BJC/OR-1287/R1

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Environmental Baseline Survey Report for the Title Transfer of the K-1330 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

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BJC ETTP Classification and Information Control Office	**Date**

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

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Environmental Baseline Survey Report for the Title Transfer of the K-1330 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

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managing the
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Paducah Gaseous Diffusion Plant Portsmouth Gaseous Diffusion Plant
under contract DE-AC05-98OR22700
for the
U. S. DEPARTMENT OF ENERGY

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This report is intended to be used in its entirety. Excerpts, which are taken out-of-context, run the risk of being misinterpreted and are, therefore, not representative of the findings of this assessment. Opinions and recommendations presented in this report apply only to site conditions and features as they existed at the time of SAIC's site visit, and those inferred from information observed or available at that time, and cannot be applied to conditions and features of which SAIC is unaware and has not had the opportunity to evaluate.

The results of this report are based on record reviews, site reconnaissance, interviews, and the radiological report reviewed and approved by BJC. SAIC has not made, nor has it been asked to make, any independent investigation concerning the accuracy, reliability, or completeness of such information.

All sources of information on which SAIC has relied in making its conclusions are identified in Chap. 7 of this report. Any information, regardless of its source, not listed in Chap. 7 has not been evaluated or relied upon by SAIC in the context of this report.

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ACRONYMS

AC	air conditioning
BJC	Bechtel Jacobs Company LLC
CDR	Covenant Deferral Request
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	*Code of Federal Regulations*
COE	U. S. Army Corps of Engineers
DCGL	derived concentration guideline level
$DCGL_{EMC}$	derived concentration guideline level $_{\text{elevated measurement comparison}}$
DOE	U. S. Department of Energy
dpm	disintegrations per minute
EBS	environmental baseline survey
EPA	U. S. Environmental Protection Agency
ESU	exterior survey unit
ETTP	East Tennessee Technology Park
FFA	Federal Facility Agreement
FSU	furnishings survey unit
HP	health physicist
ISU	interior survey unit
MARSSIM	*Multi-Agency Radiation Survey and Site Investigation Manual*
NORM	naturally occurring radioactive material
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations Office
ORR	Oak Ridge Reservation
PCB	polychlorinated biphenyls
PRG	preliminary remediation goal
QA/QC	quality assurance/quality control
RADCON	Radiological Control Organization
RCRA	Resource Conservation and Recovery Act of 1976
RCW	Recirculating Cooling Water
ROD	Record of Decision
TRU	transuranic
TVA	Tennessee Valley Authority

EXECUTIVE SUMMARY

This environmental baseline survey (EBS) documents the baseline environmental conditions of the U. S. Department of Energy's (DOE's) K-1330 building at the East Tennessee Technology Park (ETTP). DOE is proposing to transfer the title of this building to the Community Reuse Organization of East Tennessee or one of its subsidiaries. This report provides supporting information for the transfer of this government-owned facility at ETTP for reuse and redevelopment by a private company. This EBS is based upon the requirements of Sect. 120(h) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980.

The K-1330 building is located in the southeastern portion of ETTP. It is a 14,400-ft^2 (7200 ft^2 on each of the two floors), two-story masonry structure that was built in 1990 as an office building for the Environmental Restoration organization. Building K-1330 has been used by several site organizations since its construction and continues to be used for offices. There is an asphalt parking area on the north side of the building and a grassy yard that extends around the east, west, and south sides of the building. It is located outside of the ETTP property protection fence.

Preparation of this report included the review of government records, title documents, aerial photos, visual inspections of the property and adjacent properties, and interviews with current and former employees[1] to identify any areas on the property where hazardous substances and petroleum products were stored for 1 year or more, known to have been released, or disposed of (BJC 2002a). Radiological surveys were conducted to assess radiological contamination. Following is a summary of the findings of the evaluation that was performed:

- No chemicals exceeding 1000 kg have been stored and/or used in Bldg. K-1330 for one or more years.
- No asbestos was present in the building. All insulation and ceiling tiles are of man-made mineral fibers.
- There was no evidence found of a release of hazardous substances or petroleum products in excess of the substance's reportable quantity occurring in Bldg. K-1330.
- No soil sampling was conducted for this report since no exterior areas are included in the title transfer.
- The building interior, exterior, and furnishings were radiologically surveyed in accordance with the survey plan (Appendix D). The data were analyzed using the Sign test, a non-parametric statistical test, to determine if any residual contamination was present and if the contamination may exceed the derived concentration guideline level (DCGL) established for each of the survey units. Survey results showed that the K-1330 study area had no areas of elevated residual radioactivity present above DOE contamination limits or the DCGL and, therefore, can be released without radiological restrictions. The radiological survey results are discussed in Sect. 6.3 of this report.

[1]Personal communications with Lynn Francis, Ray Russell and J. L. Haymore (either previously or currently employed at the East Tennessee Technology Park).

CONCLUSIONS

Based on the U. S. Department of Energy's (DOE's) review of the existing information, including discussions and interviews referenced herein, and evaluation of the data gathered in preparation of the environmental baseline survey for Bldg. K-1330, DOE recommends the following:

1. Due to the uncertainty associated with the nature of the on-site groundwater and the need to evaluate and possibly address groundwater issues in the future, DOE recommends that the transfer of Bldg. K-1330 be achieved by a covenant deferral per the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) Sect. 120(h)(3)(c), et seq.

LAND USE RESTRICTIONS

Land use restrictions are an important component of a CERCLA covenant deferral; they help to ensure that transfer of the property is protective for the intended use. The restrictions that will apply to Bldg. K-1330 are summarized below. Full details are found in the Covenant Deferral Request package.

1. Extraction, consumption, exposure or use in any way of the groundwater underlying the property or water from any streams or ponds located on the property is prohibited.

2. Development of the property must comply with all applicable federal, state and local laws and regulations. Development activities must follow the East Tennessee Technology Park (ETTP) site procedures for obtaining excavation and penetration permits, and construction of basements is prohibited.

3. The property shall not be used or developed in a manner that is inconsistent with the land use assumptions of "unrestricted industrial use" contained in the *Record of Decision for Interim Remediation of Contaminated Soil, Material, and Buried Waste in Zone 1 of the East Tennessee Technology Park* (DOE 2002a). Accordingly, use of the area of the property below 10 ft is prohibited.

4. In order to ensure that the vapor intrusion pathway (i.e., the migration of volatile organic compounds in contaminated groundwater and/or soil to indoor air) does not contribute to an unacceptable risk to human health; DOE will address the potential for vapor intrusion in the ETTP Groundwater Record of Decision (ROD) currently scheduled to be signed by 2006; and will take interim measures to ensure protectiveness until the ROD is signed. The interim measures to be implemented include: collection of samples inside the building to confirm the pre-transfer determination that the vapor intrusion pathway does not pose a significant risk to human health, and making physical modifications to the facility as necessary to ensure protection or otherwise monitoring the stability of groundwater conditions and change in the building.

RESPONSE TO REGULATOR COMMENTS

In May 2003, DOE received a number of comments from Region 4 of the U. S. Environmental Protection Agency (EPA) on document content and level of detail. Changes in response to those comments have been incorporated throughout this report. Additional comments from EPA, the DOE Oversight Division of the Tennessee Department of Environment and Conservation, and members of the public will be included in the final version of the report.

1. PROPERTY IDENTIFICATION

The K-1330 building discussed in this environmental baseline survey is located in the southeastern portion of the East Tennessee Technology Park (ETTP) [formerly the K-25 Site] on the Oak Ridge Reservation (ORR) in Roane County, Tennessee. Building K-1330 is outside the ETTP perimeter fence and is located south of the K-1240-3C Parking Area. Figure 1.1 is a map showing the relationship of Bldg. K-1330 to ETTP, and Fig. 1.2 is an ortho image showing the footprint of the K-1330 study area. Figure 1.3 is an aerial photograph showing the location of K-1330 in relation to ETTP.

The area proposed for title transfer includes the K-1330 Building, a covered bench (K-1019-23), exterior electrical and air-conditioning equipment, and the underlying fee.

Preparation of this report included the review of government records, title documents, aerial photos, visual inspections of the property and adjacent properties, and interviews with current and former employees[2] to identify any areas on the property where hazardous substances and petroleum products were stored for one year or more, known to have been released, or disposed (BJC 2002a).

[2]Personal communications with Lynn Francis, Ray Russell, and J. L. Haymore (either previously or currently employed at the East Tennessee Technology Park).

