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ANL/EVS/AGEM/TR-08-14

Final Work Plan: Supplemental Upward Vapor Intrusion Investigation at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas

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

BGL	below ground level
CCC	Commodity Credit Corporation
cm^3	cubic centimeter(s)
DFA	difluoroethane
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
ft	foot (feet)
in.	inch(es)
ITRC	Interstate Technology and Regulatory Council
KDHE	Kansas Department of Health and Environment
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter
$\mu g/m^3$	microgram(s) per cubic meter
MCL	maximum contaminant level
mi	mile(s)
NELAC	National Environmental Laboratory Accreditation Conference
SRE	site reconnaissance and evaluation
USDA	U.S. Department of Agriculture
VOC	volatile organic compound

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1 Introduction

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

In 2007, the CCC/USDA conducted near-surface soil sampling at 61 locations and also sampled indoor air at nine residences on or adjacent to its former Hanover facility to address the residents' concerns regarding vapor intrusion. Low levels of carbon tetrachloride were detected at four of the nine homes. The results were submitted to the KDHE in October 2007 (Argonne 2007). On the basis of the results, the KDHE requested sub-slab sampling and/or indoor air sampling (KDHE 2007). This *Work Plan* describes, in detail, the proposed additional scope of work requested by the KDHE and has been developed as a supplement to the comprehensive site investigation work plan that is pending (Argonne 2008).

2 Project Technical Objective

Indoor air samples collected previously from four homes at Hanover were shown to contain the carbon tetrachloride at low concentrations (Table 2.1). It cannot be concluded from these previous data that the source of the detected carbon tetrachloride is vapor intrusion attributable to former grain storage operations of the CCC/USDA at Hanover.

TABLE 2.1 Carbon tetrachloride concentrations measured in indoor air at residences in Hanover, Kansas, July 2007.

Residence	Carbon Tetrachloride in Indoor Air (µg/m^3)
M. Goeckel	4.8
E. Meier	3.7
L. Jueneman	1.4
S. Jueneman	1.4
Bruna	ND[a]
Hagadorn	ND
J. Hyne,	ND
K. Hynek	ND
Poell	ND

[a] ND, carbon tetrachloride was not detected at the reporting limit of 1.3 µg/m^3 for U.S. Environmental Protection Agency Method TO-15.

The technical objective of the vapor intrusion investigation described here is to assess the risk to human health due to the potential for upward migration of carbon tetrachloride and chloroform into four homes located on or adjacent to the former CCC/USDA facility. The technical objective will be accomplished by collecting sub-slab vapor samples.

The preliminary data collected during the July 2007 investigation did not fully address the source of or migration pathway for the carbon tetrachloride detected in the four homes. The scope of work proposed here will generate additional data needed to help evaluate whether the source of the detected carbon tetrachloride is vapor intrusion attributable to activities of the CCC/USDA.

The additional vapor sampling at Hanover will be performed, on behalf of the CCC/USDA, by the Environmental Science Division of Argonne National Laboratory and H&P Mobile Geochemistry of San Diego (http://www.handpmg.com). Argonne is a nonprofit, multidisciplinary research center operated by UChicago Argonne, LLC, for the U.S. Department of Energy (DOE). The CCC/USDA has entered into an interagency agreement with DOE, under which Argonne provides technical assistance to the CCC/USDA with environmental site characterization and remediation at its former grain storage facilities. The professional staff members of H&P Mobile Geochemistry are nationally leading experts in soil gas sampling and vapor intrusion investigations.

3 Background and Previous Studies

Hanover, Kansas, is a rural city located in northeastern Washington County, in Section 9, Township 2 South, Range 5 East, approximately 78 mi northwest of Manhattan, Kansas, and 90 mi southwest of Lincoln, Nebraska (Figure 3.1). Hanover is a state historic site known for the Hollenberg Pony Express Station. The city has numerous small businesses, the Farmers Co-op Association, and a hospital. It also has a public school, a library, a weekly newspaper, a recreation facility, and churches.

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

Additional information on the site background and previous studies was documented previously (Argonne 2008). A summary of that information is below.

The findings of a comprehensive review of data from previous investigations of the Hanover site are summarized as follows:

- The CCC/USDA operated a grain storage facility from 1950 to the early 1970s on approximately 6.5 acres in the northeast part of the city. The facility reached its maximum operational scale in the late 1960s with 223 grain bins and 1 storage building. Nine residences are located on or adjacent to the former CCC/USDA property.

- In 1998, five private wells were sampled as part of the USDA private well sampling program and the subsequent KDHE site reconnaissance and evaluation (SRE; KDHE 1998). Carbon tetrachloride was found in groundwater at a concentration (5.9 µg/L) exceeding the MCL at one private well (Meyn). This result was confirmed in 2006 at a lower level (4.3 µg/L). The Meyn well is used for lawn and garden purposes and is approximately 1,000 ft west of the former CCC/USDA facility. Trace levels (approximately 1 µg/L) to no contamination was detected in groundwater samples collected from five private wells surrounding the former CCC/USDA facility.

- In July 1998, the KDHE collected 11 soil samples above the bedrock (9 samples at 10.5-11.5 ft BGL [below ground level] and 2 samples at 19.5 ft BGL) in a pre-CERCLIS SRE investigation. All soil samples showed trace or no carbon tetrachloride contamination, except for one collected at the west edge of the former CCC/USDA facility. A low level of carbon tetrachloride (7.1 µg/kg) was detected at 11.5 ft BGL at this location (SP-9).

- In April 2007, Argonne collected near-surface soil samples at 1.8-2.0 ft BGL at 61 locations across the former CCC/USDA facility. Analysis of soil samples using the heated-headspace method as a screening tool indicated four areas with slightly higher carbon tetrachloride concentrations. No contamination was found in analysis of the samples by the more rigorous gas chromatograph-mass spectrometer analytical method (purge-and-trap method).

- In July 2007, indoor air samples were collected from the basement areas of nine residences on or adjacent to the former CCC/USDA property. Carbon tetrachloride was detected in air samples from four residences at concentrations ranging from 1.4 µg/kg to 4.8 µg/kg.

- A search of property records and other documentation is under way to determine whether the former CCC/USDA property was used by other entities for grain storage after the CCC/USDA's lease ended in the early 1970s.

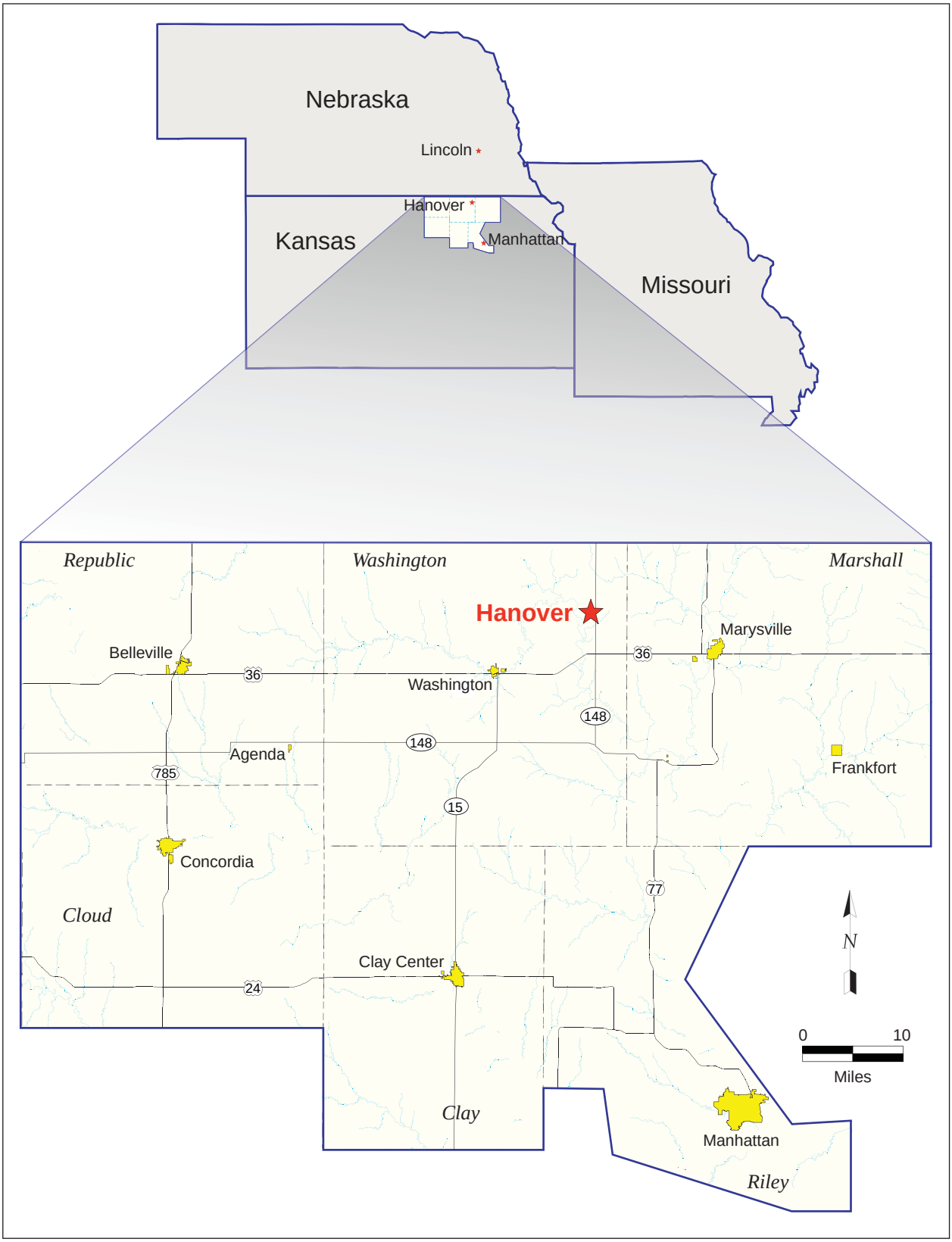

FIGURE 3.1 Location of Hanover, Kansas.

4 Proposed Scope of Work

Sub-slab soil vapor samples will be collected by an experienced sampling technician provided by H&P Mobile Geochemistry. H&P has been conducting soil gas sampling for over 20 years and is well known throughout the country for its expertise in vapor intrusion and soil gas sampling. Sub-sub samples will be collected at the following four homes in Hanover (Figure 4.1):

1. E. Meier, 400 N. East St.

2. S. Jueneman, 400 E. Kensington St.

3. L. Jueneman, 414 E. Kensington St.

4. M. Goeckel, 413 E. Kensington St.

One sub-slab sample will be collected at each residence, preferably in the center of the slab. The actual sampling location will depend on the floor covering and the preference of the residents.

Sampling will be conducted in accordance with procedures in Appendix A. Briefly, a small-diameter hole (< 1 in.) will be drilled through the slab, and a small-diameter tube will be inserted. The tubing will be sealed into the hole and purged of residual air. Then a soil gas sample will be withdrawn by a using small-volume canister (approximately 400 cm^3). After sampling is complete, the sub-slab sampling probe will be removed from the slab, and the hole will be sealed with cement.

Separate sub-slab samples and an indoor air sample will also be collected in Tedlar® bags for radon analysis as described by the U.S. Environmental Protection Agency (EPA 1992). The purpose of this analysis is to determine a foundation-specific attenuation factor, to aid in the interpretation of any detected levels of carbon tetrachloride in the sub-slab samples. The use of radon as a surrogate for determining a foundation-specific attenuation factor was described by the Interstate Technology and Regulatory Council (ITRC 2007) and in *Environmental Forensics* (McHugh et al. 2008).

The proposed order of sampling is as follows:

1. Radon sampling of indoor air will be conducted before the concrete slab is cut. This will ensure that an attenuation factor can be calculated that is representative of actual indoor conditions and has not been influenced by potential sub-slab exposure.

2. Drilling through the concrete slab will be conducted to permit installation of a temporary probe; vapor samples will be collected through the probe for carbon tetrachloride and chloroform analyses.

3. The final phase of sampling will include the collection of sub-slab vapor samples for radon analysis.

Soil vapor samples will be shipped to H&P Mobile Geochemistry and analyzed for carbon tetrachloride and chloroform by EPA Method TO-15 at a detection level of 5.0 µg/m^3. This value is below the most stringent risk-based screening level for these compounds in sub-slab samples. H&P holds National Environmental Laboratory Accreditation Conference (NELAC) certification for the TO-15 analysis.

To verify that the system is free from leaks, a tracer compound will be used to detect any leaks in the sampling train or procedure. H&P Mobile Geochemistry has selected difluoroethane (DFA) as the tracer. The KDHE has not established a standard for determining the concentration of DFA that would indicate the presence of a leak; however, the state of Missouri (2005) indicated that a concentration less than 100 µg/L indicates that the system is free from leaks. We propose to use the 100-µg/L criterion stated in the Missouri guidance (page 12 in Missouri 2005). Analyses will be conducted at the H&P laboratory. An equipment blank sample will be collected to verify that the equipment (probe, sample train, and canister) used for sub-slab sampling is free of contaminants.

FIGURE 4.1 Proposed sampling locations.

5 Schedule of Field Work and Reporting

Upon KDHE approval of this work plan, letters will be sent to the affected residents, describing the proposed work and requesting access for sampling. Once access is granted, the field work will be scheduled.

A report containing the data, relevant quality assurance/quality information information, and an interpretation of the vapor intrusion risk will be submitted to the KDHE within 30 days of completion of field work. Results of the sub-slab sampling will be provided to the owner of each individual household tested.

6 References

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KDHE, 2007, letter from C. Carey (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding *Evaluation of Indoor Air Carbon Tetrachloride Concentrations Measured in Hanover, Kansas, in July 2007*, December 5.

McHugh, T.E., D.E. Hammond, T. Nickels, and B. Hartman, 2008, "Use of Radon Measurements for Evaluation of Volatile Organic Compound (VOC) Vapor Intrusion," *Environmental Forensics* 9:107-114.

Missouri, 2005, *Missouri Risk-Based Corrective Action (MRBCA) for Petroleum Storage Tanks: Soil Gas Sampling Protocol*, Missouri Department of Natural Resources, Jefferson City, Missouri, April 21.

Appendix A:

Sub-Slab Soil Vapor
Standard Operating Procedures
(For Vapor Intrusion Applications)

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H&P Mobile Geochemistry, Carlsbad, California

Sub-Slab Soil Vapor Standard Operating Procedures

(For Vapor Intrusion Applications)

Revised January 2008

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Soil Gas Probe/Implant Construction

Materials: Stainless steel tubing

Diameter: 1/8" OD or ¼" OD

Length: Cut to desired length within or just below base of slab

Tip: SS or plastic (typically no tip required for sub-slab)

Surface Termination: Swagelok fittings or 2-way valve

Refer to Photos 1 and 2.

Notes:

- Tips (aluminum, ceramic, SS) can be put on the end if desired to give a longer screen interval, but typically are not used for sub-slab samples.
- Various surface terminations are available and the selection often depends on whether the probes are temporary or permanent and whether they need to be installed flush with the surface.

Probe Installation Protocol

1. Ensure all sub-slab utilities (public and building specific) are marked prior to installation.
2. Drill a ½" to 1" OD hole through the slab with a drill and spline bit. Do not use water. If dust prevention necessary, cover the location with a towel/cloth and drill through a pre-cut hole in the cloth (Photo 3).
3. Measure slab thickness. Cut tubing to appropriate length to reach base of slab and to give required type of surface termination (flush, recessed, protruding). If a flush or recessed surface termination is required, a larger diameter hole (1") in the upper 1-inch of the slab may be useful to leave enough room for the fitting on the probe tubing (Photo 4).
4. Insert tubing. Add sand to cover tip with about 1 inch of sand.
5. Grout to the surface using bentonite (if temporary installation) or cement (if permanent installation).
6. Wait 15 to 30 minutes prior to sampling for bentonite to congeal.

