilmore@usda.gov

Don Steck
Conservation and Environmental Protection Division
Farm Service Agency
Commodity Credit Corporation
U.S. Department of Agriculture
Room 4725, Stop 0513, South Agriculture Building
1400 Independence Avenue, SW
Washington, DC 20250-0513
202-690-0224
don.steck@wdc.usda.gov

Jeff Field
Drinking Water Branch
U.S. Environmental Protection Agency, Region VII
901 North Fifth Street
Mail Code WWPD/DWGW
Kansas City, KS 66101
913-551-7548

5.5.5 State Agency Officials

Aaron Schmidt
Department of Energy Unit Chief
Hazardous Waste Program
Federal Facilities Section
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176
573-751-3154 or 573-751-3907
573-526-5268 (fax)
aaron.schmidt@dnr.mo.gov

Shawn Muenks, Environmental Engineer
Hazardous Waste Program
Federal Facilities Section
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176
573-751-3107 or 573-751-3907
573-526-5268 (fax)
shawn.muenks@dnr.mo.gov

Ramona J. Huckstep, M.S.
Community Involvement Coordinator
Hazardous Waste Program
Missouri Department of Natural Resources
P.O. Box 176
Jefferson City, MO 65102-0176
573-522-1540
573-526-5268 (fax)
Ramona.huckstep@dnr.mo.gov

5.5.6 Citizens and Other Interested Parties

Savannah R-3 School District
408 West Market Street
Savannah, Missouri 64485
816-324-3144
Superintendent: Dr. Don Lawrence
Asst. Superintendent: Dr. Kirk Mallette
malletk@mail.savannah.k12.mo.us

Minnie Cline Elementary
808 W. Price
Savannah, Missouri 64485
816-324-3915
Principal: Vickey Rainey

Savannah Middle School
701 W. Chestnut
Savannah, Missouri 64485
816-324-3126
Principal: Leisa Blair

Savannah High School
701 W. William
Savannah, Missouri 64485
816-324-3128
Principal: Steve Kellepouris

Robert L. Caldwell
County Executive Director
Andrew County Farm Service Agency
105 W. US Highway 71
Savannah, MO 64485
816-324-3196
816-324-5879 (fax)

Savannah Area Chamber of Commerce
411 Court Street, P.O. Box 101
Savannah, MO 64485
816-324-3976
816-324-5728 (fax)
Chamber web site:
www.savannahmochamber.com
Email: schamber@ccp.com

5.5.7 Newspapers

Savannah Reporter
115 South 4th Street
Savannah, MO 64485
816-324-3149
www.readthereporter.com

St. Joseph News-Press
825 Edmond Street
St. Joseph, MO 64501
800-779-6397
816-271-8500
www.stjoelive.com

5.6 Argonne Contacts

Lorraine M. LaFreniere, Ph.D.
Manager, Applied Geosciences and
Environmental Management Section
Environmental Science Division
9700 South Cass Avenue
Argonne, IL 60439-4843
630-252-7969
lafreniere@anl.gov

James Hansen
Community Relations Representative
Environmental Science Division
Argonne National Laboratory
955 L'Enfant Plaza SW, Suite 6000
Washington, DC 20024
202-488-2453
hansenj@anl.gov

Robert A. Sedivy
Savannah Project Manager
Environmental Science Division
9700 South Cass Avenue
Argonne, IL 60439-4843
630-252-9609
402-465-9021
rsedivy@anl.gov

6 Health and Safety

The general health and safety plan for use at Savannah is in Section 3 of the *PMWP* (Argonne 2007). The general plan addresses all anticipated safety issues for the activities to be conducted. Specific emergency information for use at Savannah is in Figure 6.1 and Table 6.1.

Andrew County has 911 service for all emergency responses. The Andrew County Ambulance District office, which responds to 911 calls, is located in Savannah. Major medical services are provided by the Heartland Regional Medical Center in St. Joseph, Missouri, approximately 16 mi south of the town (Figure 6.1).

Savannah has a local medical clinic, located within 2 mi of the former CCC/USDA grain storage facility, that is open from 8 a.m. to 5 p.m. on weekdays. The city is also served by municipal police and fire departments and is the site of the Andrew County Sheriff's Office.

TABLE 6.1 Emergency information for the investigation at Savannah.[a]

Resource	Telephone Number	Name
All Emergencies	911	Andrew County 911
Hospital, Poison Control	816-271-6000	Heartland Regional Medical Center[b] 5325 Faraon Street St. Joseph, MO 64506
Medical Services	816-324-3121	Savannah Medical Clinic 803 West Hwy. 71 Savannah, MO 64485
Police (nonemergency)	816-324-7541	Savannah Police Department 402 Court Street Savannah, MO 64485
Sheriff (nonemergency)	816-324-4114	Andrew County Sheriff
Industrial Hygiene	630-252-3310	Argonne-Industrial Hygiene
Safety	630-252-2885	EVS Division[c] Field Safety Coordinator (Monte Brandner)
	630-252-3294	EVS Division[c] Environmental, Safety, and Health Coordinator (Dave Peterson)
Management	630-252-7969	AGEM Program Manager (Lorraine LaFreniere)
	630-252-1275 630-408-7114	AGEM Field Project Manager (David Surgnier) (cellular)
	630-252-9609 402-465-9021	AGEM Technical Project Manager (Robert Sedivy)
Security	 630-252-5737 630-252-5731	Argonne-Operations Security Workdays After hours and weekends
Utilities Survey	800-344-7483 800-DIG RITE	Missouri Location Service

[a] Post this table in the field operations base.
[b] The route from Savannah to the Heartland Regional Medical Center in St. Joseph is shown in Figure 6.1.
[c] Environmental Science Division at Argonne.