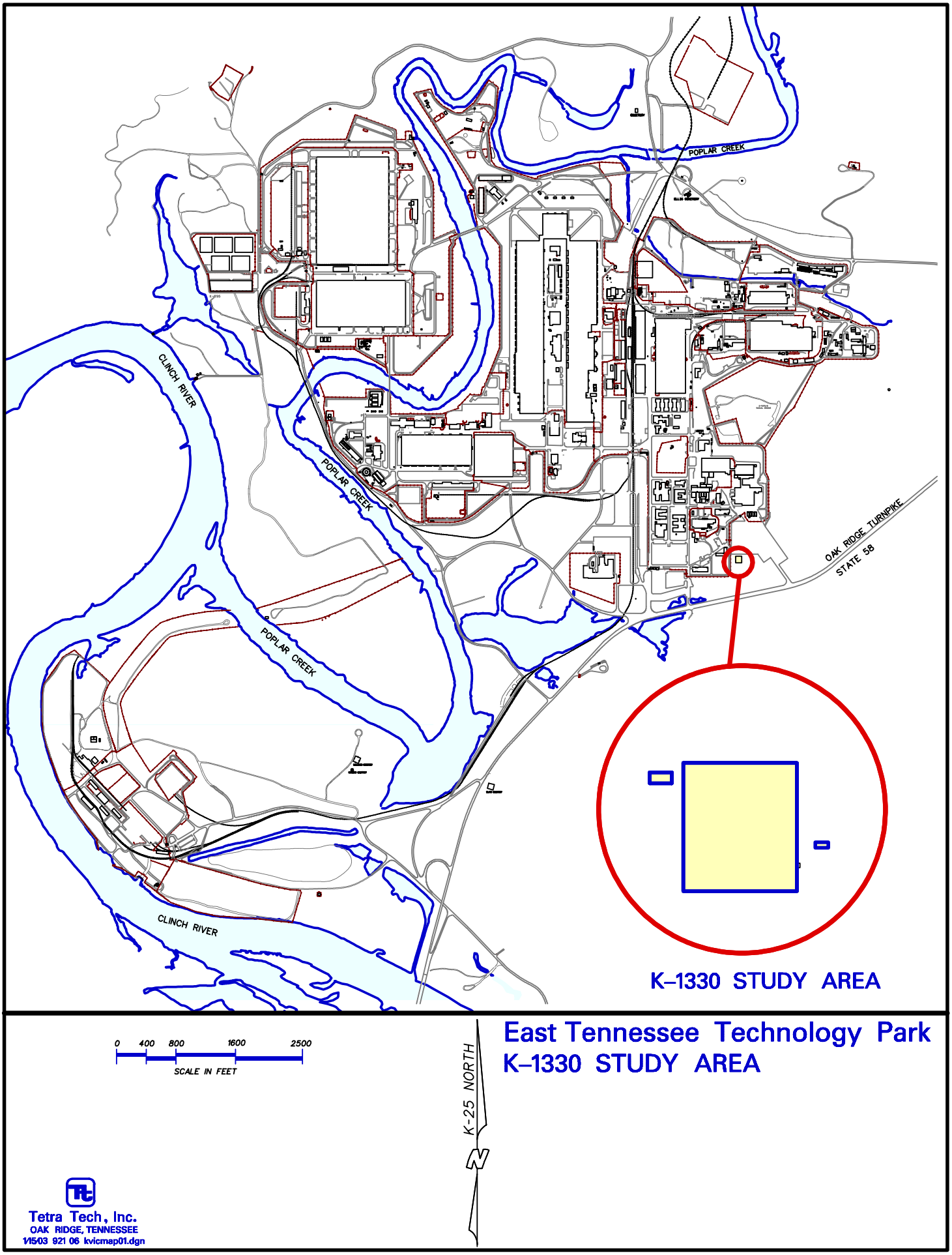

Fig. 1.1. Location map of the K-1330 study area.

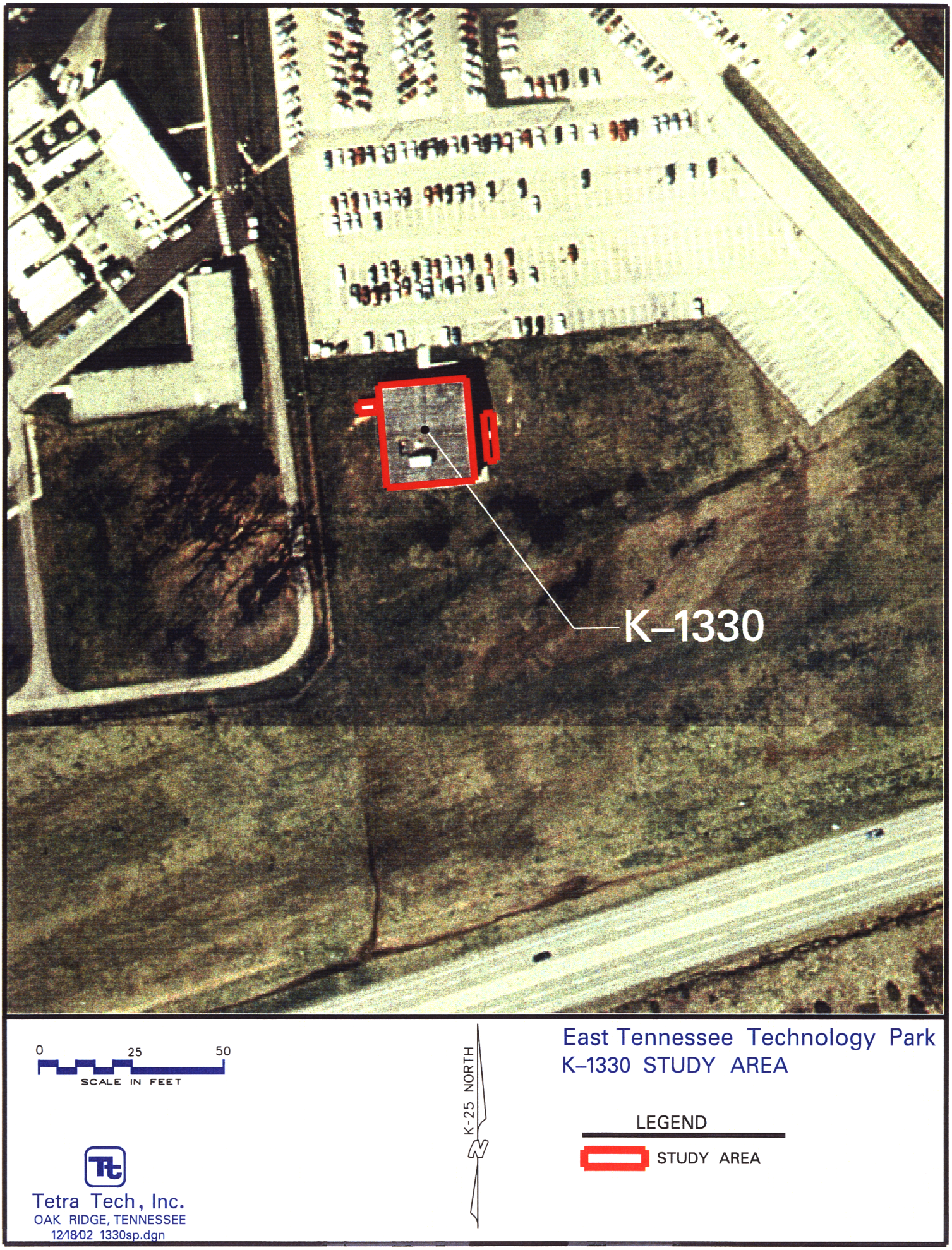

Fig. 1.2. Ortho image of the K-1330 study area.

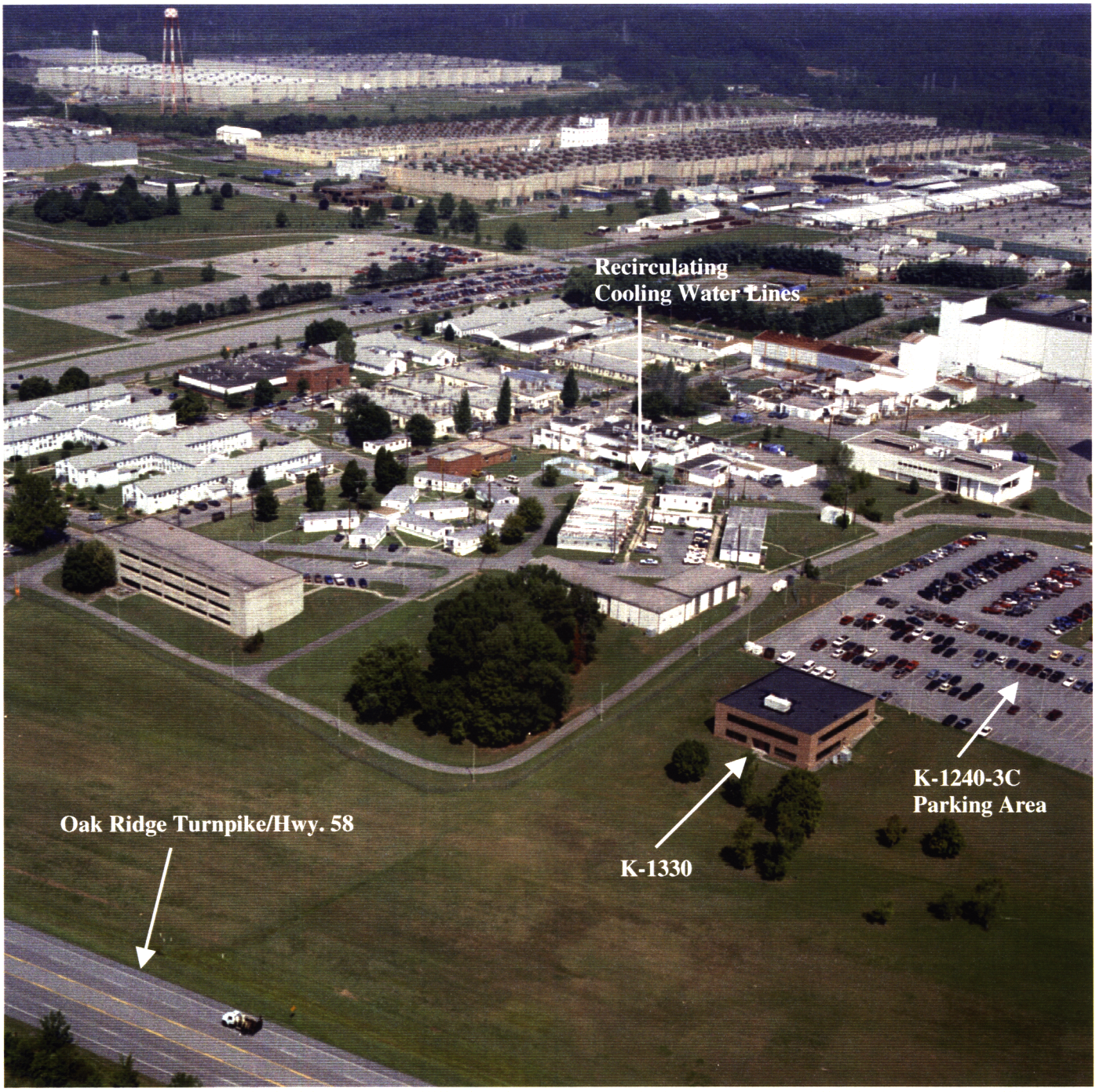

Fig. 1.3. Aerial photograph showing location of Bldg. K-1330 in relation to ETTP.

2. TITLE SEARCH

On June 4, 1996, a visit was made to the state of Tennessee Roane County Recorder's Office to conduct a review of the recorded deeds documenting previous ownership of the land tract H-720 where the K-1330 study area is located. The deeds contained no information or references to other recorded evidence that, prior to U. S. Department of Energy (DOE) ownership, the property was utilized for the storage of hazardous substances and/or petroleum products or their derivatives. Additionally, no information contained in the deeds would indicate that hazardous substances and/or petroleum products or their derivatives were released from or disposed of on the property. Prior to acquisition by the government, the area was farmland and was a combination of cultivated fields, pastures, and forested areas.