Soil Gas Sample Collection

Since sub-slab sampling is from very shallow depths (typically 2" to 6" below surface), minimum purge volumes and low volume samples are preferred to minimize potential breakthrough from the surface. Tracer/leak gas is necessary to ensure breakthrough does not occur.

Materials: 1/8" or ¼" OD nylon or Teflon tubing.

Sample Canister: syringe, tedlar bag, SS canister, gas-tight glass.

Plastic 3-way valve.

Vacuum gauge and sampling train as necessary.

Notes: If canisters with flow chokes are used, ensure flow chokes are dedicated to the canister or cleaned before reuse on another canister.

1. If syringe samples only to be collected, connect syringe to probe tubing using a 3-way valve (Photo 5). Purge out 250 cc or 4 dead-volumes of the probe and connecting tubing (~ 4 cc/ft for 1/8"OD tubing and 20 cc/ft for ¼" OD tubing), whichever is larger. Leave syringe connected to implant tubing.
2. If canister samples are being collected, connect 60 cc syringe to sampling train and purge out 250 cc or 4 dead-volumes of the probe and sampling train, whichever is larger (Photo 6).
3. For canisters with valves (not mini-cans with quick-disconnects), connect canister to sampling train or connecting tubing. Do not connect mini-cans with quick-disconnects until step 6.
4. For canister samples, check canister vacuum immediately before use. Ensure any flow chokes & filters have been flushed between samples and all connections/fittings are tight.
5. Place tracer/leak compound, typically difluoroethane or a gas tracer such as helium around the implant at the ground surface and at connections in the sampling system. Liquid tracers are easily emplaced by wetting a paper towel and wrapping around the test locations. Gas tracers require a shroud to hold the gas tracer over the probe and sampling train.
6. Once leak compound in place, open 3-way valve and collect soil gas sample in syringe. For canister samples with valves, open valve. For mini-cans with quick-disconnects, remove purging syringe and connect mini-can to sampling train (Photos 7 & 8).

7. If measurements with a portable meter to be made (e.g. oxygen), conduct measurements after collection of the soil gas sample(s) for VOC analysis.

Notes:

- For larger canisters (>1 liter), sample flow rates are not to exceed 500 ml/min (200 ml/min for CA-EPA) to minimize potential for vacuum extraction of contaminants from the soil phase.
- The presence of the tracer compound in the analysis confirms a leak and another sample is collected until no leak is detected (if on-site analysis exists).
- If large volume canisters used (3 or more liters), a purge volume test may be required to ensure sample dilution from other zones is not occurring.

Field Records

The field technician maintains a log sheet summarizing:

- Sample identification
- Probe location
- Date and time of sample collection
- Sampling depth
- Identity of samplers
- Weather conditions
- Sampling methods and devices
- Soil gas purge volumes
- Volume of soil gas extracted
- Vacuum of canisters before and after samples collected.
- Apparent moisture content (dry, moist or saturated etc.) of the sampling zone

Chain of custody protocols and records used to track samples from sampling point to analysis.

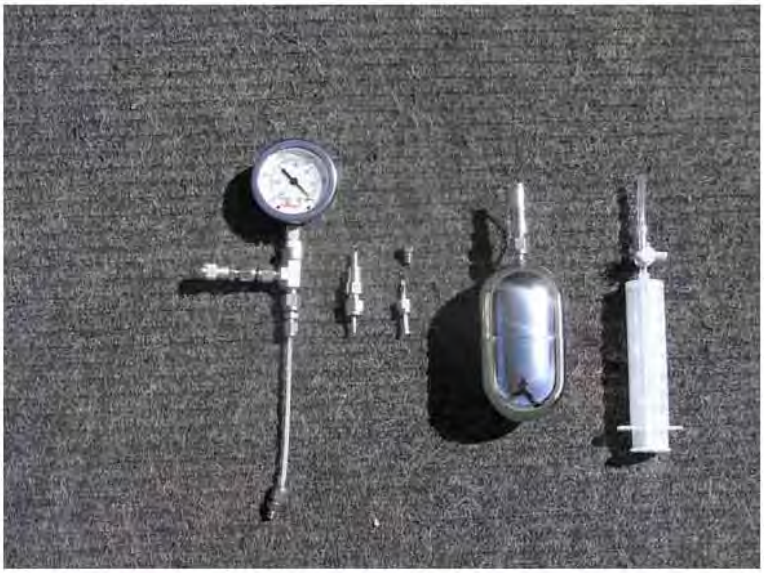


Photo 1 – Soil gas sampling materials: sample collection train, vapor implants, mini-can (400 cc), purging syringe.

Photo 2 – Sub-slab vapor implant (1/8" OD) and cap. Tubing can be cut to any length (nylon showed).

Photo 3 – Drilling hole through slab (1/2" OD).

Photo 4 – Surface completions. Left: tubing coiled in hole. Removable plug installed to make flush with surface. Right: cemented flush to surface (hole slightly recessed purposely to enable fitting to be visible in photo).

Photo 5 – Collecting sample with 60 cc syringe. Note small dead-volume of tubing connecting syringe to implant.

Photo 6 – Purging implant & sampling train with 60 cc syringe. Note small dead-volume of tubing connecting syringe to implant.

Photo 7 – Collecting soil gas sample in mini-can (400 cc).

Photo 8 – Collecting sample in larger canister (6 liter). No sampling train is required since the canister is already equipped with valve, vacuum gauge, and flow choke.

Addendum to *Final Work Plan: Supplemental Upward Vapor Risk Investigation at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas,* for Indoor Air and Ambient Air Sampling

This Addendum presents a plan for collecting indoor air samples in four homes located at the former CCC/USDA grain storage facility in Hanover, Kansas, as well as one ambient air sample to represent the Hanover site.

Project Objective

The purpose of the proposed work is to satisfy KDHE requirements and to collect additional data for assessing the risk to human health due to the potential upward migration of carbon tetrachloride and its primary degradation product (chloroform) into four houses located within or immediately next to the former grain storage facility. Indoor air data collected by the CCC/USDA in July 2007 showed low levels of carbon tetrachloride in four of the nine homes sampled. It cannot be concluded from these previous data whether the source of the detected carbon tetrachloride is vapor intrusion. Hence, the proposed work is designed to provide additional information to potentially resolve this uncertainty.

Proposed Work: Collection of Indoor Air and Ambient Air Samples

Sampling Procedure. Indoor air samples will be collected at the four homes designated for sub-slab sampling, by an experienced air sampling technician provided by Argonne National Laboratory (Argonne, Illinois) or Larsen and Associates, Inc. (Lawrence, Kansas). In addition, one ambient air sample will be collected to be representative of the site. All collection protocols will be in compliance with the KDHE vapor intrusion guidance (online at http://www.kdheks.gov/ber/download/Ks_VI_Guidance.pdf) and KDHE standard operating procedure (SOP) BER-33 (attached; online at http://www.kdheks.gov/environment/qmp_2000/download/BER_SOPs_Appendix_A.pdf).

Residence Survey Prior to Sampling. Approximately 2-5 days prior to sample collection, the four designated homes will be surveyed to identify any products known to potentially contain carbon tetrachloride or chloroform. The residents will be requested to remove these products from the premises at least 2 days prior to sample collection. Page 2 of the KDHE Field Data Air Sampling Form will be completed (in the attached SOP BER-33).

Sample Location. Indoor air samples will be collected immediately prior to the sub-slab sample collection to ensure that no interferences result from the sub-slab sampling effort. Samplers will be placed on the first floor of each residence, in a location of common occupancy (as allowed by the residents). Samples will be collected as close to the center of the room as possible, away from heating system registers, and at a height of 3-7 ft above the floor (in the breathing zone). Samples will be collected in Summa canisters, individually certified clean, for a

period of 24 hr. Meteorological conditions will be noted and recorded. Page 1 of the KDHE Field Data Air Sampling Form will be completed (in the attached SOP BER-33).

Ambient Air Sample. To be representative of the site, one ambient air sample will be collected in an upwind location, away from obvious sources of volatile organic compounds, and over the same collection period as the indoor air samples.

Sample Analysis. Air samples will be shipped to a laboratory certified for method TO-15 analysis and analyzed for carbon tetrachloride and chloroform by method TO-15, at a detection level at or below the allowable risk-based indoor air levels for each compound.

Report Deliverable

A report containing all of the data, all relevant quality assurance/quality control information, and an interpretation of the vapor intrusion risk will be submitted within 30 days of completion of the fieldwork.

Schedule of Field Work

Upon receipt of KDHE approval of this Addendum, Argonne will send follow-up letters to the residents of the four homes, describing the proposed work and requesting access. The work is tentatively scheduled for the end of January 2009.

APPENDIX A

BUREAU OF ENVIRONMENTAL REMEDIATION

STANDARD OPERATING PROCEDURES

BER-01	Collection of Groundwater Samples at Known or Suspected Groundwater Contamination Sites
BER-02	Collection of Surface Water Samples at Suspected or Known Contaminated Sites
BER-03	Collection of Soil Samples for Laboratory Analysis
BER-04	Collection of Sediment Samples
BER-05	Decontamination of Equipment
BER-06	Installation of Monitoring Wells
BER-07	KDHE Geoprobe Operations
BER-08	Characterization and Disposal of Investigative Derived Waste
BER-09	Conducting a Step-Drawdown Test
BER-10	Conducting a Constant-Rate Aquifer Test and Recovery Test
BER-11	Evaluation and Validation of Data
BER-12	Collection of Quality Control Measures for Water-Quality Data Samples
BER-13	Headspace Method for Screening Soil Samples for Volatile Organic Vapors
BER-14	Minimum Standards for Model Use **(RESCINDED)**
BER-15	Conducting Soil Vapor Extraction (SVE) Tests
BER-16	Horiba U-10 Water Quality Analyzer
BER-17	Implementing a Specialized Occupational Health Examination Program
BER-18	Field Safety Protocol
BER-19	Chain of Custody
BER-20	Guidelines for Sampling Hazardous Materials
BER-21	Levels of Protection for Field Work
BER-22	Half / Full-Mask Respirator
BER-23	Self Contained Breathing Apparatus (SCBA) **(RESCINDED)**
BER-24	Conducting On-site Reviews of Field Sampling Activities
BER-25	Mobile Laboratory
BER-26	YSI Model 63 Water Quality Analyzer
BER-27	Operation of Niton X-Ray Fluorescence (XRF) Analyzer
BER-28	Kabis Sampler
BER-29	Installation of Direct-push Monitoring Wells
BER-30	Operation of the 2020 Photoionization Air Monitor
BER-31	Field-based Colorimetric Analysis
BER-32	Garmin Model GPS III+
BER-33	Procedures for Sampling and Analysis of Indoor Air Samples
BER-34	Procedures for Sampling and Analysis of Sub-Slab Air Samples
BER-35	Installation of Vapor Monitoring Wells

APPENDIX A

STANDARD OPERATING PROCEDURE BER-33

PROCEDURES FOR SAMPLING AND ANALYSIS OF INDOOR AIR SAMPLES

TABLE OF CONTENTS

1. INTRODUCTION

This procedure describes field protocols for sampling and analytical methods to determine the presence of VOCs in ambient, indoor, or workplace atmospheres. This method establishes standard operating procedures for the collection of air samples in passivated (inert) stainless-steel canisters.

2. SAMPLING EQUIPMENT

Indoor air samples will be collected in specially prepared six liter stainless-steel spheres. The laboratory will provide either SUMMA canisters or SilcoCans for the sampling. Air flow into the canister is regulated by a sampling valve (fixed orifice) or a pneumatic flow controller, attached to an in-line particulate filter. The sampling valve is typically used for short duration grab samples; however, the valve can be set for longer duration sampling. A flow controller can be preset to regulate flow for sample collection times of 1-hour, 3-hours, 8-hours, 12-hours or 24 hours. Larger canisters are available for sampling periods in excess of 24-hours. The desired sampling rate is pre-set either by the canister manufacturer or the laboratory. Canisters will be cleaned and certified by the laboratory as per EPA Method TO-14A or TO-15 guidelines.

A pressure/vacuum gauge is utilized to measure and record the initial canister pressure. This item is not typically supplied by the laboratory but is available upon request. The canister pressure should be approximately 22 - 25 psig. If the initial pressure is less than 20 psig, the canister should be rejected and returned to the laboratory.

Stainless-steel or Teflon tubing can be attached to the inline filter to obtain samples from the breathing zone or a remote location. If only adults occupy the residence, the inlet manifold is placed in the breathing zone at approximately five feet above grade. The manifold may not be required for representative air sample in a residence with children. The laboratory will supply this material upon request.

3. BACKGROUND REVIEW

An adequate background review must be conducted to obtain information on each structure from which a sample is collected. Conduct a survey of each structure to ascertain basement, crawl space or slab on-grade building configuration. Determine if sumps, wells, or cisterns are associated with each structure. Evaluate the condition of the floors and walls, furnace use (fuel type) and building ventilation. These features may act as conduits that will facilitate the migration of VOCs from the soil and/or groundwater plume. An attached garage may store products that can contribute to contaminant impacts.

Interviews should be conducted to assess the use of potential contaminants, frequency of use, storage, as well as methods of handling and disposal. Additional information that is vital to adequately evaluate potential health risks include the following: the length of occupant residency; the ages of the adults and children that live in the structure; if the occupants smoke and how often. Any hobbies that use paints or solvents should be noted. The data referenced in this section should be entered on the Field Data Air Sampling Form in Attachment One.

4. PRELIMINARY SCREENING

Primary sampling areas will be in basements and/or the lowest potential living level, near sumps or other potential source areas. Preliminary screening of the sampling area may be conducted through use of photoionization detectors (PID) or colorimetric tubes. Screening, and subsequent sampling, will be conducted in the center of the room away from obstructions in the breathing zone, near potential sources, basements and crawl spaces. PIDs will be checked and calibrated according to manufacturers directions. Additional preliminary factors to be documented will include indoor and outdoor temperature, wind speed/ direction, and barometric pressure.

Preliminary screening and subsequent sampling can also be conducted in buildings or residences outside the area of concern to evaluate background levels of various constituents that may impact data interpretation. The data referenced in this section should be entered on the Field Data Air Sampling Form in Attachment One.

5. SAMPLING PROCEDURES

Laboratory prepared sampling apparatus configurations may vary. Specific instructions and/or diagrams for system assembly, if any, should be obtained from the laboratory suppling the canister(s). Canisters should not be placed in areas of high humidity (bathroom/laundry room), near windows, or heat registers. Record the local outdoor temperature, relative humidity and barometric pressure on the Field Data Air Sampling Form in Attachment One.

Sampling equipment apparatus may be assembled as follows: connect the flow controller, with attached in-line filter and vacuum/ pressure gauge, to the canister utilizing a compression fitting; connect a sampling tube to the sample inlet on the filter; place the canister in the predetermined location and begin sampling by turning the canister valve counter-clockwise one full turn or as specified; after sampling is complete, record the canister pressure and close the canister valve. Do not over-tighten the valves or compression fittings.

The final canister pressure should be less than atmospheric to ensure that a constant flow rate was used for the entire sampling period. Attach an identification tag that indicates the canister serial

number, sample number, location, and date to the canister for transport to the laboratory. The canisters will be shipped under proper chain-of-custody protocol. Canisters must be returned to the laboratory from which they were rented for analysis. A copy of sampling instructions for canisters with pneumatic flow controllers is in Attachment Two.