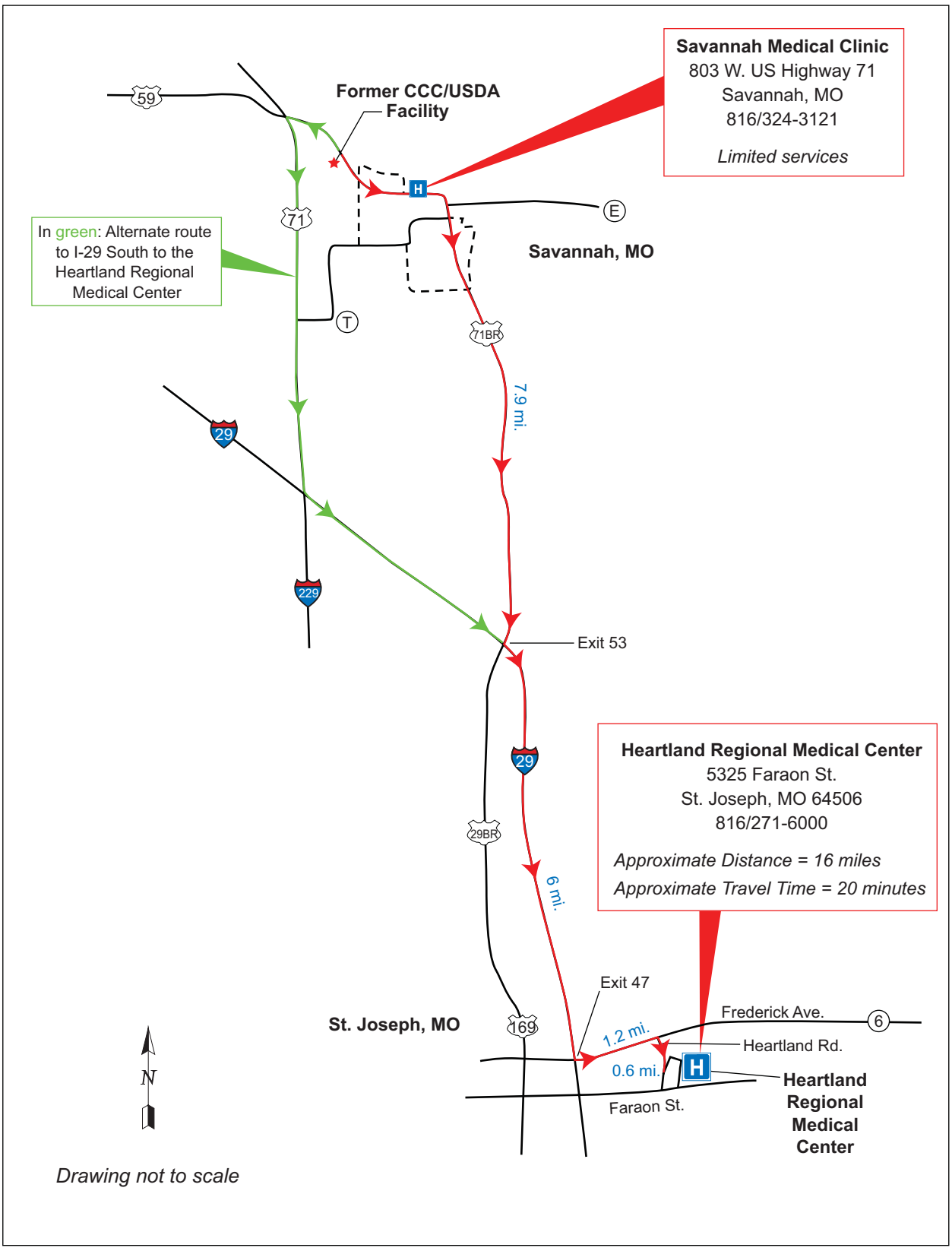


FIGURE 6.1 Emergency route from Savannah to Heartland Regional Medical Center, St. Joseph.

7 References

Alvarado, J.S., and C.M. 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.

Argonne, 2007, provisional master work plan for environmental investigations in Missouri, unpublished information based on *Final Master Work Plan: Environmental Investigations at Former CCC/USDA Facilities in Kansas, 2002 Revision*, ANL/ER/TR-02/004, prepared for Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, December 2002.

Caldwell, R., 2006, information provided by Caldwell (Executive Director, USDA Farm Service Agency–Savannah Service Center, Andrew County, Missouri) during an interview with R. Sedivy (Argonne National Laboratory, Argonne, Illinois), at the Savannah Farm Service Agency office, November 14.

CCC/USDA, 2006, electronic mail message from S. Gilmore (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.) to L. LaFreniere (Argonne National Laboratory, Argonne, Illinois), citing information provided by the Missouri Department of Natural Resources; carbon tetrachloride had been detected at 22 μg/L in the Charles Morgan private well in sampling performed on June 28, 2005.

EPA, 1999, private well sampling data pages for Savannah, Missouri, U.S. Environmental Protection Agency, Washington, D.C.