The deeds that conveyed the property from the previous owner to the U. S. Government and any deeds that conveyed the property to that previous owner were reviewed as a part of the title search. Generally, the deeds from the previous two owners of a particular Oak Ridge Reservation (ORR) parcel provide information that goes back to the early 1900s or even earlier. The deeds were reviewed for any references to previous land uses (e.g., homestead, farm, school, business, etc.). Also reviewed were any easements or conveyances referenced in the deeds that might indicate that portions of the land were used for pipelines, power lines, etc. Partial disposal or acquisition conveyance deeds were also reviewed because in some instances the land comprising a large farm had been acquired via several separate acquisitions.

In addition, property assessment records from the County Property Assessor's Office were reviewed because these documents may also contain evidence of a particular land use. Survey or subdivision maps referenced in deeds and maintained in the Register of Deeds office were also reviewed for any indications of a previous land use. Furthermore, because the Tennessee Valley Authority (TVA) was the previous owner of several large tracts of ORR land, the TVA Real Estate Office was contacted regarding their knowledge of any previous land uses. The U. S. Army Corp of Engineers (COE) was another source of information that was contacted.

3. FEDERAL RECORDS SEARCH AND REGULATORY SUMMARY

3.1 FEDERAL RECORDS SEARCH

TVA in Knoxville, Tennessee, and the COE District Office in Nashville, Tennessee, were contacted in 1996, 1997, and again on April 6, 1998, to determine if they maintained any records reflecting past or present land use relative to the land presently comprising ETTP (TVA 1998; COE 1998). Neither TVA nor COE had any information regarding the history of past or present land use that would indicate if hazardous substances or petroleum products were stored or released on the DOE-owned property currently comprising the ETTP.

In February 1997, DOE real estate records that document previous ownership of the land tract H-720 where Bldg. K-1330 is located were examined. Page A-3 of Appendix A is a statement[3] from the Realty Officer of the DOE Oak Ridge Operations Office (ORO) that the real estate records contained no information or references to other recorded evidence that, prior to DOE ownership, the property was utilized for the storage of hazardous substances. Additionally, no information contained in these records would indicate that hazardous substances were released from or disposed of on the property.

The following pre-construction aerial photographs and maps reflecting prior use of this land were also reviewed. Copies of these photographs and maps are maintained on file in the Bechtel Jacobs Company LLC (BJC) Real Estate Office.

Aerial Photographs:

Photograph Nos. and Date	Flight By	Source
No. 130-3-9, dated 1939	Unknown	BJC, Real Estate Office
Nos. 820-2-20 through -23 and 820-3-20 through -24, dated September 25, 1942	Aero Service Corp. for Stone and Webster	BJC, Real Estate Office

These photographs, which were taken in 1939 and 1942, show that the land where the study area is located was predominantly used for agricultural purposes. The remaining land was wooded. A map depicting pre-World War II structures, churches, and cemeteries that were present in the area of ETTP is also included on page B-3 in Appendix B.

Topographic and real estate maps:

1. A November 2, 1942, topographic map identified as Sect. A-1 of ORR was prepared by Aero Services Corporation for Stone and Webster.

2. A February 19, 1945, real estate map (sheet 9 of 16) prepared by the U. S. Army shows the boundaries of all land tracts upon which facilities at the site are currently located. The study area is on Land Tract H-720.

Neither the aforementioned photographs nor maps contained any information regarding the history of the past land use that would indicate that storage or releases of hazardous substances or petroleum products have occurred on the land where Land Tract H-720 is located. Copies of the 1942 topographic map and real estate map are maintained in the BJC Real Estate Office and the DOE-ORO Real Estate Office.

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[3]DOE 2002b. Statement from Realty Officer, DOE Oak Ridge Operations Office, "CERCLA 120(h) Review, Tract No. H-720, East Tennessee Technology Park, Oak Ridge Reservation," U. S. Department of Energy.

3.2 REGULATORY SUMMARY

As discussed previously, prior to ownership by DOE (and its U. S. Government predecessor agencies), the property was farmland. Any DOE operations within the footprint of K-1330 occurred under DOE's own authority, without external regulation, prior to 1984. Interviews with employees and a review of records do not show that spills occurred.

Interviews with employees or former employees[4] and the building's operational history indicate that no regulatory actions have occurred within the footprint of K-1330. Therefore, no regulatory responses have been invoked.

Additionally, there are no regulated underground storage tanks (USTs) associated with Bldg. K-1330.[5] The nearest UST was located at the Happy Valley Campground gas station at the corner of Boulevard and the Oak Ridge Turnpike.

[4]Personal communications with Ray Russell and Mike Harvey (currently employed at ETTP).

[5]Email communications from S. T. Goodpasture of CDM Federal (currently employed at ETTP and former UST manager at ETTP).

4. PAST AND PRESENT ACTIVITIES

4.1 PAST AND PRESENT ACTIVITIES FOR THE REAL PROPERTY PROPOSED FOR TRANSFER

Prior to the acquisition of the land by the government, the entire area was farmland. Over 800 acres of land were leveled and prepared in support of the Manhattan Project (to supply enriched uranium for nuclear weapons production).

The K-1330 building was built in 1990 as an office building for the Environmental Restoration organization. It has been used by several site organizations since its construction and continues to be used for offices.

As discussed in Chap. 1, interviews with former/current employees located at Bldg. K-1330 were conducted to identify any areas on the property at which hazardous substances and/or petroleum products were stored for 1 year or more, known to have been released, or disposed of. The Hazardous Materials Information System (database; HMIS 2003) has also been searched for information about storage of hazardous materials.

Based on records searches and interviews, no underground tanks existed on this property. The sources of historical information listed below were searched for additional information about spills at Bldg. K-1330. Additional research is being conducted to see if other records can be found; however, any spills at or in excess of reportable quantities would have been identified in the databases or reports, but so far none has been found.

- Approved Preliminary Hazard Screening (PHS) Document for K-1330 (Energy Systems 1991);
- Occurrence Reporting and Processing System (database; ORPS 2003);
- *Environmental, Health, and Safety Concerns for the New ORGDP Contractor* (Mitchell 1983);
- *Hazardous Waste Sites Historical Investigation* (Legeay et al. unpublished); and
- *Surveillance and Maintenance Plan for Remedial Action and Post Cleanup O&M Sites at the East Tennessee Technology Park, Oak Ridge, Tennessee* (BJC 2002c).

4.2 PAST AND PRESENT ACTIVITIES FOR THE ADJACENT PROPERTY

The study area is located outside the ETTP perimeter fence south of the K-1240-3C Parking Area. The nearest non-DOE property is the Oak Ridge Turnpike/State Highway 58, located approximately 400 ft south of the building. There is no indication that activities from this non-DOE area would have contributed any contamination to the area to be transferred.

To the west of Bldg. K-1330 is the K-1320 Engineering Expansion Office and K-1580 Engineering Building. K-1580 was built in 1980 to provide office space for Engineering personnel. In 1982 the K-1320 building was constructed to provide additional office space for Engineering. In 1984, an addition was added to K-1320 and designated K-1320-A.

There are no past or present facilities in the vicinity of K-1330 that are potential areas of contamination. The closest environmental restoration area is the Recirculating Cooling Water (RCW) Lines Leak Sites 500 ft to the northwest. The RCW Lines, in conjunction with a cooling tower, served a process support building from the mid-1950s to 1984. The makeup water for the system contained a chromate/zinc/phosphate treatment until 1977, when it was replaced by a phosphate treatment system. The cooling tower was demolished in the 1990s (Energy Systems 1995). Potential leaks from the RCW Lines are listed as a Solid Waste Management Unit under the Resource Conservation and Recovery Act of 1976 (RCRA) and Appendix C of the Federal Facility Agreement (FFA).[6] The FFA is an agreement between DOE, the U. S. Environmental Protection Agency (EPA), and the state of Tennessee to integrate the requirements of RCRA corrective actions and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 remedial investigations at specific sites within the ORR. The specific facilities to which the FFA applies are listed in Appendix C of the FFA.

4.3 HYDROGEOLOGIC ENVIRONMENT

This information is being presented to lay the basis for evaluation of potential vapor intrusion based on the information is a data gap and will be addressed in a future version of this document.

Building K-1330 is located in the southern portion of the East Tennessee Technology Park (ETTP). This portion of ETTP is underlain by bedrock of the Chickamauga Supergroup. The Chickamauga Supergroup formations in this area include the Carters Limestone, Hermitage Formation, Cannon Limestone, and Catheys Formation. Due to lack of exposures, the Cannon Limestone and Catheys Formation have been mapped as one unit at ETTP. Although less prone to karst development than the Knox Group rocks in the vicinity of ETTP, the Chickamauga formations are nevertheless subject to the development of karst. Solutionally enlarged fractures, joints and bedding planes are common in exposures of Chickamauga rocks in the vicinity of ETTP. Structurally these formations have been folded into an anticline (convex upward fold) in the vicinity of the subject area with the axis of this structure located just north of K-1330. The beds generally dip northwestward on the north side of this axis and southeastward on the south side of this axis. K-1330 is located on the south side of this axis (bedding dips to the southeast). The approximate location of the axis of this fold is indicated on Fig. 4.1. In addition to providing an indication of the direction of dip of bedding, the axis may also represent a zone of increased fracturing; thus, providing potential pathways for groundwater movement.

The bedrock formations underlying K-1330 generally consist of thick to massive beds of limestone with some thin to medium beds and occasional interbedded argillaceous limestone and calcareous shales. All of these formations are subject to karst development due to their high carbonate content. Evidence of karst development in the Chickamauga includes cavities encountered in drilling at ETTP. Approximately thirty-one percent of the monitoring wells completed in the Chickamauga at ETTP encountered cavities ranging in size from a few inches up to 7 ft. In addition, pre-construction topographic maps indicate the occurrence of sinkholes in an area west of K-1330. These sinkholes were filled during construction of the plant in the 1940s. Sinkholes were not apparent, based on the pre-construction topography, in the vicinity of the building. However, sinkholes were present in the formation that underlies K-1330 along geologic strike to the west of the building.

Hydrogeologic characterization data for K-1330 is limited because currently no groundwater monitoring wells exist in the immediate vicinity of K-1330. Much of the hydrogeologic characterization data discussed below has been interpolated from available ETTP-wide information.

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[6]DOE 1992. *Federal Facility Agreement for the Oak Ridge Reservation*, DOE/OR-1014, EPA Region 4, DOE, and TDEC, Washington, D.C.