6. SAMPLE ANALYSIS

The canisters provide storage stability for many VOCs for a period of up to 30 days. Collected samples will be submitted for laboratory analysis by either EPA Method TO-14A (EPA, January, 1997) or EPA Method TO-15 (EPA, January, 1997). EPA Method TO-14A is the more recognized method for analysis of unknown trace VOCs and is more sensitive. This method can analyze up to 41 of 187 hazardous air pollutants listed in the Title III Clean Air Act Amendment (CAAA). EPA Method TO-14A uses single or multiple detectors which are generally less desirable than the mass spectrometry detector utilized by EPA Method TO-15.

The mass spectrometry utilized for EPA Method TO-15 is a more scientifically defensible detector scheme that has a more definitive identification technique for VOC analysis than TO-14A. Therefore, EPA Method TO-15 can be applied with a higher confidence which reduces uncertainty in risk assessments that evaluate VOCs. A larger number of Title III CAAA compounds can be analyzed (97 of 187) by EPA Method TO-15. Detection limits for the various analytes, with either EPA method, range from 0.2 ppbv - 25 ppbv.

A relatively limited number of laboratories conduct air sampling analysis. The referenced lab methods can be located on the world wide web at the following addresses: www.epa.gov/ttnamtil/files/ambient/airtox/to-14a.pdf or www.epa.gov/ttnamtil/files/ambient/airtox/to-15.pdf.

References:

Method TO-14A - Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography, EPA, January, 1997

Method TO-15 - Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry, EPA, January, 1997

ATTACHMENT ONE

FIELD DATA AIR SAMPLING FORM

FIELD DATA AIR SAMPLING FORM

Site Name:_____

Sample Identification:_____/_____ Date Sampled:_____

Sample Location(s):_____
_____

Sampler:_____ Canister Serial #:_____/_____

Environmental Conditions

Outdoor Temperature:_____ Barometric Pressure:_____ Wind Speed/Direction:_____

Relative Humidity:_____ Comments:_____

Preliminary Screening

Instrumentation:_____ Calibration Date:_____ Time:_____ am/pm

Field Reading(s):_____(ppm)/_____(ppm)/_____(ppm)/_____(ppm)

Location(s):_____
_____
_____
_____

Air Sampling

	Time	Pressure	Controller Flow
Start:	_____am/pm	_____psig	_____
Stop:	_____am/pm	_____psig	_____

==========

Start:	_____am/pm	_____psig	_____
Stop:	_____am/pm	_____psig	_____

FIELD DATA AIR SAMPLING FORM

Residential Questionnaire

Tenant's Name(s):_____ Age:_____ Tenure:_____
_____ _____ _____
_____ _____ _____
_____ _____ _____
_____ _____ _____

Address:_____

Smoker(s): Y/N Product (Cigars, Pipe, Cigarettes):_____ Number Smoked/Day:_____

Basement/Crawl Space: Y/N Ventilated: Y/N Living Quarters: Y/N
Basement Activities:_____

Private Well: Y/N Sump: Y/N Cistern: Y/N In Use/Plugged: Y/N

Recent Remodeling: Y/N Activities (painting, new carpet, new cabinets): Y/N
_____

VOC sources (hobbies, paints, solvents, gasoline, etc.):_____
_____

Cleaning Products and Storage:_____

Attached Garage: Y/N Garage Storage (cars, lawn mover, etc.):_____

Furnace Type (Oil, Natural Gas, Propane):_____ Furnace Intake: Inside/Outside

Additional Heating Sources (space heater, etc):_____ Fuel Type:_____

Comments:_____
_____
_____
_____
_____

ATTACHMENT TWO

SAMPLING INSTRUCTIONS FOR CANISTERS WITH PNEUMATIC FLOW CONTROLLERS

Sampling Instructions for Canisters With Pneumatic Flow Controllers

1. Inspect your canister shipment upon arrival. Compare the contents with the packing slip and notify the lab of any discrepancy or damage.

2. Familiarize yourself with this diagram and the equipment that you received. The flow controller will be set for the appropriate sampling rate in the laboratory and should not require adjustment.

3. Remove the brass caps from the flow controller and canister. Connect the flow controller to the canister by inserting the "canister connection" into the "canister inlet" and hand tighten the swagelock nut being careful not to cross the threads. Using two open end wrenches (1/2" & 9/16") tighten the nut no more than 1/8 turn past finger tight. DO NOT use adjustable wrenches or pliers.

4. The fittings are swagelock compression fittings. Do not use teflon tape or other sealants, they are not necessary. DO NOT over-tighten any connection. Over-tightening causes leaks, not fixes them.

5. The canister and controller are now ready for ambient air sampling. If you intend to sample a remote location or source, you will need to attach a sampling line. This should be 1/4" O.D. tubing of virgin Teflon or cleaned stainless steel.

6. If arranged with your canister order, the lab will provide a swagelock nut and set of nylon ferrules for connecting line. Slide the nut, the back ferrule, then the front ferrule onto the tubing. Insert the tubing into the sample inlet and slide the ferrules into the fitting. Secure the nut being careful not to cross the threads. When using nylon ferrules, a snug finger tight should be sufficient for a leak free connection.

7. To begin sampling, simply open the canister valve by turning clockwise. One full turn is sufficient. Note the vacuum gauge reading. The vacuum gauge reading should be near the barometric pressure.

8. You can watch the decline in the vacuum to gauge the sampling rate. A one hour sample should drop in vacuum at a rate of 0.5" Hg per minute (i.e. 30"/60 min). Remember this is a rough estimate. The sampling rate is normally set in the laboratory. Occasionally the controller will lose calibration in shipment. If necessary contact the lab for assistance.

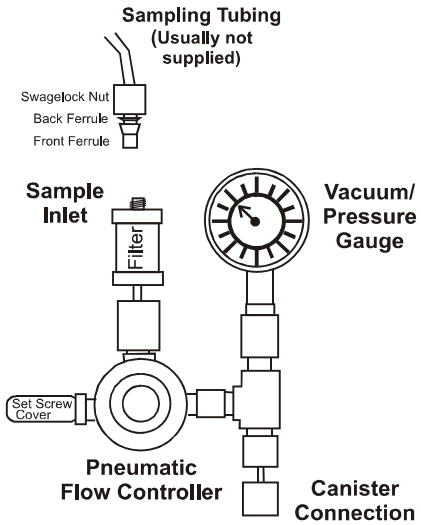
9. After sampling is complete, close the canister valve by turning clockwise until finger tight. DO NOT over-tighten as this WILL damage a very expensive valve.

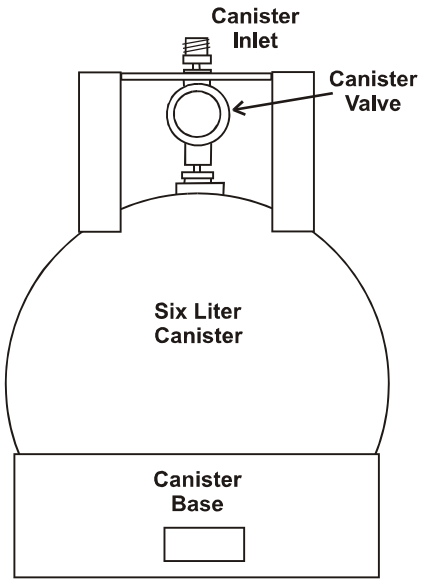
10. Disassemble the components in reverse order of the above assembly instructions. Return all components to the original shipping containers and package them as received.

11. Verify that all parts are packed for return by referencing the packing slip. The project will be charged for all missing or damaged components.

12. Complete a Chain-of-Custody Record and return the sample to the laboratory for analyses.

Teflon will sometimes have very low level freon contamination.





Addendum 2 (Revised) to *Final Work Plan: Supplemental Upward Vapor Risk Investigation at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas,* for Indoor Air Sampling at 17 Residences and for Ambient Air Sampling

This Addendum 2 (Revised) presents a plan for collecting indoor air samples in 17 homes on and near the former CCC/USDA grain storage facility in Hanover, Kansas, as well as collecting three ambient air samples to represent background air conditions during the proposed sampling event. Table 1 identifies the 17 homes where sampling is proposed. (One of these homes was not sampled previously.) Figure 1 shows the locations of the 17 residences to be sampled. Table 1 and Figure 1 also identify and show the locations of 3 homes where mitigation systems are being installed (Eleanora Meier at 400 North East Street, Maurice Goeckel at 413 East Kensington Street, and Darrell Schlabach at 311 North East Street), on the basis of results of sampling earlier in 2009.

Project Objective

The purpose of the proposed work is to satisfy KDHE requirements and to collect additional data for assessing the risk to human health due to the potential upward migration of carbon tetrachloride and its primary degradation product (chloroform) into homes on or near the former grain storage facility. Sub-slab and indoor air screening data collected by the CCC/USDA in March-April 2009 showed low levels of carbon tetrachloride in 19 homes on and downgradient of the former CCC/USDA grain storage facility (Table 1). To eliminate potential risk via inhalation where relatively higher levels of carbon tetrachloride were detected during the March-April 2009 screening, the E. Meier, M. Goeckel, and D. Schlabach homes (Table 1 and Figure 1) have been designated for mitigation. The work proposed here is designed to provide additional information to assess the potential risk at the 16 homes where initial screening in March-April 2009 indicated lower contaminant concentrations (Table 1 and Figure 1).

In addition, the residence at 303 N. East Street, to which access was previously denied, is now expected to be accessible for sampling to assess risk to human health due to potential migration of carbon tetrachloride and chloroform vapors. This brings the total number of homes to be addressed under this Addendum 2 (Revised) to 17.

Proposed Work: Collection of Indoor Air and Ambient Air Samples

Sampling Procedure. Indoor air samples will be collected at the 17 homes identified in Figure 1, if approved by the owners, by experienced air sampling technicians provided by Argonne National Laboratory (Argonne, Illinois). In addition, 3 ambient air samples will be collected to be representative of site background ambient air conditions during the proposed sampling event. All collection protocols will be in compliance with the KDHE vapor intrusion guidance (online at http://www.kdheks.gov/ber/download/Ks_VI_Guidance.pdf) and KDHE

standard operating procedure (SOP) BER-33 (attached; online at http://www.kdheks.gov/environment/qmp_2000/download/BER_SOPs_Appendix_A.pdf).

Residence Survey Prior to Sampling. Prior to placement of the sample canisters, each home will be surveyed to verify that the windows and doors are closed and that air conditioning is in use, as well as to identify any products potentially containing volatile organic compounds. Page 2 of the KDHE Field Data Air Sampling Form will be completed (in the attached SOP BER-33).

Sample Location. Indoor air samples will be collected in the first-floor living area of each home and in the basement (or the crawl space of homes so constructed). Samplers will be placed on the first floor of each residence, in a location of common occupancy (as allowed by the residents). Samples will be collected as close to the center of the room as possible, away from heating/cooling system registers, and at a height of 3-7 ft above the floor (in the breathing zone). Samplers will also be placed in the basement (or the crawl space of the residences so constructed), away from heating-ventilation-air conditioning units, sumps, or storage areas for products potentially containing volatile organic compounds. Samples will be collected in Summa canisters, individually certified clean, for a period of 24 hr. Meteorological conditions will be noted and recorded. Page 1 of the KDHE Field Data Air Sampling Form will be completed (in the attached SOP BER-33).

Ambient Air Sample. To be representative of the background air conditions during the proposed sampling event, 3 ambient air sample will be collected at locations to be determined, across the investigation area, away from obvious sources of volatile organic compounds, and over the same collection period as the indoor air sample collection.

Sample Analysis. Air samples will be shipped to TestAmerica Laboratories, Inc., South Burlington, Vermont, which is certified for method TO-15 analysis. At the laboratory, the samples will be analyzed for carbon tetrachloride and chloroform by method TO-15, at a detection level at or below the allowable risk-based indoor air levels for each compound.

Sub-slab Sampling at 303 N. East Street. At the residence at 303 N. East Street, sub-slab sampling will be conducted in accordance with the procedures in *Final Work Plan: Supplemental Upward Vapor Risk Investigation at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas,* ANL/EVS/AGEM/TR-08-14.

Quality Control. Duplicate/replicate indoor air samples will be collected and analyzed at a frequency of 1 duplicate per 20 primary samples.

Report Deliverable

A report containing all of the data and all relevant quality assurance/quality control information will be submitted within 45 days of completion of the fieldwork. Subsequently, a discussion will be held with the KDHE concerning the potential risk for vapor intrusion into each home. On the basis of this discussion, a decision will be made regarding future actions.

Schedule of Field Work

Upon KDHE approval of this Addendum 2 (Revised), the KDHE will call the residents of the 17 homes to be sampled, describing the proposed work and requesting access. The work is *tentatively* scheduled for mid summer (July-August) 2009.

The KDHE will be notified of the dates scheduled for sampling, so that the state agency can determine whether to collect its own independent data set in conjunction with the proposed CCC/USDA-Argonne sampling.

TABLE 1 Actions following the spring 2009 vapor intrusion investigation at Hanover, KS.

	Resident	Residence Address	Sample Location	Sample Date	On-site screening analysis [a] Analysis Time	On-site screening analysis [a] Carbon Tetrachloride µg/m^3	Off-site laboratory analysis [b] Carbon Tetrachloride µg/m^3	Recommened Action	Comments
Homes selected for monitoring.									
[1]	S. Jueneman	400 E. Kensington St.	Basement	7/11/07	--	--	1.4		
			1st floor	2/4/09	--	--	ND	Monitor	
			Basement	2/4/09	--	--	1.8		
			Sub-slab	2/4/09	--	--	130		
[2]	M. Poell	301 N. Belgrave St.	Basement	7/11/07	--	--	ND		
			1st floor	3/13/09	--	--	2.9	Monitor	
			Basement	3/13/09	--	--	4.2		
[3]	L. Jueneman	414 E. Kensington St.	Basement	7/11/07	--	--	1.4		
			1st floor	3/13/09	--	--	2.6	Monitor	
			Basement	3/13/09	--	--	3.7		
[4]	R. Luehring	309 E. Elm	1st Floor	3/26/09	11:16	ND	--	Monitor	
			Basement	3/26/09	11:20	1.7	--		
			Subslab	3/27/09	13:10	290	--		
[5]	Vacant [a]	311 E. Elm	1st Floor	3/26/09	10:04	ND	--	Monitor	
			Basement	3/26/09	10:10	1.8	--		
			Basement	4/8/09	18:06	ND	--		
			Subslab	4/8/09	18:15	2200	--		
[6]	R. Hoover	400 E. Elm	1st Floor	3/26/09	9:19	ND	1.7	Monitor	
			Basement	3/26/09	9:23	ND	--		
			Subslab	--	--	2800	--		
[7]	F. Jueneman	401 E. Elm	1st Floor	3/26/09	18:48	ND	--	Monitor	
			Basement	3/26/09	18:52	ND	--		
			Subslab	4/8/09	11:31	400	--		
[8]	D. Kruse	405 E. Elm	1st Floor	3/26/09	19:14	ND	2.6	Monitor	High ethanol detected.
			1st Floor -Dup	3/26/09	19:39	ND	--		
			Basement	3/26/09	19:17	22	--		
			Basement -Dup	3/26/09	19:43	19	--		
			Subslab	3/27/09	13:58	2800	--		
[9]	S. Laue	406 E. Elm	1st Floor	3/26/09	12:13	ND	--	Monitor	Partial dirt basement.
			Basement	3/26/09	12:19	3.0	--		
			Basement	4/7/09	15:27	9.4	--		
			Subslab	4/7/09	15:24	410	--		
[10]	F. Jandera	408 E. Elm	1st Floor	3/26/09	12:37	2.6	7**	Monitor	
			Basement	3/26/09	12:40	2.3	--		
			Subslab	3/27/09	14:07	1600	--		
			1st Floor	4/8/09	16:04	2.7	--		
			Basement	4/8/09	16:00	6.0	--		
			Subslab	4/7/09	14:49	1900	--		
[11]	M. Gerdes	409 E. Elm	1st Floor	3/26/09	14:47	2.4*	1.5	Monitor	
			1st Floor -Dup	3/26/09	16:01	ND	--		
			Basement	3/26/09	14:52	6.2*	ND		
			Basement -Dup	3/26/09	16:05	2.7	--		
			Subslab	3/27/09	14:29	2400	--		
[12]	Vacant [b]	412 E. Elm	1st Floor	4/10/09	--	--	2.1	Monitor	
			Subslab	4/10/09	--	--	360		
[13]	V. Landoll	513 E. Elm	1st Floor	3/26/09	12:58	2.1	ND	Monitor	
			Basement	3/26/09	13:02	ND	--		
			Subslab	3/27/09	14:14	290	260		
[14]	C. Neiman	211 N. East	1st Floor	4/8/09	12:42	1.6	--	Monitor	
			Basement	4/8/09	12:45	2.7	--		
			Subslab	4/7/09	17:52	940	--		
[15]	P. Spencer	312 E. North	1st Floor	3/26/09	13:55	ND	--	Monitor	
			Basement	3/26/09	13:59	ND	--		
			Basement	4/7/09	18:28	ND	--		
			Subslab	4/7/09	18:32	300	--		
[16]	B. Schroeder	404 E. North	1st Floor	3/27/09	12:15	ND	--	Monitor	
			Basement	3/27/09	12:29	ND	--		
			Subslab	4/8/09	11:46	180	200		
[17]	E. Koehler	303 N. East St.						Monitor	Access for sampling denied previously.
Homes selected for mitigation.									
[1]	E. Meier	400 N. East St.	Basement	7/11/07	--	--	3.7		
			1st floor	2/4/09	--	--	17	Mitigate	
			Basement	2/4/09	--	--	26		
			Sub-slab	2/4/09	--	--	62000		
			Sub-slab	2/4/09	(KDHE split sample)		28500		
[2]	M. Goeckel	413 E. Kensington St.	Basement	7/11/07	--	--	4.8		
			1st floor	2/4/09	--	--	11	Mitigate	
			Kitchen	2/4/09	(KDHE split sample)		15.9		
			Basement	2/4/09	--	--	16		
			Basement	2/4/09	(KDHE split sample)		15.9		
			Sub-slab	2/4/09	--	--	350		
[3]	D. Schlabach	311 N. East	1st Floor	3/27/09	9:46	14	--	Mitigate	Trailer on top of basement.
			1st Floor	4/7/09	16:14	4.3	--		Many chemicals present
			Basement	3/27/09	9:50	18	--		in basement workshop.
			Basement	4/7/09	16:18	9.0	--		
			Subslab	4/7/09	16:28	4500	--		