Erickson, L., 2006, information provided by Erickson (Hazardous Waste Program, Division of Environmental Quality, Missouri Department of Natural Resources, Jefferson City, Missouri), during a meeting with representatives of the CCC/USDA and Argonne at Missouri Department of Natural Resources offices, December 7.

Fuller, D., J. McMillen, H. Pick, W. Russell, and J. Wells, 1957, *Water Possibilities from the Glacial Drift of Andrew County*, Water Resources Report 15, Missouri Geological Survey and Water Resources, Rolla, Missouri.

GSA, 1975, quitclaim deed executed by the U.S General Services Administration, transferring 2.17 acres of excess Government property described as the "former Savannah bin site," from the U.S. Department of Health, Education, and Welfare to the Reorganized School District No. III, Andrew County, Missouri, January 15.

Hatcher, J., 2007a, information provided by Hatcher (City Administrator/City Clerk, Savannah, Missouri) during an interview with R. Sedivy and J. Hansen (Argonne National Laboratory, Argonne, Illinois), at the Savannah City Hall, March 6.

Hatcher, J., 2007b, electronic mail message from Hatcher (City Administrator/City Clerk, Savannah, Missouri) to R. Sedivy (Argonne National Laboratory, Argonne, Illinois), regarding questions on the Savannah water system, August 15.

Heim, G., J. Martin, and W. Howe, 1959, *Groundwater Resources of Nodaway County, Missouri*, Water Resources Report 16, Missouri Geological Survey and Water Resources, Rolla, Missouri.

Heim, G., Martin, J., and W. Howe, 1960, *Groundwater Resources of Holt County, Missouri*, Missouri Geological Survey and Water Resources, Water Resources Report 17.

Howe, W., 1968, *Guidebook to Pleistocene and Pennsylvanian Formations in the St. Joseph Area, Missouri*, Missouri Geological Survey and Water Resources, prepared for the Association of Missouri Geologists 15th Annual Field Trip and Meeting, October 4-5, 1968 (http://www.missourigeologists.org/EarlierGuidebooks/Guidebook1968.pdf).

Langer, W., Smith, D., Brady, L., Melick, R., and H. Knepper, 2002, *Geologic Map of the Saint Joseph Area, Missouri and Kansas*, United States Geological Survey, Miscellaneous Field Studies Map MF-2374, Version 1.0.

Mallette, K., 2007, information provided by Mallette (Assistant Superintendent of the Savannah R-III School District, Savannah, Missouri) during an interview with R. Sedivy and J. Hansen

(Argonne National Laboratory, Argonne, Illinois), at the school district office, Savannah, Missouri, March 5.

McQueen, H., and F. Green, 1938, *The Geology of Northwestern Missouri*, Volume XXV, Second Series, Missouri Geological Survey and Water Resources, Rolla, Missouri.

MoDNR, 2000a, *Preliminary Assessment Report, Savannah Former CCC/USDA Grain Bins Andrew County, Missouri MOSFN0703496*, Hazardous Waste Program, Division of Environmental Quality, Missouri Department of Natural Resources, Jefferson City, Missouri, March 31.

MoDNR, 2000b, *Site Inspection Report, Savannah Former CCC/USDA Grain Bins Andrew County, Missouri MOSFN0703496*, Hazardous Waste Program, Division of Environmental Quality, Missouri Department of Natural Resources, Jefferson City, Missouri, September 28.

MoDNR, 2005, *Missouri Well Construction Rules — Private Water Wells, Heat Pump Systems, Pump Installations and Monitoring Wells*, Division of Environmental Quality, Missouri Department of Natural Resources, Jefferson City, Missouri, November.

NAIP, 2006, *Compressed County Mosaic, Andrew County, Missouri*, naip_1-1_2n_s_mo003_2006_1, National Agriculture Imagery Program, Aerial Photography Field Office, Farm Service Agency, U.S. Department of Agriculture, Salt Lake City, Utah, August 16.

USDA, 1960, aerial photograph CCC-YAA-1960C, U.S. Department of Agriculture, Washington, D.C., November 17.

USDA, 1974, aerial photograph 29003-174-59A, U.S. Department of Agriculture, Washington, D.C., September 5.

USDA, 1981, aerial photograph 27003-181-70EC, U.S. Department of Agriculture, Washington, D.C., September 9.

Appendix A:

Property Ownership Records

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SA-VII-3 (FY 1975)

QUITCLAIM DEED

THIS INDENTURE, made this 15th day of January, 1975, between the United States of America, GRANTOR, acting by and through the Secretary of Health, Education, and Welfare, by the Regional Director for Region VII of the Department of Health, Education, and Welfare, under and pursuant to the powers and authority contained in the Federal Property and Administrative Services Act of 1949, as amended (63 Stat. 377) (hereinafter called the Act), and the Civil Rights Act of 1964 and the regulations promulgated thereunder, and The Reorganized School District No. III - Andrew County, Missouri, GRANTEE.