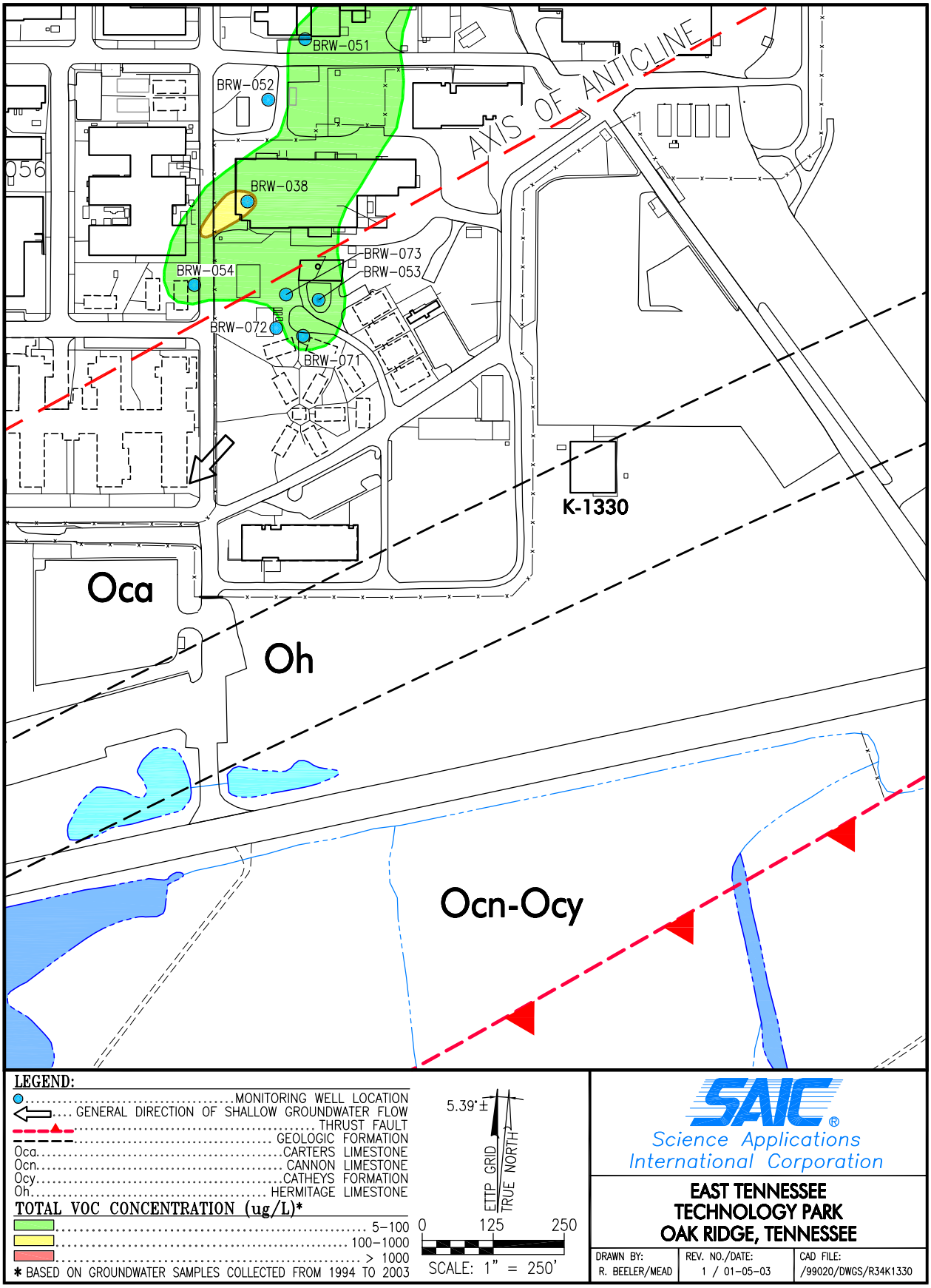


Fig. 4.1. Groundwater VOC concentrations in the vicinity of K-1330.

As stated above, no monitoring wells exist in the immediate vicinity of K-1330. For this reason, depth to bedrock and depth to groundwater are interpolated. Depth to bedrock, (interpolated) is expected to be from 2 to 20 ft below ground surface (bgs). The interpolated depth to groundwater, based on the ETTP-wide potentiometric map, indicate depths to water ranging from 12 to 20 ft bgs. The depth to groundwater is suspected to become more shallow moving from northeast to southwest in the vicinity of the building. Shallow groundwater flow is anticipated to be to the southwest in the area of K-1330. Hydrologic parameters such as hydraulic conductivity and hydraulic gradient at K-1330 are also estimated using available data. Hydraulic conductivity for the Chickamauga bedrock and overburden materials, as determined from slug tests conducted in numerous monitoring wells throughout ETTP, is presented in Table 4.1 with additional hydrogeologic characterization parameters for K-1330.

Table 4.1. Summary of hydrogeologic conditions at K-1330

Parameter	Site conditions
Is a groundwater plume present beneath the site?	None identified
Distance from site to nearest upgradient plume (ft)	450
Is karst present?	Yes
Depth to bedrock (ft)	2-20[a]
Depth to groundwater (ft)	12-20[a]
Are fill materials present at the site?	Yes
Composition of overburden materials present.	Silty clay[a]
Shallow groundwater flow direction	SW
Hydraulic conductivity of overburden materials (cm/sec)	1.15E-03[b]
Hydraulic conductivity of bedrock (cm/sec)	4.08E-03[c]
Hydraulic gradient at the site (ft/ft)	0.05[a]
Is a perched water table present at the site?	Unknown

[a]Represents interpolated value based available data.

[b]Represents average hydraulic conductivity of bedrock at ETTP based on slug tests of wells completed in overburden developed above Chickamauga bedrock.

[c]Represents average hydraulic conductivity of unconsolidated zone at ETTP based on slug tests of wells completed in Chickamauga bedrock.

Although a groundwater plume has not been identified beneath K-1330, there are data gaps regarding possible groundwater contamination beneath this building. As mentioned previously, groundwater flowpaths in bedrock at ETTP are a significant unknown due to the complex geology and geologic structure underlying ETTP. An identified groundwater plume exists within 450 ft of K-1330, but this plume is located hydraulically side gradient and not directly upgradient of the building (Fig. 4.1). However, this plume occurs in bedrock and the possibility of transport through bedrock flowpaths towards the building cannot be completely discounted based on available data.

Table 4.2 provides a summary of the analytical results for the monitoring wells located nearest to Bldg. K-1330 (BRW-038, BRW-053, BRW-054, BRW-071, BRW-072, and BRW-073). Monitoring wells BRW-053 and BRW-054 are the only wells in this group that have been sampled since 1998; however, well BRW-053 was not sampled between 1994 and 2000 and BRW-054 was not sampled between 1998 and 2003. Well BRW-038 has not been sampled since 1995 and the remaining wells have not been sampled since 1998. Monitoring well BRW-071, which is located approximately 500 ft northwest of K-1330 (Fig. 4.1), contained trichloroethene (TCE) at a maximum concentration of 10 μg/L during sampling events conducted between 1994 and 1998. Monitoring well BRW-053, located 500 ft from, and side gradient to, K-1330 and representing the most contaminated well near K-1330, was sampled in 2003. During the September 2003 sampling event at well BRW-053 TCE was detected at a concentration of 100 μg/L and 1,2-dichloroethene at a concentration of 43 μg/L. Concentrations of these compounds drop to estimated concentrations of 8 μg/L and 3 μg/L, respectively, at BRW-071 located only 75 ft downgradient from BRW-053. Given the

Table 4.2. Summary of VOCs detected in groundwater samples from bedrock monitoring wells northwest of Bldg. K-1330

		BRW-038			BRW-053						BRW-054					
Analyte (µg/L)	**MCL**	**Oct-94**	**Mar-95**	**Oct-95**	**Sep-00**	**Apr-01**	**Sep-01**	**Mar-02**	**Sep-02**	**Mar-03**	**Oct-94**	**Mar-95**	**Sep-95**	**May-98**	**Jul-98**	**Mar-03**
1,1,1-Trichloroethane	200	100 U	14	25 U	200 U	20 U	2 U	2 U	2	20 U	5 U	5 U	2 U	2 U	5 U	2 U
1,2-Dichloroethene	70[a]	49 J	6 J	33	200 U	67	37	30	**130**	43	2 J	4 J	3 J	6	7	3.3
Benzene	5	100 U	10 U	25 U	200 U	20 U	2 U	2 U	2 U	20 U	5 U	5 U	1 J	5 U	5 U	2 U
Tetrachloroethene	5	**36 J**	3 J	**17 J**	200 U	20 U	2 U	2 U	2 U	20 U	5 U	**8**	**8**	**9**	**13 J**	3.9
Trichloroethene	5	**170**	**35**	**120**	200 U	**99**	**44**	**50**	**87**	**100**	**13**	**17**	**13**	**15**	**20 J**	**13**
Vinyl chloride	2	200 U	20 U	50 U	100 U	10 U	**3**	1	**7**	10 U	10 U	10 U	10 U	10 U	10 U	1 U

		BRW-071					BRW-072					BRW-073				
Analyte (µg/L)	**MCL**	**Oct-94**	**Mar-95**	**Oct-95**	**June-98**	**Aug-98**	**Oct-94**	**Mar-95**	**Oct-95**	**June-98**	**Aug-98**	**Oct-94**	**Mar-95**	**Oct-95**	**Jun-98**	**Aug-98**
1,1,1-Trichloroethane	200	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	2 U	5 U	5 U	5 U	5 U	5 U
1,2-Dichloroethene	70[a]	3 J	3 J	2 J	4 J	3 J	5 U	5 U	5 U	5 U	2 U	3 J	3 J	2 J	8 J	3 J
Benzene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	50 U	5 U	5 U	5 U	5 U	5 U
Tetrachloroethene	5	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U
Trichloroethene	5	3 J	**6**	5 U	**10 J**	**8 J**	5 U	5 U	4 J	5 U	2 U	**7**	5 U	4 J	**17 J**	5 J
Vinyl chloride	2	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U

[a]Represents MCL for the cis-1,2-dichloroethene isomer.
MCL = maximum contaminant level.
J = estimated concentration.
UJ = analyte not detected at indicated concentration, which is an estimated concentration
U = analyte not detected at indicated concentration.
Bold indicates the concentration exceeds the MCL.

observed concentrations in monitoring wells located nearest to K-1330, the age of original source releases, and natural attenuation effects, it appears unlikely that concentrations of TCE in groundwater at K-1330, if transported to this building, would exceed those observed at monitoring well BRW-071.