Data contains results for July 2007 indoor air sampling at residences on former CCC/USDA facility.
* Possible interferences causing high bias in results.
** H&P reported problem with sample. Result questionable.

[a] The residence at 311 E. Elm is vacant. Owners Mr. & Mrs. E. Hynek no longer reside in the home. It is used periodically by the daughter and son-in-law when visiting Hanover.

[b] The residence at 412 E. Elm is vacant. Owner J. Poell lives at 5220 W. 102nd St. Apt 215; Bloomington, MN 55437.

HANOVER, KS
Approved Indoor Air Monitoring Locations and Mitigation Locations

APPENDIX A

BUREAU OF ENVIRONMENTAL REMEDIATION

STANDARD OPERATING PROCEDURES

BER-01	Collection of Groundwater Samples at Known or Suspected Groundwater Contamination Sites
BER-02	Collection of Surface Water Samples at Suspected or Known Contaminated Sites
BER-03	Collection of Soil Samples for Laboratory Analysis
BER-04	Collection of Sediment Samples
BER-05	Decontamination of Equipment
BER-06	Installation of Monitoring Wells
BER-07	KDHE Geoprobe Operations
BER-08	Characterization and Disposal of Investigative Derived Waste
BER-09	Conducting a Step-Drawdown Test
BER-10	Conducting a Constant-Rate Aquifer Test and Recovery Test
BER-11	Evaluation and Validation of Data
BER-12	Collection of Quality Control Measures for Water-Quality Data Samples
BER-13	Headspace Method for Screening Soil Samples for Volatile Organic Vapors
BER-14	Minimum Standards for Model Use **(RESCINDED)**
BER-15	Conducting Soil Vapor Extraction (SVE) Tests
BER-16	Horiba U-10 Water Quality Analyzer
BER-17	Implementing a Specialized Occupational Health Examination Program
BER-18	Field Safety Protocol
BER-19	Chain of Custody
BER-20	Guidelines for Sampling Hazardous Materials
BER-21	Levels of Protection for Field Work
BER-22	Half / Full-Mask Respirator
BER-23	Self Contained Breathing Apparatus (SCBA) **(RESCINDED)**
BER-24	Conducting On-site Reviews of Field Sampling Activities
BER-25	Mobile Laboratory
BER-26	YSI Model 63 Water Quality Analyzer
BER-27	Operation of Niton X-Ray Fluorescence (XRF) Analyzer
BER-28	Kabis Sampler
BER-29	Installation of Direct-push Monitoring Wells
BER-30	Operation of the 2020 Photoionization Air Monitor
BER-31	Field-based Colorimetric Analysis
BER-32	Garmin Model GPS III+
BER-33	Procedures for Sampling and Analysis of Indoor Air Samples
BER-34	Procedures for Sampling and Analysis of Sub-Slab Air Samples
BER-35	Installation of Vapor Monitoring Wells

APPENDIX A

STANDARD OPERATING PROCEDURE BER-33

PROCEDURES FOR SAMPLING AND ANALYSIS OF INDOOR AIR SAMPLES

TABLE OF CONTENTS

1. INTRODUCTION

This procedure describes field protocols for sampling and analytical methods to determine the presence of VOCs in ambient, indoor, or workplace atmospheres. This method establishes standard operating procedures for the collection of air samples in passivated (inert) stainless-steel canisters.

2. SAMPLING EQUIPMENT

Indoor air samples will be collected in specially prepared six liter stainless-steel spheres. The laboratory will provide either SUMMA canisters or SilcoCans for the sampling. Air flow into the canister is regulated by a sampling valve (fixed orifice) or a pneumatic flow controller, attached to an in-line particulate filter. The sampling valve is typically used for short duration grab samples; however, the valve can be set for longer duration sampling. A flow controller can be preset to regulate flow for sample collection times of 1-hour, 3-hours, 8-hours, 12-hours or 24 hours. Larger canisters are available for sampling periods in excess of 24-hours. The desired sampling rate is pre-set either by the canister manufacturer or the laboratory. Canisters will be cleaned and certified by the laboratory as per EPA Method TO-14A or TO-15 guidelines.

A pressure/vacuum gauge is utilized to measure and record the initial canister pressure. This item is not typically supplied by the laboratory but is available upon request. The canister pressure should be approximately 22 - 25 psig. If the initial pressure is less than 20 psig, the canister should be rejected and returned to the laboratory.

Stainless-steel or Teflon tubing can be attached to the inline filter to obtain samples from the breathing zone or a remote location. If only adults occupy the residence, the inlet manifold is placed in the breathing zone at approximately five feet above grade. The manifold may not be required for representative air sample in a residence with children. The laboratory will supply this material upon request.

3. BACKGROUND REVIEW

An adequate background review must be conducted to obtain information on each structure from which a sample is collected. Conduct a survey of each structure to ascertain basement, crawl space or slab on-grade building configuration. Determine if sumps, wells, or cisterns are associated with each structure. Evaluate the condition of the floors and walls, furnace use (fuel type) and building ventilation. These features may act as conduits that will facilitate the migration of VOCs from the soil and/or groundwater plume. An attached garage may store products that can contribute to contaminant impacts.

Interviews should be conducted to assess the use of potential contaminants, frequency of use, storage, as well as methods of handling and disposal. Additional information that is vital to adequately evaluate potential health risks include the following: the length of occupant residency; the ages of the adults and children that live in the structure; if the occupants smoke and how often. Any hobbies that use paints or solvents should be noted. The data referenced in this section should be entered on the Field Data Air Sampling Form in Attachment One.

4. PRELIMINARY SCREENING

Primary sampling areas will be in basements and/or the lowest potential living level, near sumps or other potential source areas. Preliminary screening of the sampling area may be conducted through use of photoionization detectors (PID) or colorimetric tubes. Screening, and subsequent sampling, will be conducted in the center of the room away from obstructions in the breathing zone, near potential sources, basements and crawl spaces. PIDs will be checked and calibrated according to manufacturers directions. Additional preliminary factors to be documented will include indoor and outdoor temperature, wind speed/ direction, and barometric pressure.

Preliminary screening and subsequent sampling can also be conducted in buildings or residences outside the area of concern to evaluate background levels of various constituents that may impact data interpretation. The data referenced in this section should be entered on the Field Data Air Sampling Form in Attachment One.

5. SAMPLING PROCEDURES

Laboratory prepared sampling apparatus configurations may vary. Specific instructions and/or diagrams for system assembly, if any, should be obtained from the laboratory suppling the canister(s). Canisters should not be placed in areas of high humidity (bathroom/laundry room), near windows, or heat registers. Record the local outdoor temperature, relative humidity and barometric pressure on the Field Data Air Sampling Form in Attachment One.

Sampling equipment apparatus may be assembled as follows: connect the flow controller, with attached in-line filter and vacuum/ pressure gauge, to the canister utilizing a compression fitting; connect a sampling tube to the sample inlet on the filter; place the canister in the predetermined location and begin sampling by turning the canister valve counter-clockwise one full turn or as specified; after sampling is complete, record the canister pressure and close the canister valve. Do not over-tighten the valves or compression fittings.

The final canister pressure should be less than atmospheric to ensure that a constant flow rate was used for the entire sampling period. Attach an identification tag that indicates the canister serial

number, sample number, location, and date to the canister for transport to the laboratory. The canisters will be shipped under proper chain-of-custody protocol. Canisters must be returned to the laboratory from which they were rented for analysis. A copy of sampling instructions for canisters with pneumatic flow controllers is in Attachment Two.

6. SAMPLE ANALYSIS

The canisters provide storage stability for many VOCs for a period of up to 30 days. Collected samples will be submitted for laboratory analysis by either EPA Method TO-14A (EPA, January, 1997) or EPA Method TO-15 (EPA, January, 1997). EPA Method TO-14A is the more recognized method for analysis of unknown trace VOCs and is more sensitive. This method can analyze up to 41 of 187 hazardous air pollutants listed in the Title III Clean Air Act Amendment (CAAA). EPA Method TO-14A uses single or multiple detectors which are generally less desirable than the mass spectrometry detector utilized by EPA Method TO-15.

The mass spectrometry utilized for EPA Method TO-15 is a more scientifically defensible detector scheme that has a more definitive identification technique for VOC analysis than TO-14A. Therefore, EPA Method TO-15 can be applied with a higher confidence which reduces uncertainty in risk assessments that evaluate VOCs. A larger number of Title III CAAA compounds can be analyzed (97 of 187) by EPA Method TO-15. Detection limits for the various analytes, with either EPA method, range from 0.2 ppbv - 25 ppbv.

A relatively limited number of laboratories conduct air sampling analysis. The referenced lab methods can be located on the world wide web at the following addresses: www.epa.gov/ttnamtil/files/ambient/airtox/to-14a.pdf or www.epa.gov/ttnamtil/files/ambient/airtox/to-15.pdf.

References:

Method TO-14A - Determination of Volatile Organic Compounds (VOCs) in Ambient Air Using Specially Prepared Canisters with Subsequent Analysis by Gas Chromatography, EPA, January, 1997

Method TO-15 - Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially-Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry, EPA, January, 1997

ATTACHMENT ONE

FIELD DATA AIR SAMPLING FORM

FIELD DATA AIR SAMPLING FORM

Site Name:_____

Sample Identification:_____/_____ Date Sampled:_____

Sample Location(s):_____
_____

Sampler:_____ Canister Serial #:_____/_____

Environmental Conditions

Outdoor Temperature:_____ Barometric Pressure:_____ Wind Speed/Direction:_____

Relative Humidity:_____ Comments:_____

Preliminary Screening

Instrumentation:_____ Calibration Date:_____ Time:_____ am/pm

Field Reading(s):_____(ppm)/_____(ppm)/_____(ppm)/_____(ppm)

Location(s):_____
_____
_____
_____

Air Sampling

	Time	Pressure	Controller Flow
Start:	_____am/pm	_____psig	_____
Stop:	_____am/pm	_____psig	_____

==========

Start:	_____am/pm	_____psig	_____
Stop:	_____am/pm	_____psig	_____

FIELD DATA AIR SAMPLING FORM

Residential Questionnaire

Tenant's Name(s):_____ Age:_____ Tenure:_____
_____ _____ _____
_____ _____ _____
_____ _____ _____
_____ _____ _____

Address:_____

Smoker(s): Y/N Product (Cigars, Pipe, Cigarettes):_____ Number Smoked/Day:_____

Basement/Crawl Space: Y/N Ventilated: Y/N Living Quarters: Y/N
Basement Activities:_____

Private Well: Y/N Sump: Y/N Cistern: Y/N In Use/Plugged: Y/N

Recent Remodeling: Y/N Activities (painting, new carpet, new cabinets): Y/N
_____

VOC sources (hobbies, paints, solvents, gasoline, etc.):_____
_____

Cleaning Products and Storage:_____

Attached Garage: Y/N Garage Storage (cars, lawn mover, etc.):_____

Furnace Type (Oil, Natural Gas, Propane):_____ Furnace Intake: Inside/Outside

Additional Heating Sources (space heater, etc):_____ Fuel Type:_____

Comments:_____
_____
_____
_____
_____

ATTACHMENT TWO

SAMPLING INSTRUCTIONS FOR CANISTERS WITH PNEUMATIC FLOW CONTROLLERS

Sampling Instructions for Canisters With Pneumatic Flow Controllers

1. Inspect your canister shipment upon arrival. Compare the contents with the packing slip and notify the lab of any discrepancy or damage.

2. Familiarize yourself with this diagram and the equipment that you received. The flow controller will be set for the appropriate sampling rate in the laboratory and should not require adjustment.

3. Remove the brass caps from the flow controller and canister. Connect the flow controller to the canister by inserting the "canister connection" into the "canister inlet" and hand tighten the swagelock nut being careful not to cross the threads. Using two open end wrenches (1/2" & 9/16") tighten the nut no more than 1/8 turn past finger tight. DO NOT use adjustable wrenches or pliers.

4. The fittings are swagelock compression fittings. Do not use teflon tape or other sealants, they are not necessary. DO NOT over-tighten any connection. Over-tightening causes leaks, not fixes them.

5. The canister and controller are now ready for ambient air sampling. If you intend to sample a remote location or source, you will need to attach a sampling line. This should be 1/4" O.D. tubing of virgin Teflon or cleaned stainless steel.

6. If arranged with your canister order, the lab will provide a swagelock nut and set of nylon ferrules for connecting line. Slide the nut, the back ferrule, then the front ferrule onto the tubing. Insert the tubing into the sample inlet and slide the ferrules into the fitting. Secure the nut being careful not to cross the threads. When using nylon ferrules, a snug finger tight should be sufficient for a leak free connection.

7. To begin sampling, simply open the canister valve by turning clockwise. One full turn is sufficient. Note the vacuum gauge reading. The vacuum gauge reading should be near the barometric pressure.

8. You can watch the decline in the vacuum to gauge the sampling rate. A one hour sample should drop in vacuum at a rate of 0.5" Hg per minute (i.e. 30"/60 min). Remember this is a rough estimate. The sampling rate is normally set in the laboratory. Occasionally the controller will lose calibration in shipment. If necessary contact the lab for assistance.