W I T N E S S E T H

WHEREAS, by letter dated December 6, 1974, certain surplus real property consisting of 2.17 acres of land, more or less, identified as former Savannah Bin Site, Savannah, Missouri, hereinafter more fully described (hereinafter called the property), was assigned by the Regional Administrator of the General Services Administration to the Department of Health, Education, and Welfare for disposal upon recommendation of the Department that said property was needed for educational purposes in accordance with the provisions of the Act; and

WHEREAS, the GRANTEE has made a firm offer to purchase the said property under the provisions of the Act and has made application for 100 percent public benefit allowance; and proposes to use said property for educational purposes; and

WHEREAS, the General Services Administration has notified the Department of Health, Education, and Welfare that no objection will be interposed to the transfer of the said property to the GRANTEE; and

WHEREAS, the GRANTOR has accepted the offer of the GRANTEE,

NOW, THEREFORE, the GRANTOR, for an in consideration of the foregoing and of the observance and performance by the GRANTEE of the covenants, conditions, and restrictions hereinafter contained and other good and valuable consideration, receipt of which is hereby acknowledged, has remised, released, and forever quitclaimed and by these presents does remise, release, and

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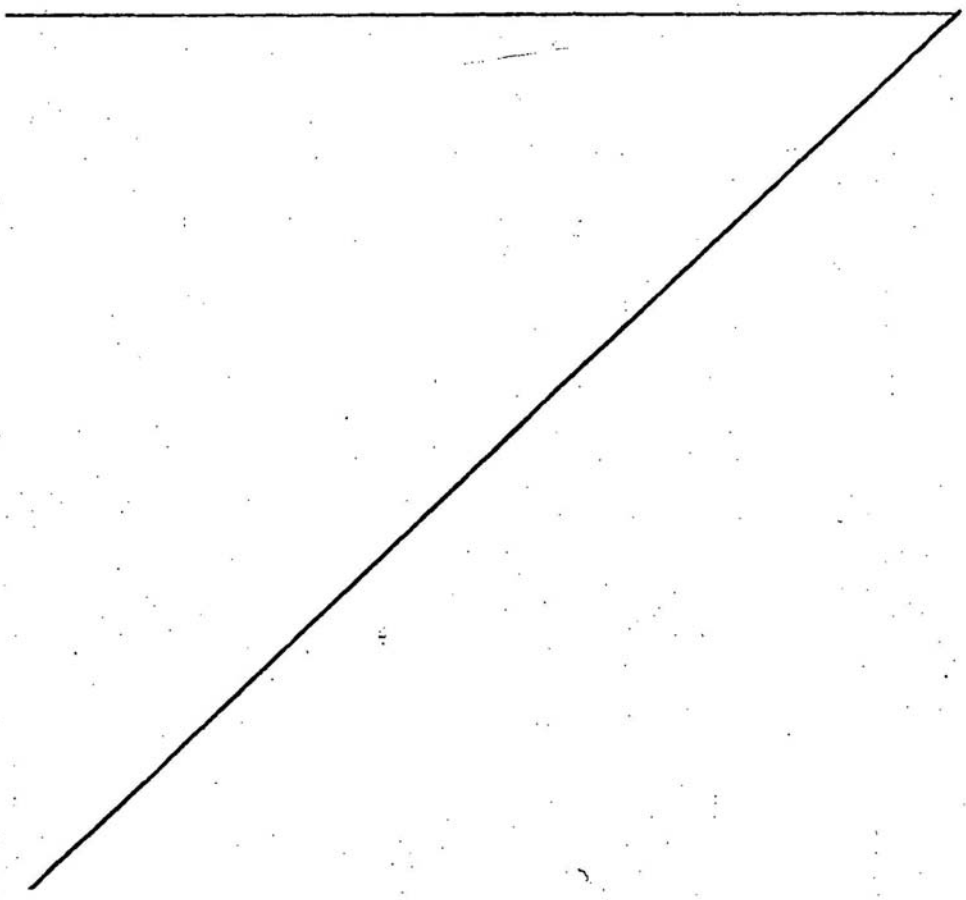
forever quitclaim to the said GRANTEE, its successors and assigns forever, all right, title, interest, claim, and demand which the said GRANTOR has in and to the following described property reserving and excepting such rights to the GRANTOR as may be contained in the conditions subsequent hereinafter expressed, situate, lying, and being in the County of Andrew _____, State of Missouri _____, to wit:

Beginning at a point that is 5 chains East and 12 chains North of the Southwest (SW) corner of the Southeast (SE) Quarter (1/4) of Section 5, Township 59, Range 35, thence East 7.815 chains to the West line of U.S. Highway 71, thence North 24 degrees and 45 minutes West along the West line of said highway 3.31 chains, thence West 6.395 chains, thence South 3.05 chains to the point of beginning, containing 2.17 acres, more or less.



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Premises described hereinbefore and conveyed by this quitclaim deed are transferred subject to all easements, licenses, and permits, including those for roads, highways, railways, pipelines, and sewers, for power, telephone, gas, and water lines, and for any other public and private utilities. With respect to any such easements, licenses, and permits, the GRANTEE, by acceptance of this quitclaim deed or any rights hereunder, assumes all rights, duties, and obligations of the GRANTOR.

TO HAVE AND TO HOLD the foregoing described property provided, however, that this deed is made and accepted upon each of the following conditions subsequent, which shall be binding upon and enforeable against the GRANTEE, its successors or assigns, and each of them, as follows:

1. That for a period of thirty (30) years from the date of this deed the above-described property herein conveyed shall be utilized continuously for educational purposes in accordance with the proposed program and plan as set forth in the application of the GRANTEE dated July 15, 1974, ~~xxxxxxxxxx~~ and for no other purpose.
2. That during the aforesaid period of thirty (30) years, the GRANTEE will resell, lease, mortgage, or encumber, or otherwise dispose of the above-described property or any part thereof or interest therein only as the Department of Health, Education, and Welfare or its successor in function, in accordance with its existing regulations, may authorize in writing.
3. That one year from the date of this deed and annually thereafter for the aforesaid period of thirty (30) years, unless the Department of Health, Education, and Welfare or its successor in function otherwise directs, the GRANTEE will file with the Department of Health, Education, and Welfare or its successor in function reports on the operation and maintenance of the above-described property and will furnish, as requested, such other pertinent data evidencing continuous use of the property for the purpose specified in the above-identified application.