4.4 EVALUATION OF POTENTIAL VAPOR INTRUSION EXPOSURE PATHWAY

EPA issued the *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Draft Vapor Intrusion Guidance)*, EPA530-F-052, in November 2002. This guidance is intended to help determine if the vapor intrusion exposure pathway poses a significant risk to human health; it was originally written in support of the environmental indicators program. Vapor intrusion is the migration of VOCs in contaminated groundwater and/or soil to indoor air. According to the Draft Vapor Intrusion Guidance, in extreme cases, the vapors may accumulate in occupied buildings to levels that may pose safety hazards and/or adverse health effects. Typically, however, the chemical concentration levels are low or, depending on site-specific conditions, vapors may not be present at detectable concentrations. Due to the occurrence of VOCs in shallow groundwater in some areas at ETTP and because a Covenant Deferral approach under CERCLA Sect. 120(h) will be used to support the transfers, EPA Region 4 recommended investigation of the vapor intrusion pathway for ETTP facilities that are targeted for transfer to CROET or other qualified parties.

In accordance with the Draft Vapor Intrusion Guidance, and through consultation with representatives from EPA Region 4, DOE Oak Ridge Operations (ORO) has developed a process to evaluate the potential for vapor intrusion at existing ETTP facilities to be transferred to the private sector under a CERCLA Sect. 120(h) Covenant Deferral Request (CDR). The following outlines that process with a focus on the first group of buildings scheduled for transfer to CROET in May 2004. This first group consists of five office buildings designated as K-1007, K-1225, K-1330, K-1400, and K-1580. Two of these buildings (i.e., K-1400 and K-1225) are located within 100 ft of a VOC-contaminated groundwater plume, while the other three (K-1007, K-1330, and K-1580) are not in close proximity (more than 100 ft) and generally down or side gradient from a plume.

ORO, EPA Region 4, and TDEC agree that vapor intrusion will be addressed in the ETTP site-wide groundwater Record of Decision (ROD). The groundwater ROD is currently scheduled to be signed by 2006. Until that time, ORO will take the following actions to ensure that transfer of these buildings is protective of human health.

1. ORO will collect building sub-slab soil-vapor samples in these five buildings and will proceed as follows:

   a. EPA will review the soil-vapor sampling plans prior to implementation (see Appendix C).

   b. Samples will be collected during the winter months prior to transfer.

   c. Individual sample results will be compared to pre-established trigger levels for soil vapor that will be developed using a Hazard Index of 0.1 and a risk value of 10^{-5}.

   d. If the soil vapor analytical results are below the trigger levels, then no further action in the building will be necessary unless site (i.e., groundwater) or building conditions change (see below for further details).

   e. If the soil vapor analytical results are above the trigger levels, discussions will be held with EPA to determine if indoor samples should be collected to determine whether the vapor

intrusion pathway is complete. Factors that will be considered to determine if air sampling is necessary will include the contaminant and how significant the exceedance is (i.e., whether the risk from the vapor intrusion pathway is greater than 10^{-4}).

f. If air samples are collected, the results will be compared to the 25-year industrial preliminary remediation goals (PRGs). If the results yield unacceptable risks (i.e., the PRGs are exceeded), the vapor intrusion pathway will be considered complete and ORO will consult with the transferee (e.g., CROET) to determine if they are still interested in transfer of the building. If the transferee desires the building, it will be retrofitted as necessary to eliminate or reduce the risk to acceptable levels, and confirmatory sampling will be conducted.

g. If the indoor air samples do not result in an unacceptable risk (i.e., the PRGs are not exceeded), the building will be transferred, and annual indoor air sampling will be conducted to ensure that the vapor intrusion pathway has not become complete due to any changed conditions in the integrity of the building structure.

h. ORO will conduct a follow-up sub-slab sampling event for these five buildings in the summer of 2004 to confirm protectiveness after transfer. The same process will be followed as described above. If the results of the evaluation indicate that vapor intrusion poses an unacceptable risk to human health, ORO will take the necessary actions to ensure protectiveness.

i. After the follow-up summer sampling, and in accordance with CERCLA, together with EPA's Draft Vapor Intrusion guidance, and/or other appropriate EPA guidance, re-evaluation of the vapor intrusion pathway will be conducted only if site conditions (i.e., groundwater) and/or building use changes. The ETTP site-specific groundwater data (gathered over the past 10+ years) show stable conditions and a decreasing trend in VOC concentrations. As part of a site-wide groundwater monitoring program, ORO collects samples on an annual basis. Data from the annual monitoring will be used to determine if site conditions change. Specifically, a sample from the active groundwater monitoring well nearest to the building being evaluated and downgradient from the nearest plume will be collected annually. If more than one active well exists, then the one with the highest average concentration of TCE will be used for sampling. An initial sample from this well will be collected to establish current conditions. In the absence of a suitable well nearby to accurately monitor the groundwater conditions, the FFA parties will determine the best approach to evaluate changes. *(The specific manner in which groundwater data will be used to monitor the stability of site conditions is still being negotiated between ORO and EPA Region 4 and negotiations are expected to close in February 2004, after additional information on the DOE proposed approach is provided to EPA and before the final CDR is submitted for EPA approval.)* If the groundwater conditions change in a way that might create an unacceptable risk of exposure through the vapor intrusion pathway, ORO will conduct a re-evaluation of the building. Additionally, comprehensive changes to the building structure of infrastructure (e.g., replacement of the heating ventilation and air conditioning system) that have the potential to alter previous conclusions may require re-evaluation. If such changes are made, the transferee (i.e., CROET) will notify DOE and, if necessary, DOE will re-evaluate to ensure that the pre-transfer determination has not changed. It should be noted that the buildings will continue to be used for occupational purposes in accordance with deed restrictions.

j. A re-evaluation will consist of additional soil-vapor sampling and, if necessary, indoor-air sampling. If the results of the re-evaluation indicate that vapor intrusion poses a significant risk to human health, ORO will take necessary actions to ensure protectiveness.

2. The transfer process for these facilities will proceed concurrent with the process laid out above. EPA's approval of the CDR will be pending until completion of the first sampling activity (i.e., winter) and evaluation of the data to ensure protectiveness.

3. The CDR package will be issued for the required 30-day public comment period prior to completion of the winter sampling. The data from this sampling, as well as the data collected in the summer, will be made available to the public by posting them on a web site. When the data are posted, announcements will be made regarding their availability.

4. All other building and land parcels will be considered for evaluation on a case-by-case basis. However, it should be noted that sampling is not planned for facilities not intended for occupancy (e.g., telecommunication/utility buildings and the railroad).

5. RESULTS OF VISUAL AND PHYSICAL INSPECTIONS

5.1 VISUAL AND PHYSICAL INSPECTIONS OF THE PROPERTY FOR TRANSFER

In May 2002, a walkdown of the K-1330 building was conducted by representatives from Science Applications International Corporation and BJC to observe the environmental conditions of the building. This chapter documents the observations of this inspection.

The first and second floor plans for Bldg. K-1330 are shown in Figs. 5.1 and 5.2, respectively. There is 7200 ft^2 of floor space on each level. The building is a rectangular-shaped, two-story, masonry structure that is used for office space. The building exterior is red clay brick; the interior is cinderblock with drywall covering it. Offices are located on the outside walls with the restrooms, storerooms, conference room, stairway, and elevator in the center of the building. Each floor has a similar floor plan.

Access to Bldg. K-1330 is controlled by badge readers to prevent entry by unauthorized personnel. There are badge readers at the main entrance of the second floor and the first floor entrance on east side of the building. The door on the south side of the 1st floor is for emergency exit only.

The floors in the office areas are carpeted. Painted concrete floors and vinyl floor tiles are in the janitor's closets and maintenance rooms. The restrooms have ceramic floor tile, and the stairwells are a combination of rubber matting and vinyl floor tiles. The ceilings are suspended, man-made mineral fiber panels with fluorescent light fixture insets. Due to the recent construction of the building (built in 1990), it is not suspected that these light fixtures contain polychlorinated biphenyls (PCBs) in the ballast. All insulation in the building is man-made mineral fiber. In 1995 an asbestos survey[7] of the K-1330 building reported there are no asbestos-containing materials in the building. Due to the fact that the building was recently built, it is improbable that lead-based paint exists in the building.

Emergency lighting is provided by lights that are mounted on walls throughout the building. Each is powered by a lead-acid battery. The only other chemicals that are stored in the building are janitorial supplies and the hydraulic fluid for the elevator.

Building K-1330 is cooled using an exterior chiller located on the northeast side of the building that is connected by insulted piping to the air-handling equipment in the building. Heating is accomplished by several electric units inside the building.

Also included in the title transfer are a covered bench, electrical transformer and disconnect, and air-conditioning (AC) unit located on the exterior of K-1330. The AC unit is located on a concrete pad on the northeast side of the building. It is a closed-loop, air-cooled chilled water system that uses a re-circulating water/glycol mixture as the coolant. Electricity for K-1330 is provided through a 13.8 kV transformer and disconnect on the east side of the building. The transformer is a dry-type and contains no oil. The covered bench is constructed of transparent plastic panels in an aluminum frame on a concrete pad. It is used as a smoking area during inclement weather and is identified in Fig. 5.1 as K-1019-23.

5.2 VISUAL AND PHYSICAL INSPECTION OF ADJACENT PROPERTY

The adjacent areas are owned by DOE, and an assessment (review of records, reports, and data) determined that actual or potential releases of hazardous substances or petroleum products have not

[7]Radian Corporation 1995. Oak Ridge K-25 Site Building K-1330 Asbestos Survey, June.