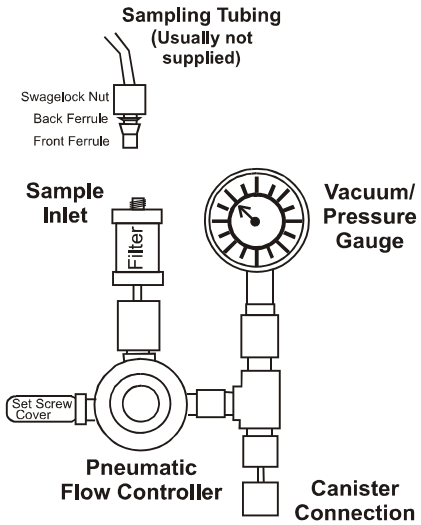
9. After sampling is complete, close the canister valve by turning clockwise until finger tight. DO NOT over-tighten as this WILL damage a very expensive valve.

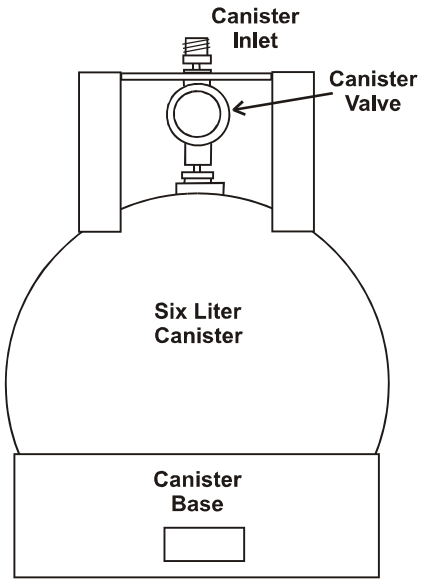
10. Disassemble the components in reverse order of the above assembly instructions. Return all components to the original shipping containers and package them as received.

11. Verify that all parts are packed for return by referencing the packing slip. The project will be charged for all missing or damaged components.

12. Complete a Chain-of-Custody Record and return the sample to the laboratory for analyses.

Teflon will sometimes have very low level freon contamination.





Final Addendum 3 to *Final Work Plan: Supplemental Upward Vapor Risk Investigation at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas,* for Indoor Air Sampling in Homes in Midwinter 2010

This Addendum 3 expands the approved *Final Work Plan*[1] by providing for sampling and additional investigation of the potential risk associated with vapor intrusion at the Hanover site. Addendum 3 presents a plan for collecting indoor air samples in homes in Hanover, Kansas, plus ambient air samples to represent background air conditions. The homes to be sampled fall into three groups, as follows:

- The 17 homes (Table 1) identified during the investigation of groundwater Zone 1 in August 2009 under "Addendum 2 (Revised),"[2] at the locations shown in Figure 1.
- The 3 homes, at the locations shown in Figure 2, identified during the investigation of groundwater Zone 1 as being at risk, in which mitigation systems were installed in August 2009.[3,4,5]
- The 9 homes overlying carbon tetrachloride contamination at depths < 40 ft BGL (below ground level), as identified during subsequent investigation of groundwater Zone 2 in September-October 2009,[6] in the area indicated in Figure 3.

The purposes of the proposed work are to (1) collect additional information during the winter season for homes where the Kansas Department of Health and Environment (KDHE)

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

[2] "Addendum 2 (Revised) to *Final Work Plan: Supplemental Upward Vapor Risk Investigation at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas*, for Indoor Air Sampling at 17 Residences and for Ambient Air Sampling," ANL/EVS/AGEM/CHRON-1273, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, July 1, 2009.

[3] *Vapor Mitigation Work Plan, Former USDA Grain Bin Site, Hanover, Kansas*, ANL/EVS/AGEM/CHRON-1285, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, August 5, 2009.

[4] "Responses to KDHE Comments of August 10, 2009, on *Vapor Mitigation Work Plan, Former USDA Grain Bin Site, Hanover, Kansas*," ANL/EVS/AGEM/CHRON-1296, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, September 15, 2009.

[5] *Technical Memorandum: Vapor Intrusion Mitigation System Installations, Former USDA Grain Bin Site, Hanover, Kansas*, prepared for Argonne National Laboratory, Argonne, Illinois, by EnviroGroup, Limited, Topeka, Kansas, October 19, 2009.

[6] *Summary of Preliminary Results of the Groundwater Zones 2-4 Investigation at Hanover, Kansas, in September-October 2009*, ANL/EVS/AGEM/CHRON-1314, prepared for the Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C., by Argonne National Laboratory, Argonne, Illinois, November 24, 2009.

recommended additional sampling,[7] (2) verify the performance of the mitigation systems installed in three homes in August 2009, (3) perform initial screening for homes located in the area where the carbon tetrachloride contamination in groundwater Zone 2 is shallower than 40 ft BGL, and (4) perform radon testing, in accordance with homeowners' preferences, by using short-term monitoring kits obtained from the Washington County offices.

Sampling in the Seventeen Groundwater Zone 1 Homes Sampled in August 2009

The results of the August 2009 indoor air sampling in the 17 approved homes are summarized in Table 1. The August samples were collected in 24-hr canisters and were analyzed by TestAmerica Laboratories, Inc., South Burlington, Vermont, with Method TO-15.

The midwinter 2010 sampling in 16 of the 17 homes will be conducted according to the procedures described in "Addendum 2 (Revised),"[2] including the provisions specified in KDHE standard operating procedure (SOP) BER-33. Samples will again be collected in Summa canisters for 24 hr, from the basement (or crawl space) and in the first-floor living area of each home. Meteorological conditions will be recorded, and two or more ambient (background) air samples will be collected. The samples will be shipped to TestAmerica for analysis by Method TO-15. Duplicate/replicate indoor air samples will be collected and analyzed at a frequency of 1 duplicate per 20 primary samples.

Resampling of the 17th home (Leo and Ellie Jueneman) is being deferred at the request of the family, with KDHE approval.[8]

Radon testing will be offered to the homeowners. The radon kits used, with KDHE approval,[8] will be obtained from the Washington County offices. The kits (charcoal canisters or pouches) will be used as directed and will be left in place for 3-4 days, to be returned by the homeowners (after exposure) to National Radon Program Services at Kansas State University (133 Ward Hall, Manhattan, KS 66506-2508). The results will be reported to the KDHE when available.

Sampling in the Three Mitigated Homes

Mitigation systems were installed in 3 homes (E. Meier at 400 North East Street, M. Goeckel at 413 East Kensington Street, and D. Schlabach at 311 North East Street) on August 25-27, 2009, by EnviroGroup.[5] A 30-day baseline monitoring event in these homes occurred on September 28, 2009 (Table 2). The purpose of the midwinter 2010 indoor air sampling is to verify that the systems are maintaining performance criteria during cold-weather, closed-house conditions. The sampling and analysis procedures will be the same as for the 17 homes discussed above.[2]

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[7] Electronic mail message from E. Finzer (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding a recent discussion of Hanover vapor intrusion issues, September 15, 2009.

[8] Electronic mail message from C. Carey (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to L. LaFreniere (Argonne National Laboratory, Argonne, Illinois), January 21, 2010.

In conjunction with the midwinter 2010 indoor air sampling, the second monitoring event described by EnviroGroup[5] will be conducted, and the vacuum and flow measurements recommended by the KDHE[9] for individual suction points in the Meier home will be made, as a one-time event. In addition, radon sampling will be offered for the E. Meier and M. Goeckel homes, where radon was detected in previous sampling.

Sampling in the Nine Homes overlying the Zone 2 Contamination

As discussed previously,[6] carbon tetrachloride contamination was identified in groundwater Zone 2 at depths of less than 40 ft BGL (Figure 3). A vapor intrusion investigation in this area is warranted to address 9 homes inferred to overlie the groundwater Zone 2 contamination. Approximately 12 homes were previously estimated in that area on the basis of the 2008 aerial photograph (Figure 3). The physical presence of 9 homes and their addresses were verified in a site visit during the week of January 4; the 3 additional buildings in the area proved not to be residential structures. Testing of these 9 homes will be consistent with procedures outlined for the groundwater Zone 1 homes.[2]

Report Deliverable

A report containing all of the data and all relevant quality assurance/quality control information will be submitted within 45 days of completion of the fieldwork. Subsequently, a discussion will be held with the KDHE concerning potential risks for vapor intrusion. On the basis of this discussion, decisions will be made regarding future actions and time frames for implementation.

Schedule of Field Work

Upon KDHE approval of this Addendum 3 and provision of homeowner contact information by Argonne, the KDHE will contact the owners of homes overlying the shallow portion of groundwater Zone 2 to notify them of KDHE's recommendations for testing and Argonne's pending attempts to schedule the sampling event. Owners of homes overlying groundwater Zone 1 have previously been notified by the KDHE, via letter, of the KDHE's recommendations for resampling. Owners of the mitigated homes were notified by Argonne in September 2009 of the need to resample.

The implementation of this plan is scheduled for midwinter 2010. The KDHE will be notified of the dates scheduled for sampling to allow the agency to schedule oversight and independent sampling activities.

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[9] Letter from E. Finzer (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding the EnviroGroup Technical Memorandum, December 8, 2009.

TABLE 1 The 17 homes overlying groundwater Zone 1 at Hanover in which indoor air sampling is scheduled in midwinter 2010.

No.	Resident	Residence Address	Sample Location	Sample Date	Concentration[a] (µg/m^3) Carbon Tetrachloride	Concentration[a] (µg/m^3) Chloroform
1	Scott and Julia Jueneman	400 E. Kensington St.	First floor	8/12/09	1.5	1.2
			Basement	8/12/09	1.8	1.1
2	Mary Esther Poell	301 N. Belgrave St.	First floor	8/12/09	ND	ND
			Basement	8/12/09	ND	ND
3	Leo and Ellie Jueneman	414 E. Kensington St.	First floor	8/12/09	1.4	1.7
			Basement	8/12/09	1.5	1.6
4	Russell and Bonnie Luehring	309 E. Elm	First floor	8/12/09	3.0	18
			Basement	8/12/09	ND	9.3
5	Vacant (Larry and Linda Thomas out-of-town owners)	311 E. Elm	First floor	8/12/09	1.6	1.4
			Basement	8/12/09	2.3	ND
6	Robert and Amanda Hoover	400 E. Elm	First floor	8/12/09	ND	ND
			Basement	8/12/09	ND	ND
7	Frank and Melony Jueneman	401 E. Elm	First floor	8/12/09	ND	3.5
			Basement	8/12/09	1.6	4.6
8	Denise Kruse	405 E. Elm	First floor	8/12/09	2.3	3.3
			Basement	8/12/09	2.9	2.6
9	Shirley Laue (also 404 Elm)	406 E. Elm	First floor	8/12/09	1.5	ND
			Basement	8/12/09	4.5	ND
10	Frank Jandera	408 E. Elm	First floor	8/12/09	11	ND
			Basement	8/12/09	17	ND
11	Martha Gerdes	409 E. Elm	First floor	8/12/09	ND	ND
			Basement	8/12/09	1.4	ND
12	Vacant (Joseph Poell out-of-town owner)	412 E. Elm	First floor	8/12/09	1.9	ND
			Basement	8/12/09	2.8	ND
13	Charles and Bobbi Neiman	211 N. East	First floor	8/12/09	1.8	ND
			Basement	8/12/09	2.5	ND

TABLE 1 (Cont.)

No.	Resident	Residence Address	Sample Location	Sample Date	Concentration[a] (µg/m^3) Carbon Tetrachloride	Chloroform
14	Edward and Shirley Koehler	303 N. East	First floor	8/12/09	1.4	3.4
			Basement	8/12/09	1.9	3.3
			Subslab	8/12/09	ND	19
15	Don and Patty Spencer	312 E. North	First floor	8/12/09	2.0	ND
			Basement	8/12/09	3.2	ND
16	Bernita Schroeder	404 E. North	First floor	8/12/09	1.6	ND
			Basement	8/12/09	1.8	ND
17	Vera Landoll	513 E. Elm	First floor	8/13/09	ND	ND
			Basement	8/13/09	ND	ND
Ambient		East of CCC/USDA	Water tower	8/12/09	ND	ND

[a] Samples were collected in August 2009 and were analyzed by TestAmerica according to Method TO-15.

TABLE 2 Performance ranges for the three homes having installed mitigation systems, with baseline measurements reported by EnviroGroup.[5]

Schlabach (Suction Point 1)		Meier (Combined)		Goeckel (Suction Point 1)	
Vacuum (in. water)	Flow (cfm)	Vacuum (in. water)	Flow (cfm)	Vacuum (in. water)	Flow (cfm)
Day 1					
-3.69	23.6	-2.69	51.5	-3.72	20.1
Day 30					
-3.82	38.5	-2.50	52.9	-3.75	39.2
Performance range					
± 0.5 (-4.32 to -3.32)	± 20% (46.2 to 30.8)	± 0.5 (-2.0 to -3.0)	± 20% (63.5 to 42.3)	± 0.5 (-4.25 to -3.25)	± 20% (47.0 to 31.4)

HANOVER, KS

FIGURE 1 Approved Indoor Air Monitoring Locations and Mitigation Locations (8/17/09 version)

HANOVER, KS

FIGURE 2 Homes with Mitigation Systems Installed in August 2009

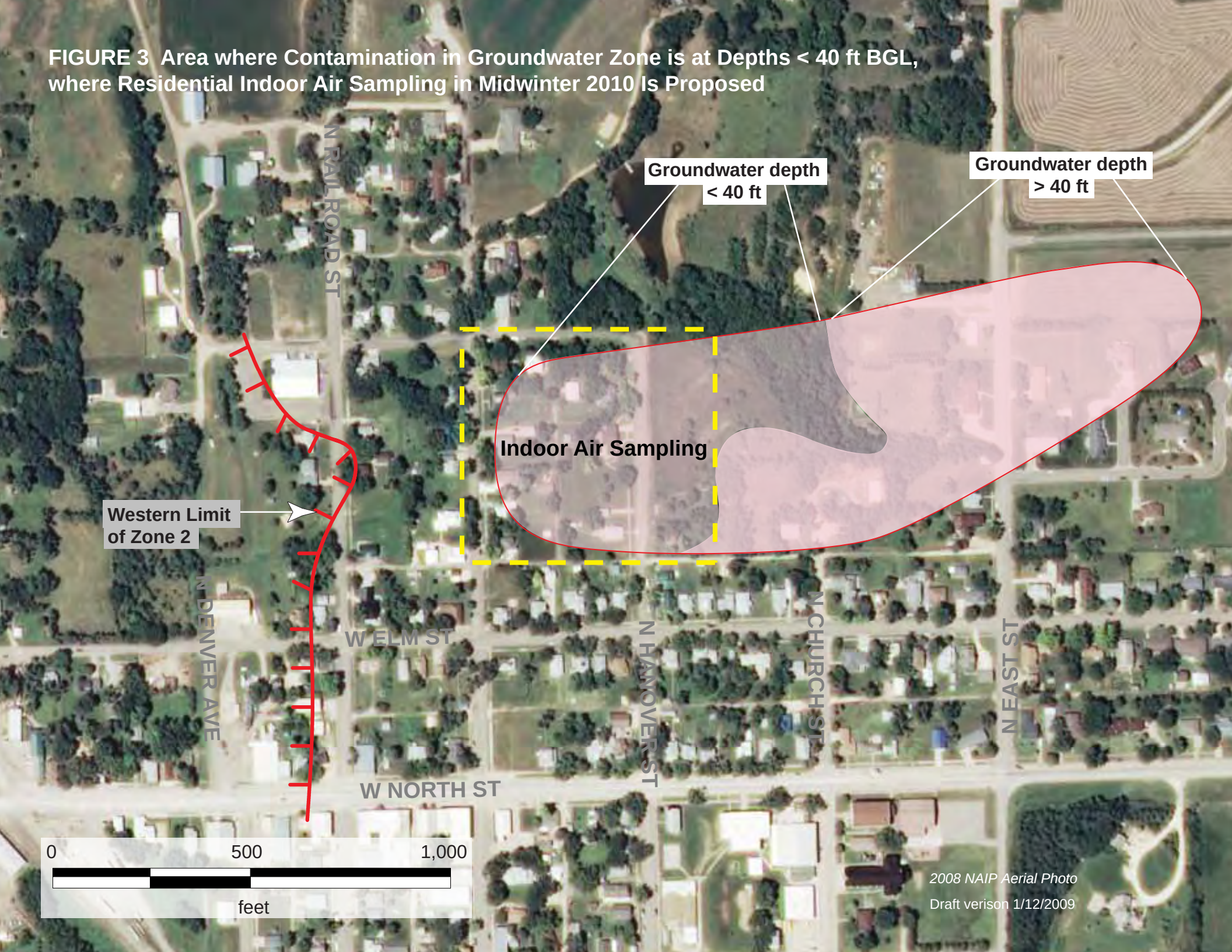
FIGURE 3 Area where Contamination in Groundwater Zone is at Depths < 40 ft BGL, where Residential Indoor Air Sampling in Midwinter 2010 Is Proposed
Groundwater depth < 40 ft
Groundwater depth > 40 ft
Indoor Air Sampling
Western Limit of Zone 2
N RAILROAD ST
N DENVER AVE
W ELM ST
N HANOVER ST
N CHURCH ST
N EAST ST
W NORTH ST
0
500
1,000
feet
2008 NAIP Aerial Photo
Draft verison 1/12/2009

Final Addendum 4 to *Final Work Plan: Supplemental Upward Vapor Risk Investigation at the Former CCC/USDA Grain Storage Facility in Hanover, Kansas,* for Indoor Air Sampling in Schools in Winter 2010

Addendum 4 to the approved *Final Work Plan*[1] expands the investigation of potential risk associated with vapor intrusion potentially originating from the former CCC/USDA grain storage site area in Hanover, Kansas. Specifically, Addendum 4 is focused on testing and assessing the presence of carbon tetrachloride in indoor air in the facilities of the Hanover Public Schools (kindergarten through grade 12) and St. John's School (preschool and grades 1-8).