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4. That for the period during which the above-described property is used for a purpose for which the Federal financial assistance is extended by the Department or for another purpose involving the provision of similar services or benefits, the GRANTEE hereby agrees that it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352) and all requirements imposed by or pursuant to the Regulation of the Department of Health, Education, and Welfare (45 CFR Part 80) issued pursuant to that title and as in effect on the date of this deed, to the end that, in accordance with Title VI of that Act and the Regulation, no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under the program and plan referred to in condition number 1 above or under any other program or activity of the GRANTEE, its successors or assigns, to which such Act and Regulation apply by reason of this conveyance.

In the event of a breach of any of the conditions set forth above, whether caused by the legal or other inability of said GRANTEE, its successors or assigns, to perform any of the obligations herein set forth, all right, title, and interest in and to the above-described property shall, at its option, revert to and become the property of the United States of America, which shall have an immediate right of entry thereon, and the GRANTEE, its successors or assigns, shall forfeit all right, title, and interest in and to the above-described property and in any and all of the tenements, hereditaments, and appurtenances thereunto belonging; PROVIDED HOWEVER, that the failure of the Department of Health, Education, and Welfare, or its successor in function, to insist in any one or more instances upon complete performance of any of the said conditions shall not be construed as a waiver

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or a relinquishment of the future performance of any such conditions, but the obligations of the GRANTEE with respect to such future performance shall continue in full force and effect; PROVIDED FURTHER, that in the event the United States of America fails to exercise its option to re-enter the premises for any such breach of conditions subsequent numbered 1, 2, and 3 herein within 31 years from the date of this conveyance, conditions numbered 1, 2, and 3 herein, together with all rights of the United States of America to re-enter as in this paragraph provided with respect to conditions numbered 1, 2, and 3 herein, shall, as of that date, terminate and be extinguished; PROVIDED FURTHER, that the expiration of conditions numbered 1, 2, and 3 and the rights to re-enter shall not affect the obligation of the GRANTEE, its successors and assigns with respect to condition numbered 4 herein or the right reserved to the United States of America to re-enter for breach of said condition.

The GRANTEE, by acceptance of this deed, covenants and agrees for itself, its successors and assigns, and every successor in interest to the property herein conveyed or any part thereof--which covenant shall attach to and run with the land for so long as the property herein conveyed is used for a purpose for which the Federal financial assistance is extended by the Department or for another purpose involving the provision of similar services or benefits and which covenant shall in any event, and without regard to technical classification or designation, legal or otherwise, be binding to the fullest extent permitted by law and equity, for the benefit and in favor of and enforceable by the GRANTOR and its successors against the GRANTEE, its successors and assigns, and every successor in interest to the property, or any part thereof--that it will comply with Title VI of the Civil Rights Act of 1964 (P.L. 88-352) and all requirements imposed by or pursuant to the Regulation of the Department of Health, Education, and Welfare (45 CFR Part 80) issued pursuant to that title and as in effect on the date of this deed, to the end that, in accordance with Title VI of that Act and the Regulation, no person in the United States shall, on the ground of race,

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color, or national origin, be excluded from participation in, be denied the benefits of, or be otherwise subjected to discrimination under the program and plan referred to in condition numbered 1 above or under any other program or activity of the GRANTEE, its successors or assigns, to which such Act and Regulation apply by reason of this conveyance.

The GRANTEE, by the acceptance of this deed, further covenants and agrees, for itself, its successors and assigns, that in the event the property conveyed hereby is sold, leased, mortgaged, encumbered, or otherwise disposed of, or is used for purposes other than those set forth in the above-identified program and plan without the consent of the Department of Health, Education, and Welfare, all revenues or the reasonable value, as determined by the Department of Health, Education, and Welfare, or benefits to the GRANTEE deriving directly or indirectly from such sale, lease, mortgage, encumbrance, disposal, or use (or the reasonable value as determined by the Department of Health, Education, and Welfare of any other unauthorized use) shall be considered to have been received and held in trust by the GRANTEE for the GRANTOR and shall be subject to the direction and control of the Department of Health, Education, and Welfare.

~~The GRANTEE, by the acceptance of this deed, further covenants and agrees for itself, its successors and assigns, that during the aforesaid period of thirty (30) years (i) all revenues, bonuses, delayed rentals, royalties, or other payments from oil and gas leases, or other instruments with respect to oil and gas on or under the described property, shall be received in trust for and promptly paid to the United States of America; (ii) all net revenues and proceeds resulting from the production of oil and gas by the GRANTEE, its successors and assigns, shall be received in trust for and promptly paid to the United States of America; and in addition thereto the United States of America reserves the right during said period of thirty (30) years to re-enter and revest title to any and all oil and gas or interest therein including the right to prospect for and produce such oil and gas.~~

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The GRANTEE, by the acceptance of this deed, further covenants and agrees, for itself, its successors and assigns, that if the GRANTEE, its successors and assigns, shall cause any of said improvements to be insured against loss, damage, or destruction and any such loss, damage, or destruction shall occur during the period GRANTEE holds title to said property subject to said conditions numbered 1, 2, and 3, said insurance and all moneys payable to the GRANTEE, its successors or assigns, thereunder shall be held in trust by the GRANTEE, its successors or assigns, and shall be promptly used by the GRANTEE for the purpose of repairing such improvements and restoring the same to their former condition and use or for the purpose of replacing said improvements with equivalent or more suitable improvements or, if not so used, shall be paid over to the Treasurer of the United States in an amount not exceeding the unamortized public benefit allowance of the buildings, structures, or improvements lost, damaged, or destroyed.