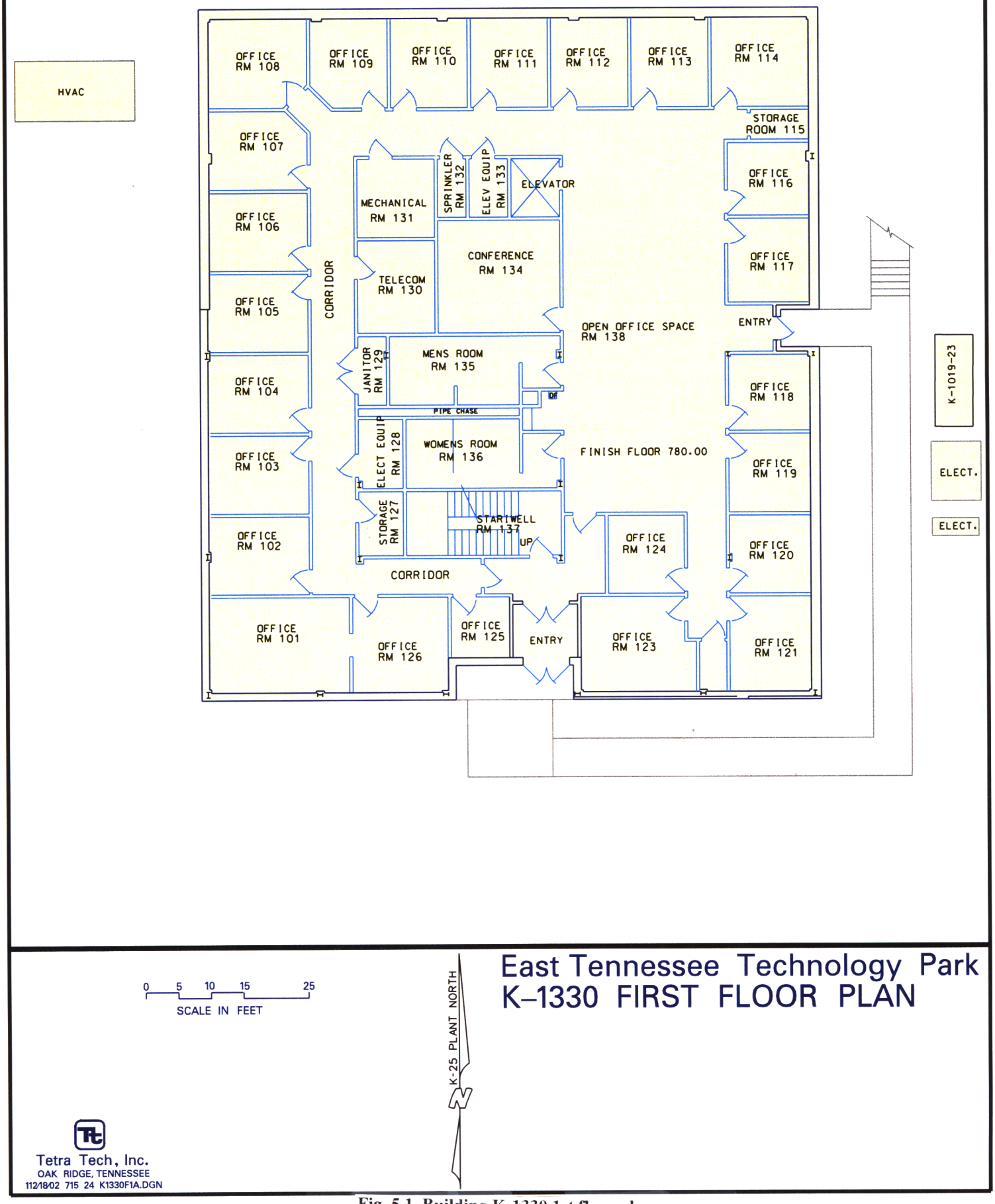
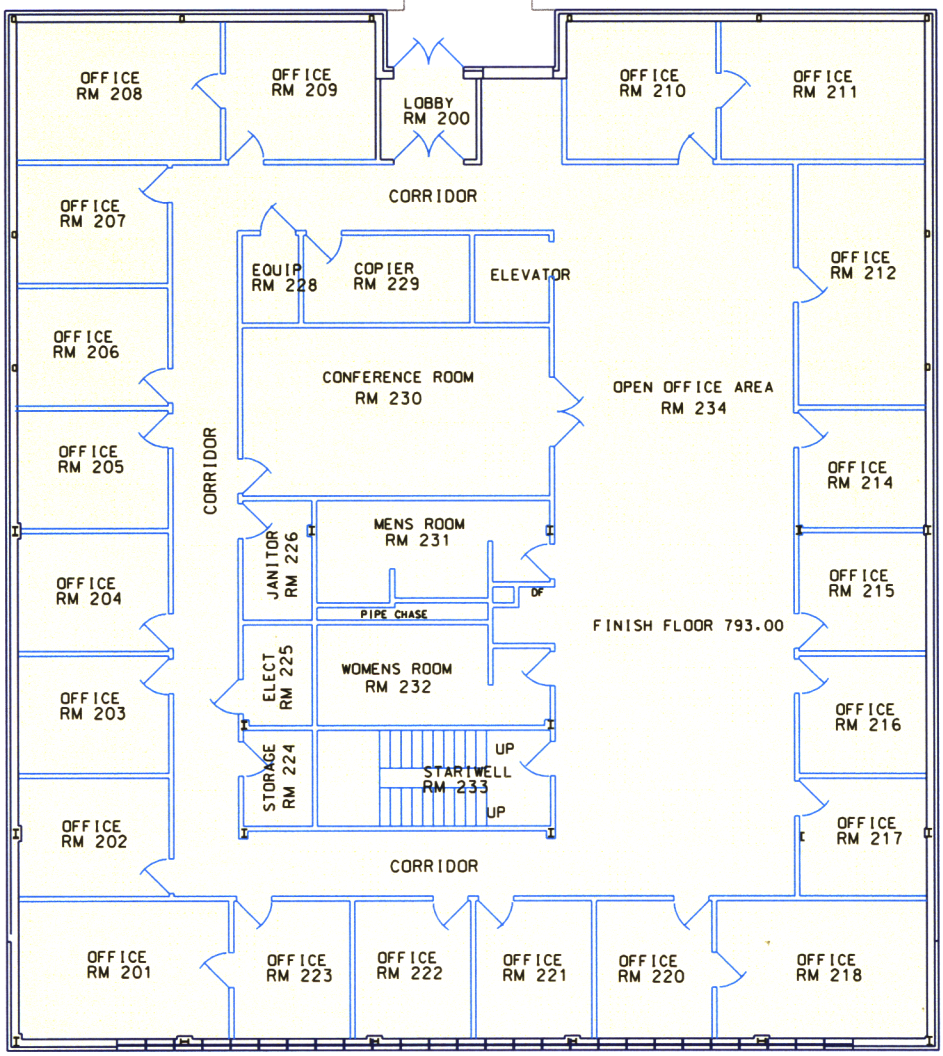


Fig. 5.1. Building K-1330 1st floor plan.



0 5 10 15 25

SCALE IN FEET

K-25 PLANT NORTH

N

East Tennessee Technology Park
K–1330 SECOND FLOOR PLAN

Tetra Tech, Inc.
OAK RIDGE, TENNESSEE
12/18/02 715 24 K1330F2A.DGN

Fig. 5.2. Building K-1330 2nd floor plan.

occurred. The nearest area that may contain contamination is the RCW Line Leaks 500 ft to the northwest. Information about this area is documented in Sect. 4.2.

The K-1580 Engineering Office Building is a three-story structure with 12,737 ft^2 of floor space for a total of 38,211 ft^2. It is constructed of reinforced concrete with pre-cast concrete siding. It was built in 1980.

The K-1320 Engineering Expansion Office Building is a two-story structure with a lightweight steel frame and pre-finished aggregate, asbestos/concrete siding. It was built in 1982. In 1984, Bldg. K-1320 was expanded with the addition of K-1320-A. It is constructed like K-1320 except without asbestos in the siding. The two buildings have a total floor space of 13,270 ft^2.

6. SAMPLING RESULTS

6.1 DESCRIPTION OF BUILDING K-1330

The area proposed for title transfer includes the K-1330 building, the covered bench on the eastern side of the building, the electrical and air-conditioning equipment to the east and west of the building, and the underlying property, also known as the underlying fee. No exterior laydown, parking, or soil areas are associated with the title transfer footprint. The K-1330 building has been used for office space since its construction in 1990 and has two floors (7200 ft^2 on each of the two floors for a total of 14,400 ft^2).

6.2 CHEMICAL AND RADIOLOGICAL SAMPLING

Based on discussions with EPA, it has been agreed that the need to collect soil and groundwater samples to support title transfer activities will be determined on a case-by-case basis. Factors such as a facility's past operational history and geographic location will be considered. In addition, the history and knowledge of activities at adjacent properties are evaluated. Based on document reviews of the K-1330 property and adjacent areas, there is no indication that the area has been contaminated from past activities; therefore, no samples were collected. Any potential risk that a future tenant may be exposed to is evaluated in the *Risk Screen to Support the Title Transfer of the K-1330 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-1292/R1 (BJC 2004).

6.3 RADIOLOGICAL SURVEYS

Radiological surveys were performed to assess the radiological condition of the facility. Surveys were conducted on the interior and exterior surfaces of K-1330, the building contents, the exterior sidewalk, the covered bench, and the electrical and air-conditioning equipment on the eastern and western sides of the building. This section presents and discusses the current radiological survey data that have been collected and reported in ETTP/PEM-0215, *Radiological Survey Report for the Transfer of the K-1330 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee, to the Community Reuse Organization of East Tennessee* (BJC 2002b). A discussion of the historical survey data is presented (Sect. 6.3.1), followed by a discussion of the current survey plan, results, and quality assurance/quality control (QA/QC) of the data (Sect. 6.3.2). The final subsection (Sect. 6.3.3) presents a summary of the data review and results of the statistical analysis of the survey data set for the area.

Process history of the ETTP site indicates that uranium (whether natural, depleted, or enriched) would be the most prominent radiological contaminant potentially present in the K-1330 building due to the potential for tracking of contamination from other on-site buildings. Uranium-235 enrichment levels expected from operations since the early 1960s would be anticipated to range between 0.2 to 5.0%. Most facilities potentially would be contaminated via tracking from enrichments of less than 3%.[8] However, because this facility has been an administrative building throughout its history, it is assumed that the uranium would be from natural sources and that the enrichment is approximately that of natural uranium, which is 0.72%.

Other radionuclides (^{60}Co, ^{137}Cs, $^{89/90}Sr$, ^{237}Np, ^{99}Tc, and $^{238/239/240}Pu$) also have been detected at ETTP. These other radionuclides originated from the introduction of contaminated materials from ORNL and from the Hanford and Savannah River reactor returns uranium-reprocessing program; however, these radionuclides are expected to be found in much lower quantities than uranium and to be undetectable in

[8]Contracted Health Physics Technician Training handouts, K-25, 1993.

this area, based upon its history as an administrative facility. If they were present, it is assumed that they would be present at ratios of 1140:1 for uranium to transuranic (U:TRU) and 350:1 for uranium to technetium-99 (U:^{99}Tc) [both ratios are process buildings weighted averages].[9]

6.3.1 Historical Surveys

A search of the BJC Radiation Control Organization (RADCON) electronic survey data collected since 1996 revealed that three surveys were performed in, or near, the building. A review of these surveys provided some information for the survey classification of the individual survey units; however, the majority of the input to the survey unit classifications is from the building's historical use.