This expansion of the original vapor intrusion investigation[1] was prompted by concerns expressed by several Hanover residents and by the principal of the Hanover Public Schools, Ms. Valeria Converse, at a meeting of the Chamber of Commerce on October 22, 2009. This meeting was attended by representatives of both Argonne National Laboratory, on behalf of the Commodity Credit Corporation of the U.S. Department of Agriculture (CCC/USDA), and the Kansas Department of Health and Environment (KDHE).

The CCC/USDA, which is conducting the work at Hanover, directed Argonne to proceed with vapor intrusion testing in the schools. This action is in keeping with the ongoing commitment of the CCC/USDA to the health and safety of all Hanover residents. The development of Addendum 4 and the subsequent testing is being performed in consultation with vapor intrusion specialist Dr. Blayne Hartman (Hartman Environmental Geoscience, Solana Beach, California), and with the approval of the KDHE.[2]

Radon was previously detected in area homes at levels posing a significant health hazard. The CCC/USDA opted to offer radon testing in the schools, and the respective administrators are agreeable. The radon testing is not required by the KDHE, and if radon contamination is detected, the CCC/USDA is not liable and will not be held responsible for mitigation. Radon is a naturally occurring radioactive gas resulting from the decay of uranium.

Preliminary On-site Visit

At the CCC/USDA's direction, Argonne technical staff and Dr. Hartman visited the schools and conferred with the principals regarding the vapor intrusion testing on January 13, 2010. Inspections of both Hanover schools were conducted at that time. Both schools are older masonry buildings with lower basement floors that are below or partially below grade. Further, the Hanover Public Schools facility consists of multiple buildings, some more than 100 years old.

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

2 Letter from E. Finzer (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to C. Roe (Commodity Credit Corporation, U.S. Department of Agriculture, Washington, D.C.), regarding vapor intrusion assessment of the schools at Hanover, October 29, 2009.

The below-grade construction of the school buildings and the complex arrangement of the rooms in the public school facilities prevented ready identification of preferential entry points into the structures and the most appropriate rooms for collection of time-integrated indoor air samples in canisters. Consequently, we propose a two-step strategy of preliminary screening in a large number of rooms, followed by time-integrated sampling with canisters in a smaller number of targeted locations.

Procedures for Preliminary Screening for Carbon Tetrachloride and Chloroform in Air

To identify the most appropriate rooms for time-integrated sampling with canisters, we propose initially to conduct preliminary screening of the air in most of the rooms in each school facility for carbon tetrachloride and chloroform. The preliminary screening will involve the collection of grab samples in glass syringes, with real-time analysis by the EPA SW-846 Method 8021 on a gas chromatograph with an ultra-sensitive electron capture detector. The procedure will be the same as that used during the spring 2009 assessment of the neighboring homes.

Locations for the subsequent collection of time-integrated canister samples will be determined on the basis of the preliminary screening results from the Method 8021 analyses. In general, the rooms showing the highest concentrations in the screening evaluation will be selected for time-integrated sampling with canisters. More specific plans for selecting rooms for canister sampling — in the event that the contaminants of concern are not detected in the screening evaluation — are discussed below for the two school facilities.

Procedures for Canister Sampling for Carbon Tetrachloride and Chloroform

Sample collection in canisters will be in accordance with KDHE standard operating procedure BER-33[3] and in compliance with KDHE vapor intrusion guidance.[4] Samples will be collected in evacuated Summa canisters, individually certified clean, for a period of 8-10 hr during the normal school day (to provide an accurate assessment of indoor air concentrations to which students and staff are exposed, per the 1989 *Risk Assessment Guidance for Superfund* [RAGS]).[5,6] Sampling canisters will be placed at a distance from heating system registers and at a height of 3-7 ft above the floor (in the breathing zone). Meteorological conditions will be noted

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[3] "Procedures for Sampling and Analysis of Indoor Air Samples," BER-33 in *Appendix A: Bureau of Environmental Remediation Standard Operating Procedures*, December 2000 (http://www.kdheks.gov/environment/qmp_2000/download/BER_SOPs_Appendix_A.pdf).

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

[5] *Risk Assessment Guidance for Superfund: Volume I. Human Health Evaluation Manual (Part A)*, EPA/540/1-89/002, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., December 1989 (http://www.epa.gov/oswer/riskassessment/ragsa/pdf/rags-vol1-pta_complete.pdf).

[6] *Calculating Upper Confidence Limits for Exposure Point Concentrations at Hazardous Waste Sites*, OSWER 9285.6-10, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, Washington, D.C., December 2002 (http://www.epa.gov/oswer/riskassessment/pdf/ucl.pdf).

and recorded. The first page of the field data air sampling form in KDHE procedure BER-33 (included in this addendum) will be completed. Sampling locations are discussed further below.

After completion of the school-day sampling, at least one overnight sample will be collected in each school to represent worst-case conditions. The locations will be selected in consultation with the KDHE.

Hanover Public Schools Facilities

The public school facilities consist of several different buildings. Floor plans are included in this attachment. The proposed sample locations for each building are as follows:

- The *main (oldest) building* of the public school consists of a basement level plus two upper floors. All rooms will be subjected to the preliminary screening with analysis by Method 8021. Rooms will be selected for indoor air sampling with canisters on the basis of the screening data. We propose to collect a total of four indoor air canister samples in this building. If carbon tetrachloride is not detected in any room, we will place the sampling canisters as follows: two on the basement floor and two on the main floor.
- The *gymnasium and cafeteria building* houses a large gymnasium and attached cafeteria. The air exchange between the gym and cafeteria is clearly rapid, and the air is expected to be well mixed. The high gymnasium ceilings suggest very high dilution of any volatile organic compounds (VOCs) that might enter via vapor intrusion. One or two canister samples are proposed for this building. Location(s) for the canister sampling will be based on the screening data (Method 8021).
- The *new building* consists of one floor, of slab-on-grade construction, with science laboratories that could contain carbon tetrachloride sources. Any carbon tetrachloride detections in this building would be extremely difficult to interpret. For this reason, we do not propose to sample this building.
- Activities conducted in the *wood and machine shop building* use numerous products that were observed during the inspection — glues, paints, oils, solvents, etc. These products could possibly be a source of carbon tetrachloride and certainly are a source of other VOCs. Any carbon tetrachloride detections in this building would be extremely difficult to interpret. For this reason, we do not propose to sample this building.
- Activities conducted in the *art building* use numerous products that were observed during the inspection — glues, paints, oils, paint cleaners, etc. These products could possibly be a source of carbon tetrachloride and certainly are a source of other VOCs. Any carbon tetrachloride detections in this building would be extremely difficult to interpret. For this reason, we do not propose to sample this building.
- Any modifications to the proposed locations and number of samples will be made in consultation with the KDHE.

St. John's School Facility

The St. John's School consists of one large building with a lower level (partially below grade), plus two upper floors. Floor plans are included in this attachment. The lowest floor consists of a gymnasium on the eastern end (at grade) with a locker room, a boiler room, a preschool classroom, and storage rooms on the western end. The boiler room connects directly to the preschool classroom; the indoor air in these two rooms is assumed to be similar.

We propose to collect a total of four indoor air canister samples in the St. John's School building. All rooms will be subjected to the preliminary screening with analysis by Method 8021, and rooms will be selected for canister sampling on the basis of the Method 8021 screening data. If carbon tetrachloride is not detected in any room, we will place the sampling canisters as follows: two on the lowest floor (one in the preschool room and one in the gymnasium) and two on the main floor.

Any modifications to the proposed locations and number of samples will be made in consultation with the KDHE.

Collection of Ambient Air Samples

Two ambient (outside) air samples will be collected, one on the northern side of each school facility (toward the location of the former CCC/USDA facility), over the same collection period as the indoor air sampling.

Analysis of Canister Samples

After sampling, the canisters will be shipped to TestAmerica, a certified independent laboratory, for analysis for carbon tetrachloride and chloroform by method TO-15, at a detection level at or below the allowable risk-based indoor air level.

Data Interpretation

Interpretation of analytical results for the canister samples will be done with full consideration for the prevalence of sources of chloroform (especially) and carbon tetrachloride (to a lesser extent) that are unrelated to vapor intrusion from the subsurface.

Radon Analysis

Kits will be used for radon analysis in every room of the of the St. John's School building. Radon kits will also be placed in the public school facilities, as follows: in every room of the main (oldest) building; in the gym and cafeteria; and in selected rooms of the new building, the wood and machine shop building, and the art building.

The kits to be used were approved by the KDHE for the January 2010 residential indoor air sampling at Hanover.[7] The kits will be obtained from the Washington County offices. The

[7] Electronic mail message from C. Carey (Bureau of Environmental Remediation, Kansas Department of Health and Environment, Topeka, Kansas) to L. LaFreniere (Argonne National Laboratory, Argonne, Illinois), January 21, 2010.

kits (charcoal canisters or pouches) will be used as directed and will be left in place for 3-4 days, to be returned by Argonne personnel (after exposure) to National Radon Program Services at Kansas State University (133 Ward Hall, Manhattan, KS 66506-2508). The results will be reported to the KDHE when available.

Report Deliverables

A report containing all of the results of the analyses and all relevant quality assurance/quality control information will be submitted within 45 days of the receipt of the data package from TestAmerica.

Schedule of Sampling Event

Implementation of the plan presented here for the testing of the indoor air and potential for vapor intrusion is scheduled to begin before the school day on Tuesday, February 23, 2010, with the preliminary screening of both school facilities. Canister deployment will follow on Wednesday, February 24, 2010, commencing prior to the arrival of the students and ending with retrieval of the canisters at the end of the day. Confirmation sampling in canisters will occur overnight on Wednesday evening, February 24, to Thursday morning, February 25. After sampling, the canisters will be shipped to TestAmerica for delivery on Friday, February 26, 2010. The dates of the sampling event were determined in discussion with personnel of the Hanover schools. The KDHE will be notified of any changes to the schedule for sampling to allow the agency to perform oversight and independent sampling activities.

FIELD DATA AIR SAMPLING FORM

Site Name:_____

Sample Identification:_____/_____ Date Sampled:_____

Sample Location(s):_____
_____

Sampler:_____ Canister Serial #:_____/_____

Environmental Conditions

Outdoor Temperature:_____ Barometric Pressure:_____ Wind Speed/Direction:_____

Relative Humidity:_____ Comments:_____

Preliminary Screening

Instrumentation:_____ Calibration Date:_____ Time:_____ am/pm

Field Reading(s):_____(ppm)/_____(ppm)/_____(ppm)/_____(ppm)

Location(s):_____
_____
_____
_____

Air Sampling

	Time	Pressure	Controller Flow
Start:	_____am/pm	_____psig	_____
Stop:	_____am/pm	_____psig	_____