The GRANTEE, by the acceptance of this deed, further covenants and agrees, for itself, its successors and assigns, that the United States of America shall have the right during any period of emergency declared by the President of the United States or by the Congress of the United States to the full unrestricted possession, control, and use of the property hereby conveyed, or of any portion thereof, including any additions or improvements thereto made subsequent to this conveyance. Prior to the expiration or termination of the 30-year period of restricted use by the GRANTEE, such use may be either exclusive or non-exclusive and shall not impose any obligation upon the Government to pay rent or any other fees or charges during the period of emergency, except that the Government shall (i) bear the entire cost of maintenance of such portion of the property used by it exclusively or over which it may have exclusive possession or control, (ii) pay the fair share, commensurate with the use, of the cost of maintenance of such of the property as it may use non-exclusively or over which it may have non-exclusive possession or control, (iii) pay a fair rental for the use of improvements or additions to the premises made by the GRANTEE without Government aid, and (iv) be responsible for any damage to the property caused by its use--reasonable wear and tear and acts of God and the common enemy excepted.

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Subsequent to the expiration or termination of the 30-year period of restricted use, the obligations of the Government shall be as set out in the preceding sentence, and, in addition, the Government shall be obligated to pay a fair rental for all or any portion of the conveyed premises which it uses.

In the event title to the above-described premises is reverted to the United States of America for noncompliance or voluntarily reconveyed in lieu of reverter, the GRANTEE, at the option of the Department of Health, Education, and Welfare, or its successor in function, shall be responsible and shall be required to reimburse the United States of America for the decreased value of the above-described property not due to reasonable wear and tear, to acts of God, or to alterations and conversions made by the GRANTEE to adapt the property to the use for which the property was acquired. The United States of America shall, in addition thereto, be reimbursed for such damages, including such costs as may be incurred in recovering title to or possession of the above-described property, as it may sustain as a result of the noncompliance.

The GRANTEE, by the acceptance of this deed, covenants and agrees for itself, and its successors and assigns, that in the event the GRANTOR exercises its option to revert all right, title and interest in the property to the GRANTOR, then the GRANTEE shall provide protection and maintenance of said property at all times until such time as the title is actually reverted to GRANTOR, including the period of any notice of intent to revert. Such protection and maintenance shall, at a minimum conform to the standards prescribed by General Services Administration in its regulations FPMR 101-47.4913 (41 CFR Part 101) in effect as of the date of this deed, a copy of which is attached to the GRANTEE'S application dated July 15, 1974, previously incorporated herein.

The GRANTEE may secure abrogation of the conditions subsequent numbered 1, 2, and 3 herein by:

a. Obtaining the consent of the Department of Health, Education, and Welfare, or its successor in function; and

b. Payment to the United States of America in accordance with the following conditions:

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(i) If abrogation is requested by the GRANTEE for the purpose of making the property or a portion thereof available to serve the needs or purposes of a third party, payment shall be based upon the current fair value, as of the date of any such requested abrogation, of the property to be released from the conditions and restrictions, less amortized credit at the rate of 3-1/3 percent of the public benefit allowance granted on the original fair market value for each twelve (12) months during which the property has been utilized in accordance with purposes specified in the above-identified application.

(ii) If abrogation is requested by the GRANTEE for the purpose of making the property available as security for financing of new construction, for acquiring substitute or better facilities, or for relocating elsewhere, all for the purpose of further advancing or promoting the program specified in the above-identified application, payment shall be based upon the public benefit allowance granted to the GRANTEE of 100 percent from the fair value of $ 5,400.00 , as of the date of this instrument, less a credit at the rate of 3-1/3 percent of the public benefit allowance granted for each twelve (12) months during which the property has been utilized in accordance with the purpose specified in the above-identified application; PROVIDED, HOWEVER, the GRANTEE shall execute such agreement, supported by surety bond or other security that may be deemed by the Department to be necessary or advisable, to assure that the proceeds of sale obtained by GRANTEE in any disposal of any portion of the property for effectuating one or another of

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the aforesaid purposes for which abrogation is requested, will be devoted to the program use specified in the above-identified application.

IN WITNESS WHEREOF, the parties hereto have caused this instrument to be executed this 15th day of January, 1975.

UNITED STATES OF AMERICA
Acting by and through the Secretary of Health, Education, and Welfare,
GRANTOR

By Max Milo Mills
Max Milo Mills, Regional Director
Region VII, Department of Health, Education, and Welfare

WITNESSES:
Robert H. Hurst
Frederic N. Dickens

ACKNOWLEDGMENT

STATE OF MISSOURI)
)ss
COUNTY OF JACKSON)

Be it remembered that on this 15th day of January, 1975, before me Margaret M. Burns, a Notary Public in and for Jackson County, Missouri, personally appeared Max Milo Mills, Regional Director for the Department of Health, Education, and Welfare, Region VII, who is personally known to me, and who is known to me to be the Regional Director for the Department of Health, Education, and Welfare, and as the identical person whose name is affixed to the foregoing instrument, and he duly acknowledged the execution of the same for and on behalf of and as the free act and deed of the United States of America, acting by and through the Secretary of Health, Education, and Welfare.