Two equipment surveys were conducted in October and December 1997 of pneumatic piston vibrators and a pallet of material. No elevated activity above background levels was detected for the direct and removable contamination readings.

6.3.2 Current Surveys

A total of 54 surveys (including all associated QA/QC surveys) were conducted in the footprint (Table 6.1). See Figs. 6.1 and 6.2 for the locations of the first and second floor interior survey units (ISUs) and Fig. 6.3 for the exterior survey units (ESUs). These surveys were performed from October 1 to October 29, 2002, in accordance with ETTP RADCON procedures,[10] the survey design document[11] (hereafter referred to as the "design document"), and the survey plan (see Appendix D).

Table 6.1. ETTP current radiological survey numbers

20021001PA01388001	20021010PA01388002	20021014KA36155001	20021010KA36145001
20021001PA01388002	20021014PA01388001	200210143CEDESK001	20021014KA36145001
20021003PA01388001	20021014PA01388003	20021010KA36155001	200210220020826004
20021003PA01388002	20021015PA01388001	200210070020826001	200210220020826003
20021004PA01388001	20021016PA01388001	20021016KA36155001	20021018PA01388003
20021004KA36145001	20021017PA01388003	20021017KA36155001	20021002PA01388003
20021007PA01388001	20021017KA36145002	20021018KA36155001	20021002PA01388002
20021007PA01388002	20021023KA36155001	20021003KA36155001	20021003PA01388004
20021009PA01388002	200210220020826002	20021021KA36145001	20021003PA01388003
20021010PA01388001	20021017KA36145001	200210070020826002	20021008PA01388001
20021029PA01388002	200210090020826001	20021014PA01388002	20021017PA01388002
20021008PA01388002	20021010PA01388001	20021015KA36145001	20021022PA01388001
20021009PA01388001	20021011PA01388002	20021017PA01388001	20021017PA01388004
20021018PA01388002	20021029PA01388003		

ETTP = East Tennessee Technology Park.

[9] *Isotopic Distribution of Contamination Found at the U. S. Department of Energy Gaseous Diffusion Plants*, Science Applications International Corporation (SAIC) report delivered to Bechtel Jacobs Company LLC, SAIC document number 143.19991103.002, October 1999.

[10] Primarily SH-B-4012, "Radioactive Contamination Control and Monitoring," found in BJC-SH-04, Vol. I, *Radiation Protection Program.*

[11] BJC 2000. *Design of Radiological Surveys of Potential Lease Space at East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-554, Bechtel Jacobs Company LLC, March.

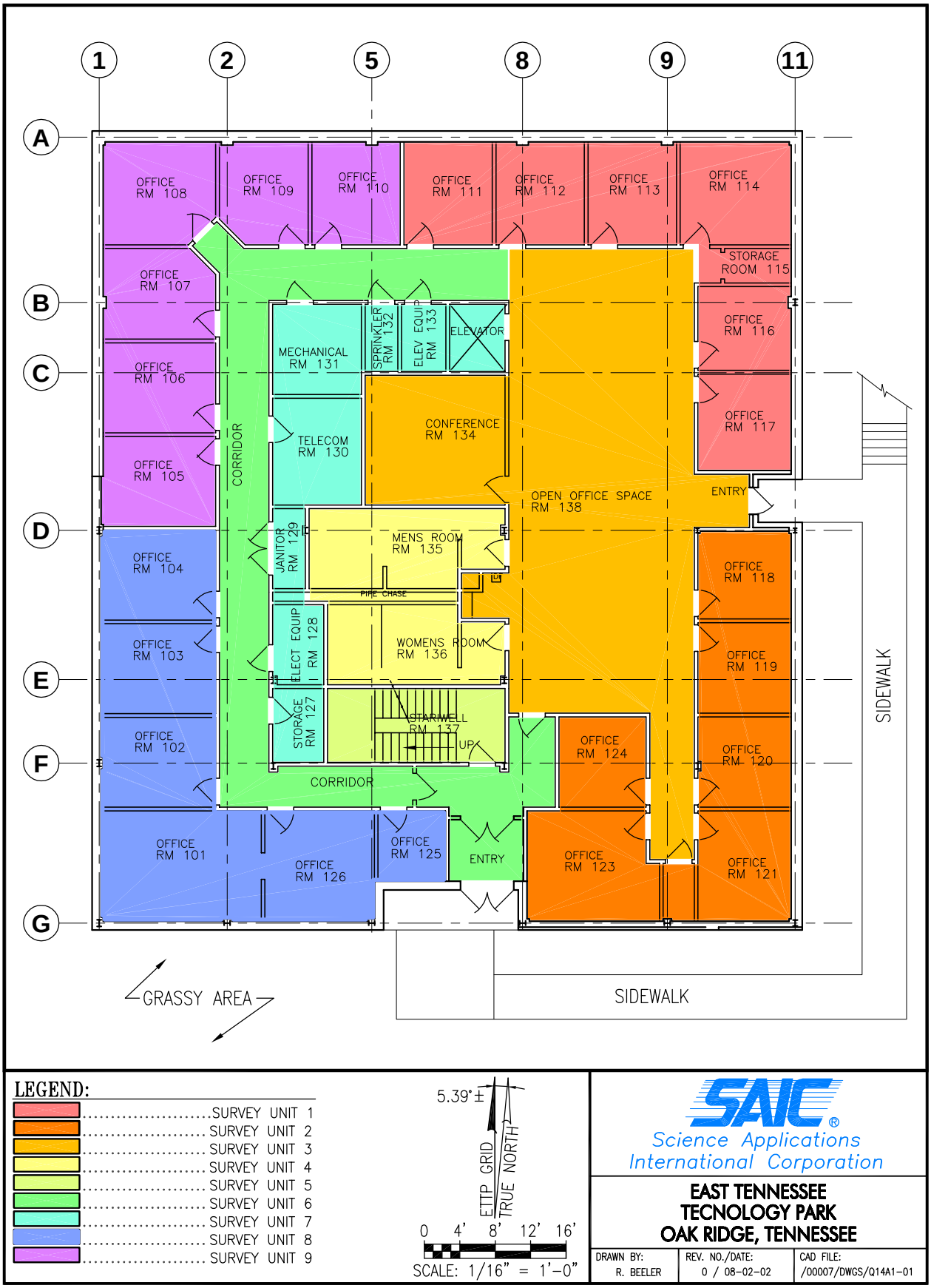


Fig. 6.1. K-1330 first floor survey units.

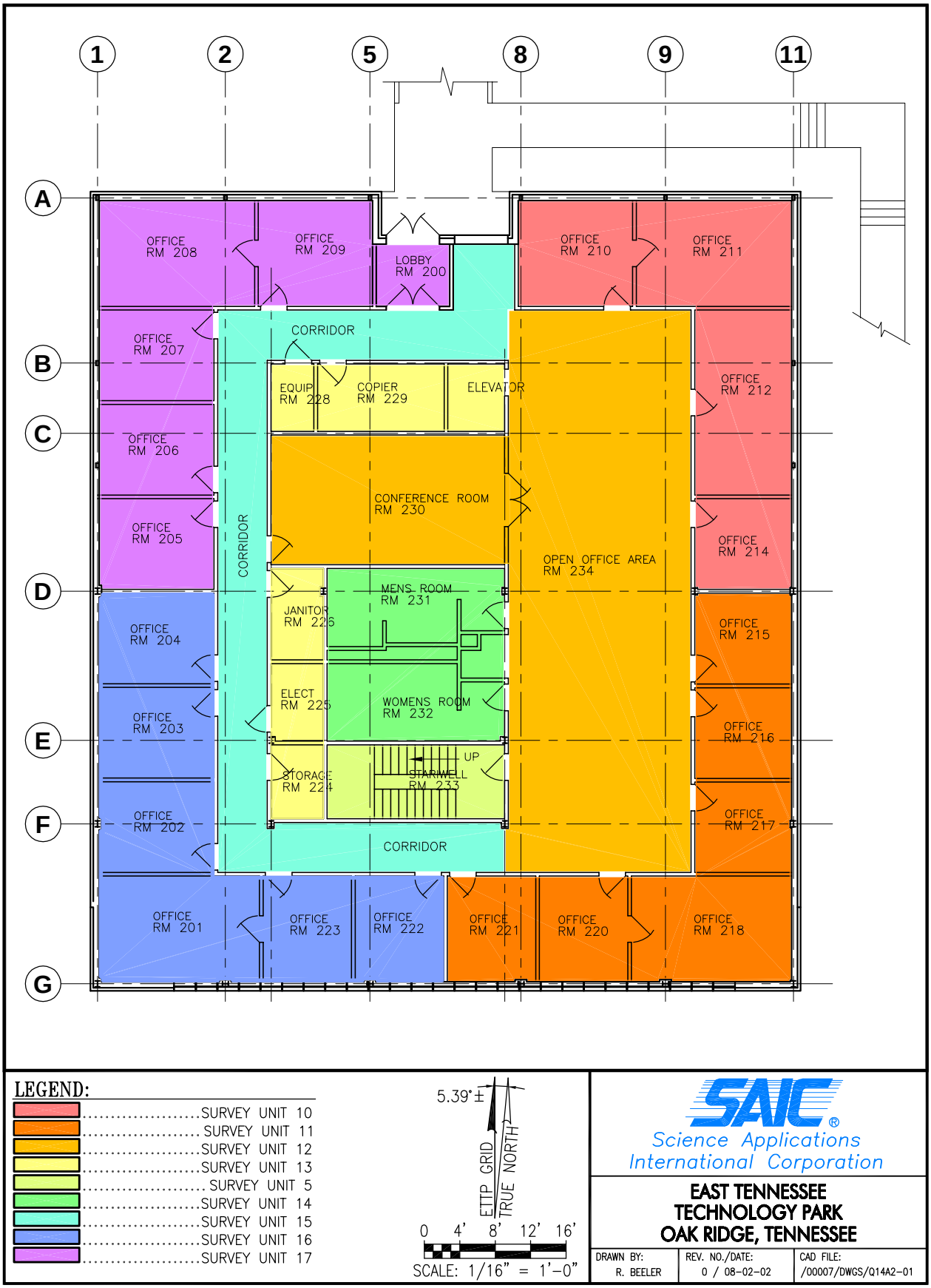


Fig. 6.2. K-1330 second floor survey units.