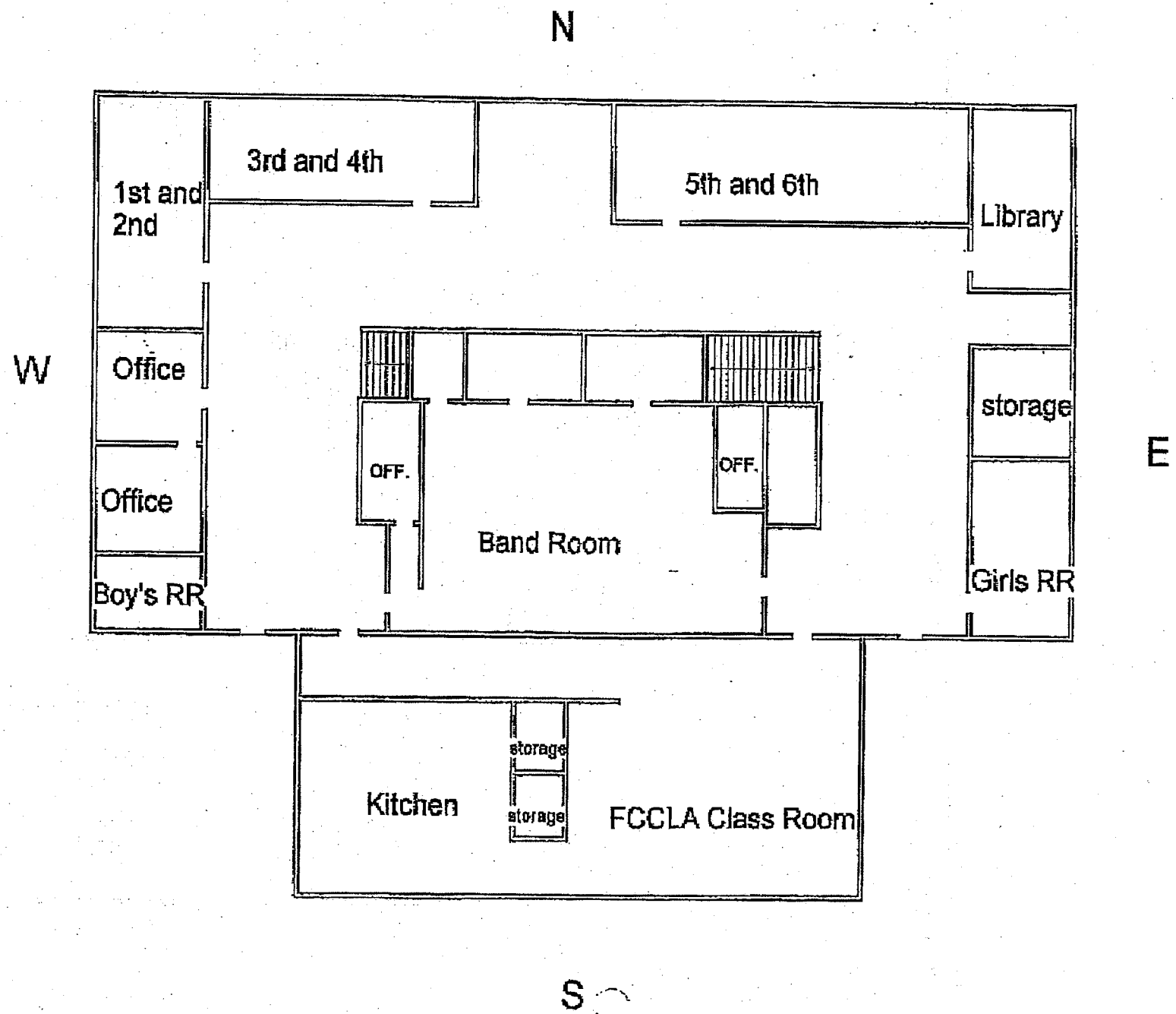
==========

Start:	_____am/pm	_____psig	_____
Stop:	_____am/pm	_____psig	_____

Hanover Public Schools

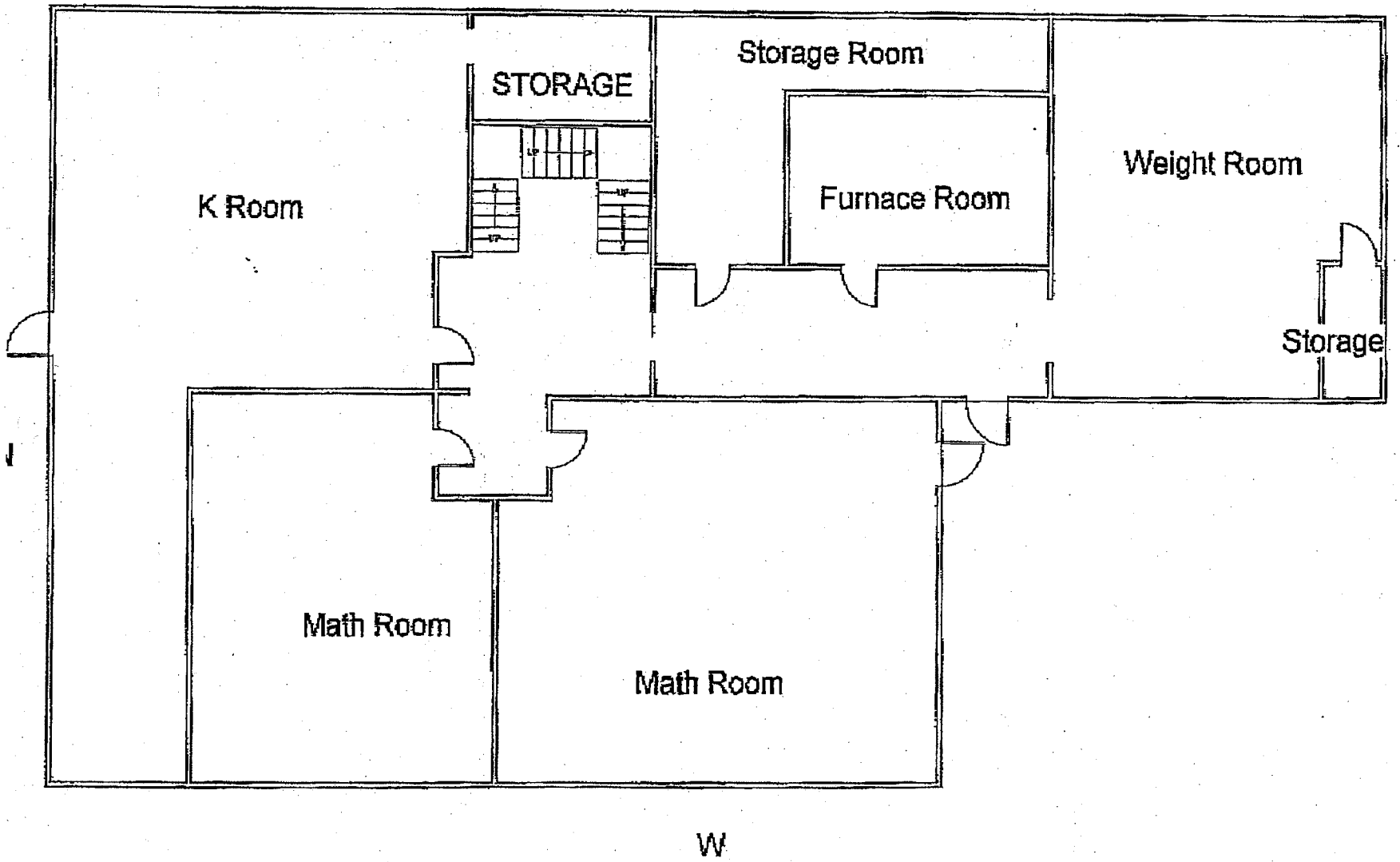
Main Floor

Hanover Attendance Ctr.



Hanover Attendance Ctr.