IN WITNESS WHEREOF, I have hereunto set my hand and affixed my seal at Kansas City, Missouri, the day and year last above written.

Margaret M. Burns
Notary Public

MARGARET M. BURNS NOTARY PUBLIC JACKSON COUNTY, MO.

My commission expires 7-27-76.

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ACCEPTANCE

The foregoing instrument is hereby accepted by The Reorganized School District No. III - Andrew County, Missouri, which agrees by this acceptance to assume and be bound by all of the obligations, conditions, covenants, and agreements therein contained.

THE REORGANIZED SCHOOL DISTRICT No. III
Andrew County, Missouri

By Steven P. Watkins

Title Superintendent
Authorized Representative

STATE OF MISSOURI }
COUNTY OF ANDREW } ss.

I, Cameron F. Fuller, Recorder within and for the county aforesaid, hereby certify that the instrument of writing hereunto attached with the certificate thereon, was filed for record in my office on the 17 day of Jan. 19 75, at 1 o'clock 05 minutes, P. M., and the same is duly recorded in office book 273 at page 78

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the Seal of said office. Done at Savannah, this 17 day of January 1975

Cameron F. Fuller
Circuit Clerk and Recorder.

By Rose Lowery Deputy.

Appendix B:

AGEM-29 – Standard Operating Procedure for Rotary-Percussion Drilling of Hard Paved Surfaces, with Measurement of Possible Sub-Slab Vapor Concentrations

Appendix B:

AGEM-29 – Standard Operating Procedure for Rotary-Percussion Drilling of Hard Paved Surfaces, with Measurement of Possible Sub-Slab Vapor Concentrations

B.1 Purpose and Scope

This standard operating procedure (SOP) describes a method for the penetration of hard paved surfaces (including concrete foundations, roadways, and walkways) to facilitate the investigation or sampling of materials (soils, soil gases, groundwater, etc.) underlying these surfaces. The procedure describes the use of a rotary-percussion drilling method to advance a roughly circular hole into and through the paved surface. Penetration of the surface is achieved by a combination of hammer percussion and slow rotation of the drill bit, which progressively chip away small fragments of the hard surface. This method permits penetration without (1) the generation of excessive heat or (2) a requirement for the use of water or other coolants that might adversely affect the physical or chemical properties of the sub-pavement materials targeted for investigation or sampling.

The specific drilling procedure outlined here is designed for use with (1) the Argonne 540B portable Geoprobe (with power unit), equipped with a GH40 rotary-percussion hydraulic hammer, and (2) standard Geoprobe drill bits and related components. The key elements of this procedure are sufficiently generic, however, to permit their adaptation for use with similar equipment (from Geoprobe or other manufacturers) designed for rotary-percussion drilling through hard surfaces.

If the pavements being investigated are known or suspected to overlie soils or groundwater contaminated with carbon tetrachloride (or other volatile organic contaminants), the potential may exist for local accumulation of gases or vapors in the soils beneath the (relatively impermeable) paved surfaces. This SOP, therefore, includes a method for the detection and preliminary (non-compound-specific) quantitation of possible sub-pavement gases that might be encountered upon breaching of the surface being drilled. The detection method relies on the use of a portable photoionization detector (PID).

This SOP does not present instructions for routine operation of the Geoprobe equipment or the PID; all equipment is to be used in accord with the operating, maintenance, and safety requirements specified by the manufacturers.

B.2 Equipment and Supplies

The field equipment and materials needed for pavement drilling may include the following:

- Model 540B Geoprobe with hydraulic hammer and power unit (or similar)
- Drill steels (lengths 24 in. to 48 in., as required)
- Anvil retainer cap assembly
- Carbide-tipped drill bits (diameters 1.5 in. to 2.5 in., as required)
- Traffic cones, warning signs, caution tape (or other suitable equipment to demark and restrict access to the drilling location)
- Logbook and record-keeping supplies
- Decontamination supplies

The field equipment and materials needed for preliminary detection and measurement of possible sub-slab gases may include the following:

- Hand-held PID equipped with 11.7-eV lamp (required for detection of carbon tetrachloride)
- Calibration gas, gas regulator, and related supplies
- Teflon or Teflon-lined PID inlet probe extension tubing

- Logbook and record-keeping supplies

- Decontamination supplies

B.3 Health and Safety

All activities described in this SOP are to be performed in accord with the health and safety requirements outlined in the *Master Work Plan*, in the site-specific work plan and health and safety plan, and in the manufacturers' operating and safety instructions for the specific drilling equipment and PID instrument being used. All members of the field party of equipment operators must review and become familiar with these documents. The documents are to be maintained at the site during the field activities.

B.3.1 Working Alone

The activities described in this SOP are not to be performed by individuals working alone. A minimum field party of two equipment operators, plus one observer/safety monitor, is required for all pavement drilling operations conducted under this SOP.

Personnel in the immediate vicinity of the drilling location during the activities described in this SOP should be limited to the required field party. Traffic cones, signs, caution tape, or other suitable methods should be used to delineate and restrict access to the drilling site while the drilling operations are in progress.