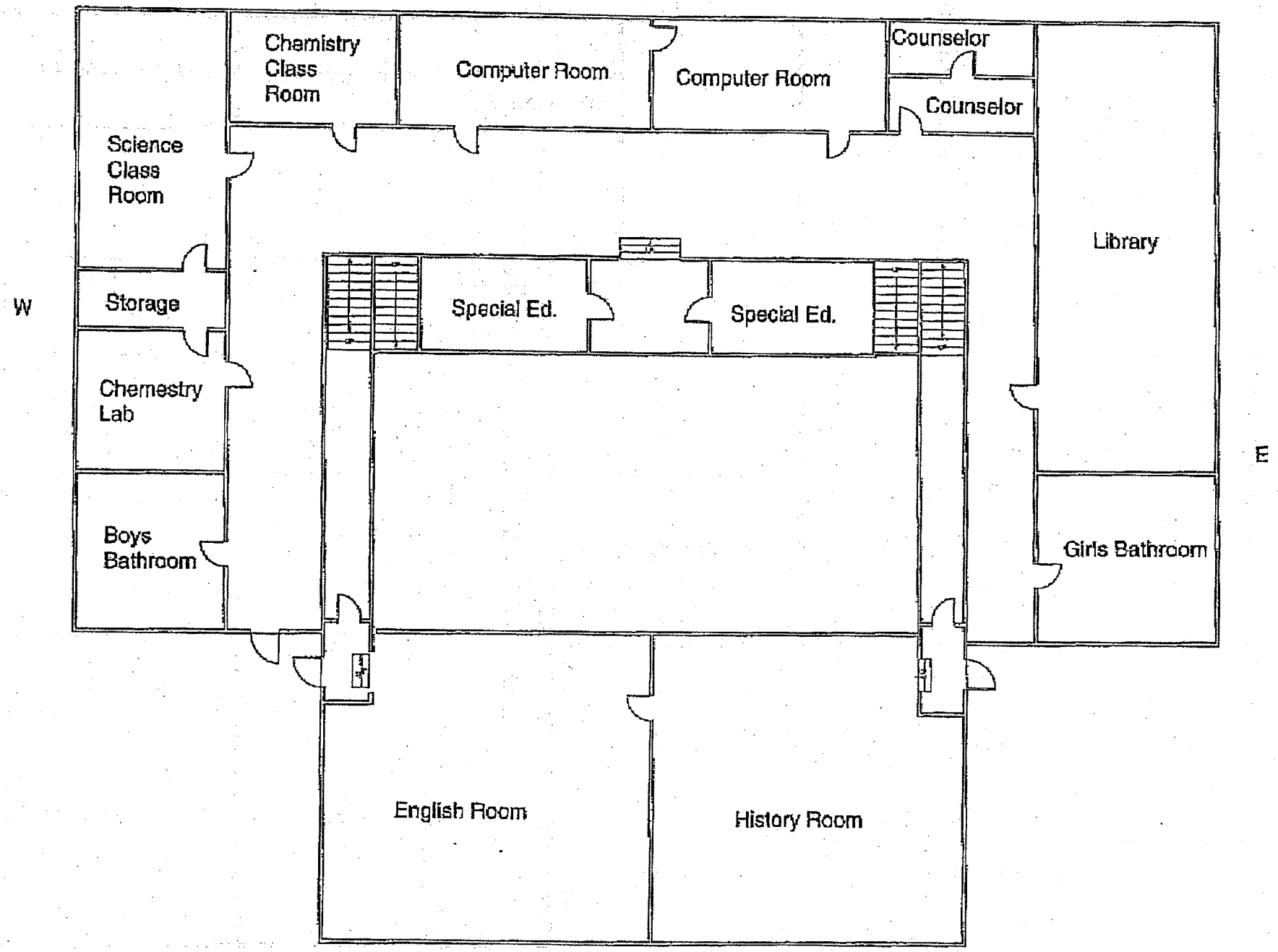
Basement



Hanover Public Schools

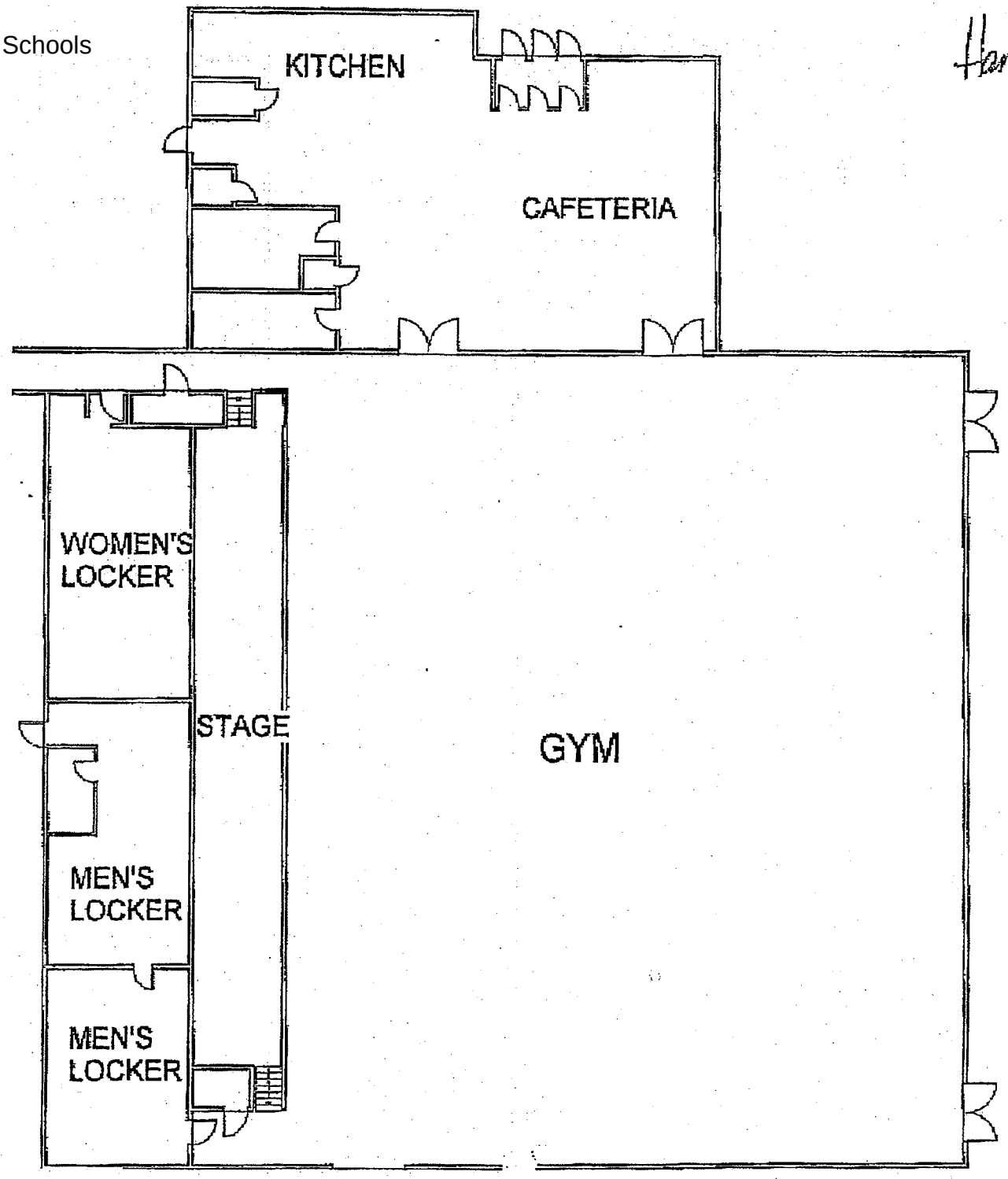
N Top Floor

Hanover Attendance Ctr

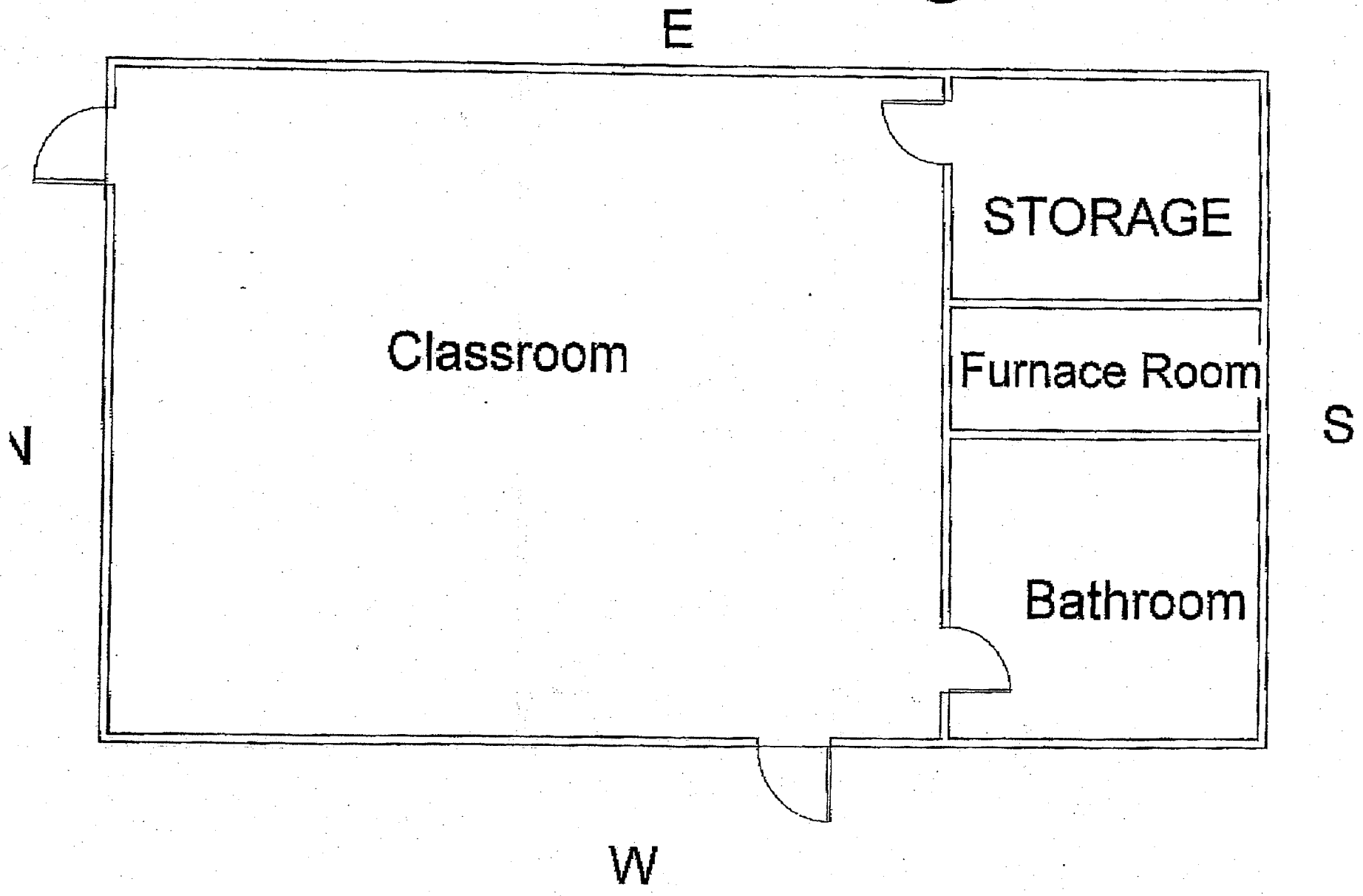


Hanover Public Schools

Hanover Attendance Ctr

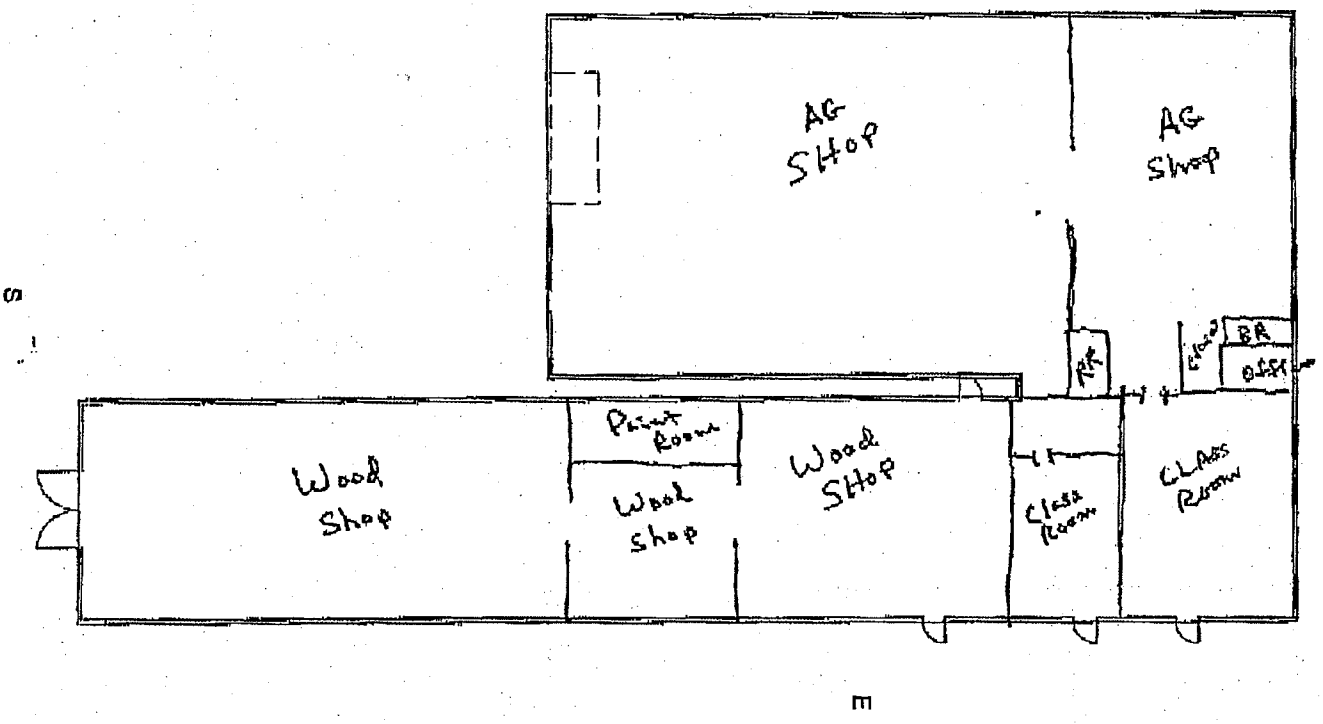


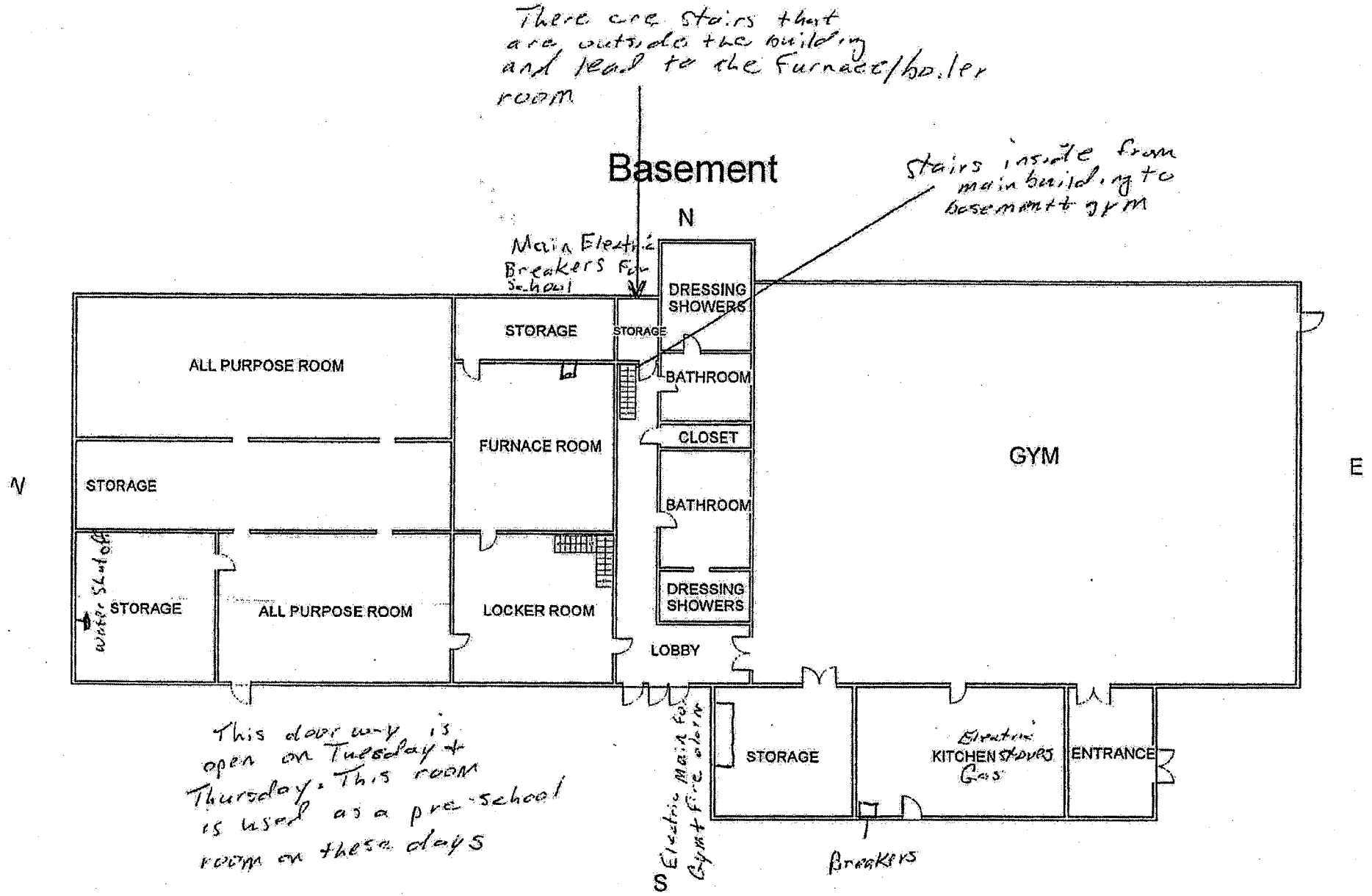
Art Building



Hanover Public Schools

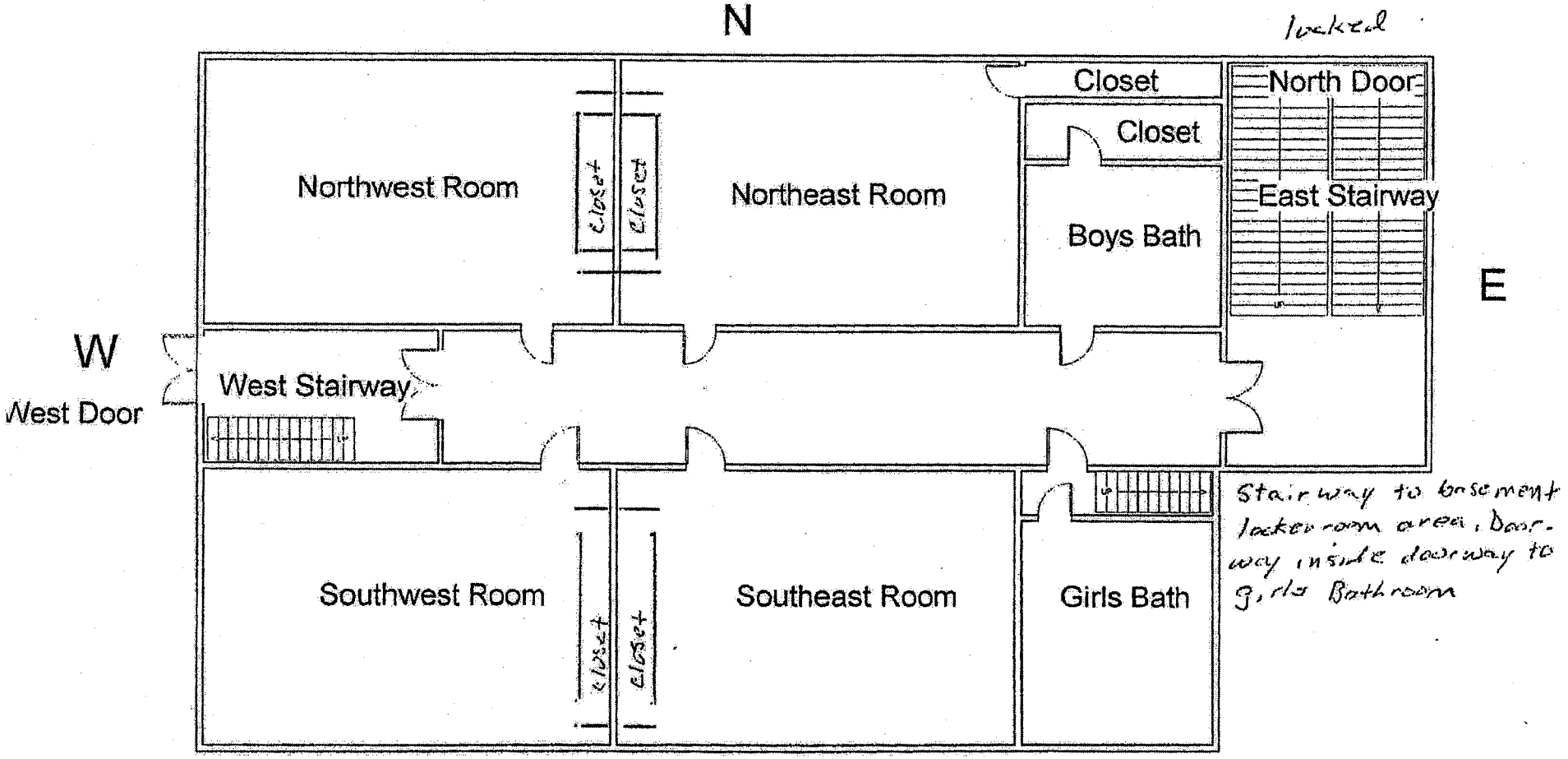
Wood/Ag Shops





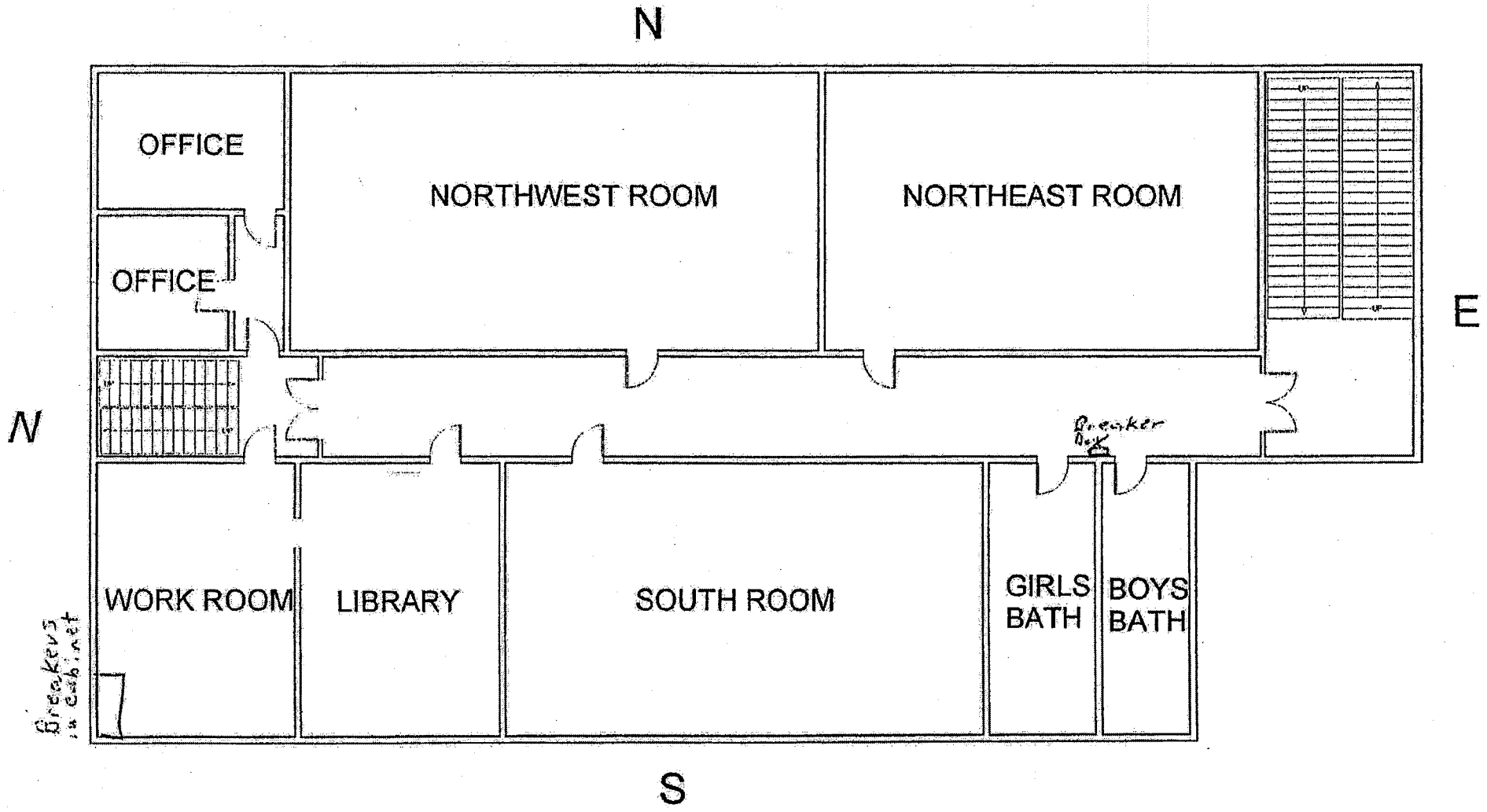
St. John's School, Hanover, Kansas

First Floor Fire Exits



St. John's School, Hanover, Kansas

Second Floor Fire Exits



St. John's School, Hanover, Kansas

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