B.3.2 Personal Protective Equipment

At a minimum, personal protective equipment for the field party members during drilling operations will include the following:

- Hard hats

- Safety glasses

- Safety shoes
- Heavy work gloves
- Hearing protection (during operation of the drilling equipment)

B.3.3 Air Monitoring for Contaminant Levels

During operation, the ambient air to which workers are exposed is to be monitored for volatile organic contaminants. The built-in capabilities of the PID instrument are to be used, according to the manufacturer's instructions, to activate an alarm automatically when the exposure limits are reached.

An indication of a concentration above the Threshold Limit Value — Short Term Exposure Limit guideline of the American Conference of Governmental Industrial Hygienists is to result in protective action, beginning immediately and continuing until the contaminant values fall below the action level. The protective actions are to consist of additional compound-specific sampling, increased ventilation, evacuation of the area, or a combination of these.

B.4 Procedures

The methods to be used for drilling of pavements and the determination of possible sub-slab gas concentrations are outlined in this section.

B.4.1 Preparation

The following procedure is to be used in preparation for the drilling operation:

- Record in the project logbook all project data, including the site name, date and time, and names of field party personnel.
- Determine the thickness of the pavement to be drilled at its edge, if possible, by probing or digging to obtain an estimate of the penetration depth required

at the chosen drilling location within the pavement. Record this thickness in the project logbook.

- Select a boring location, preferably away from obvious fractures or as required to meet program needs. Record the specific drilling location in the project logbook.

- Assemble a clean drill steel (of sufficient length), carbide-tipped bit (of sufficient diameter), and anvil retainer cap per manufacturer instructions; confirm that all threaded connections are tight. Record in the project logbook the size and type of drill steel and bit used.

- Prepare the Geoprobe, power unit, and hydraulic hammer; test for proper operation.

- Position the Geoprobe mast over the intended drilling location.

- Position traffic cones, caution tape, etc. to identify the drilling area; restrict access to this area to required personnel only.

- Calibrate the PID instrument by using isobutylene or another recommended gas per the manufacturer's instructions.

- Enter the appropriate correction factor(s) on the calibrated PID, for the most probable contaminant species expected at the site.

- Attach Teflon or Teflon-lined extension tubing to the PID inlet port in sufficient length to permit gas sampling from a level immediately above the exposed soil surface at the bottom of the completed pavement boring.

- Check the PID response. Unstable zero readings or a response to moisture or movement of the instrument may indicate a need to clean the lamp.

- Obtain a "clean air" reading daily, before testing for possible contamination at the target drilling location(s).

- Record, in the project logbook and in the dedicated equipment logs (if available), all relevant drilling equipment and PID information, including calibration results and descriptions of required maintenance activities.

B.4.2 Pavement Drilling

The following procedure is to be used for the pavement drilling operation:

- Install the drill steel and bit assembly on the hydraulic hammer.

- Set the hammer/rotation selector on the drilling unit to provide the slowest counterclockwise rotation speed possible in the hammer mode. (Excessive rotation speed will lead to premature bit wear.)

- Lower the hammer until static weight is just barely applied to the drill steel and bit. Then raise the hammer approximately 1-2 in. to allow the drill steel to move freely within the drive unit while still maintaining contact with the pavement surface. With the drive controls disengaged, check for adequate travel by manually raising and lowering the drill steel.

- Activate the hydraulic hammer, with rotation.

- Slowly lower the hammer to obtain the optimum amount of downward force on the drill steel. A defined "thudding" sound and a metallic "pinging" will be noted when the correct amount of force is applied; under this condition, the bit is quickly striking and then rebounding from the pavement while the drill steel vibrates freely within the hammer drive. Muffled "thumping" with possible stoppage of the bit rotation or excessive "clanging" sounds with sporadic hammer contact indicate, respectively, that too much or too little static weight is being applied.

- Adjust the position of the hammer up or down in small increments, as necessary, to maintain the proper drilling force as the bit advances into the pavement.

- If unacceptable heating of the surface or drilling equipment is noted, temporarily discontinue drilling until temperatures return to appropriate levels. Retract the drill bit with rotation to help prevent binding of the bit in the hole.

- If penetration is impeded because of the presence of rebar or other obstacles within the pavement, retract the drill bit with rotation. Reposition the Geoprobe approximately 1 ft from the original drilling location, and repeat the preceding steps to initiate drilling at the new location.

- Upon penetration of the surface, retract the drill bit with rotation. Measure and record the actual drilled depth in the project logbook.

- Disassemble the drill steel and bit assembly, and decontaminate as necessary if the equipment is to be used for the drilling of additional locations.

B.4.3 Measurement of Sub-Pavement Vapor Concentrations

The following procedure is to be used for measurement of sub-pavement vapor concentrations:

- Immediately following the withdrawal of the drilling bit from the completed pavement boring, insert the inlet extension tubing of the PID meter to a level just above the surface of the soil exposed at the bottom of the boring.

- Operate the PID inlet sampling pump for a sufficient period (based on the calculated volume of the inlet extension tubing) to completely flush the inlet tubing.

- Continue to operate the PID inlet pump for 1 min. Record the highest concentration value observed in the project logbook.

- Decontaminate or remove and replace the PID inlet extension tubing, if necessary, if the instrument is to be used for readings at additional locations.

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