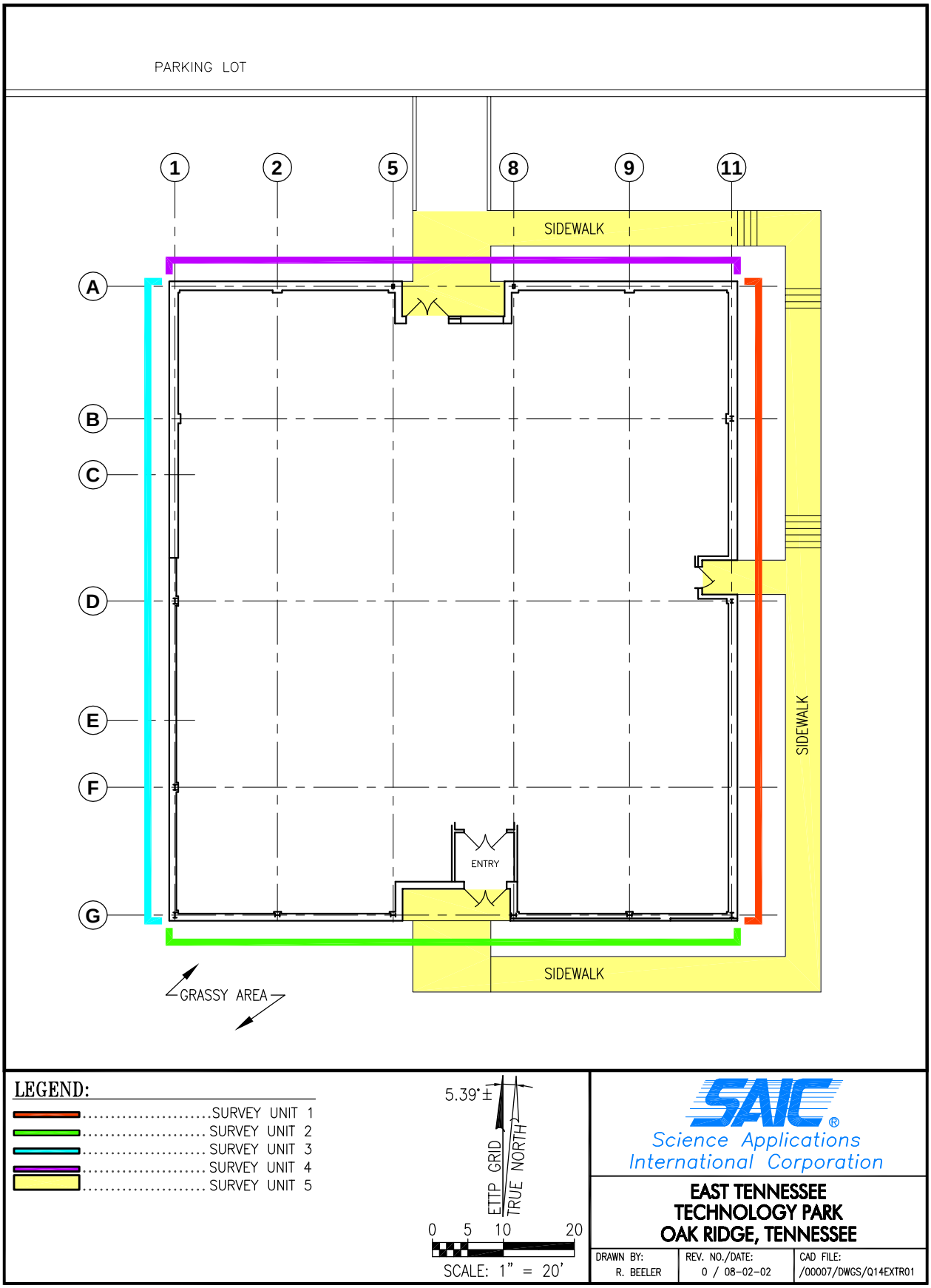


Fig. 6.3. K-1330 exterior survey units.

Radiological survey procedures and area survey units were described in the survey plan presented in Appendix D. Each area was classified as either a Class 3, 2, or 1 survey unit based upon historical data and process knowledge as described in the design document. All areas within the survey footprint were classified as Class 3 except for the older furnishings that were classified as Class 2.

Hand-held meter survey results were taken and compared to the following values (Table 6.2), which are the appropriate 10 *Code of Federal Regulations* (*CFR*) 835[12] and DOE Order 5400.5[13] surface contamination gross alpha or gross beta criteria, which are referred to as derived concentration guideline levels (DCGLs) in the design document, for the survey area:

Table 6.2. Contamination limits (DCGLs) for all survey units

	DCGL (dpm/100 cm^2)	Class 3, 25% of DCGL (dpm/100 cm^2)	$DCGL_{EMC}$ (dpm/area)
Total alpha	5000	1250	15,000
Removable alpha	1000	250	N/A
Total beta-gamma	5000	1250	15,000
Removable beta-gamma	1000	250	N/A

DCGL = derived concentration guideline level.
$DCGL_{EMC}$ = derived concentration guideline $level_{elevated\ measurement\ comparison}$.
dpm = disintegrations per minute.
N/A = not applicable.

Each survey unit data set was first evaluated by comparing the maximum result after background subtraction to the screening level for the survey unit classification. If the net maximum survey result was less than the screening level for the specific survey unit (e.g., 25% DCGL limits for Class 3 survey units), then the unit was said to pass and have rejected the null hypothesis, (H_o). The null hypothesis specifies that the residual contamination in each of the individual survey units exceeds the survey unit DCGL. If the net maximum result was greater than the screening level for any single reading, further readings were obtained in the 1-m^2 area in order to determine the average for the square meter. If the net average reading for the square meter was greater than the screening level for the specific survey unit, then Class 3 and 2 survey units were reclassified and resurveyed under the protocol of the new classification. If the net maximum result was greater than the DCGL for Class 1 units, the non-parametrical statistical Sign test was used to evaluate the data as outlined in the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) [NRC 1997].

6.3.2.1 Interior survey units

All ISUs of the K-1330 building were classified as Class 3 ISUs. Per the design document, Class 3 survey units have an upper limit of 25% of the DCGL [i.e., 1250 disintegrations per minute (dpm)/100 cm^2 alpha or beta activity]. The Class 3 survey criteria for ISUs were the following: 10% scan of the primary traffic areas and work surfaces with floor monitors and hand-held meters (including usage of a floor monitor probe set up as a hand-held probe and calibrated to detect alpha and beta-gamma contamination for large area scans of non-floor surfaces), as appropriate; any location on the walls or ceiling that, using professional judgment, potentially could have residual radioactivity present was to be scanned over the suspected area and documented on the survey; no removal of suspended ceiling tiles or floor panels was required for this survey; eleven measurements of total and removable contamination, at a minimum, were

[12]*CFR* 1999. 10 *Code of Federal Regulations* 835, *Occupational Radiation Protection*; the values are taken from Appendix D, "Surface Radioactivity Values."

[13]DOE 1990. *Radiation Protection of the Public and Environment*, DOE Order 5400.5, Fig. IV-1, "Surface Contamination Guidelines," p. IV-6, U. S. Department of Energy, February 8.

recorded within each survey unit at locations determined during the scan survey to have the highest activity; a general dose rate walkover survey of each survey unit, using a Bicron MicroRem® meter,[14] was performed to determine if any variations exist in the penetrating radiation dose rate; and dose rate measurements were obtained at a minimum of every 20 ft in hallways and large rooms. Several of the survey units have more than the minimum number of data points (11); the critical value for the Sign Test was determined using the actual number of data points for each survey unit and an alpha error (Type I error) of 0.05.

No ISU had any result above 25% of the DCGL. One of the QA/QC verification results for an ISU, however, had a result of 1621 dpm/100 cm^2. This result was obtained in the men's restroom on a glazed clay tile floor; therefore, it is less than the limit established in the survey plan of 3500 dpm/100 cm^2 for such materials. Since all results were less than the screening level for Class 3 units, no further statistical analysis was performed. From an inspection of the individual surveys, all total activities were less than 118 dpm/100 cm^2 total alpha and 1012.0 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 5.4 dpm/100 cm^2 removable alpha and 64 dpm/100 cm^2 removable beta-gamma. The maximum tissue-equivalent dose rate was 5 μrem/h (microrem/h). See Table 6.3 for the summary of the survey results for all ISUs.

6.3.2.2 Exterior survey units

All exterior areas were classified as Class 3 and surveyed up to a minimum height of 8 ft with hand-held meters or with a gas-proportional probe, with an emphasis on air intakes and vents, windowsills, gutter downspouts, and any other area that the survey technician's professional judgment would indicate a higher probability of finding elevated readings. No exterior areas, other than the building exterior walls and roof, were covered under the survey plan. All Class 3 ESUs were scan surveyed over a minimum of 10% of the accessible area, with 11 measurements of total and removable activity taken (alpha and beta-gamma) at locations having the highest activities, as determined during the scan survey. No tissue-equivalent dose rates were required per the survey plan. As with the ISUs, several of the survey units have more than the minimum number of data points (11); the critical value for the Sign was determined using the actual number of data points for each survey unit and an alpha error (Type I error) of 0.05. See Fig. 6.3 for the exterior survey units.

Most beta-gamma readings taken on the exterior of the building exceeded 1250 dpm/100 cm^2 total activity due to the naturally occurring radioactive material (NORM) found in the red clay bricks' matrix. The survey plan allowed for up to 2800 dpm/100 cm^2 total beta-gamma activity on red clay bricks. No results exceed 2800 dpm/100 cm^2. One of the beta-gamma results taken on the roof exceeded 1250 dpm/100 cm^2 total activity (1749 dpm/100 cm^2). This reading, however, was taken in very close proximity to a corner of the roof, where two red clay brick walls intersect, thus increasing the amount of NORM detected in the general proximity. Due to the geometry of the reading location, this data point also had the 2800 dpm/100 cm^2 NORM content background applied to it. Since all results were less than the screening level for Class 3 units, no further statistical analysis was performed. From an inspection of the individual surveys, all total activities were less than 45.3 dpm/100 cm^2 total alpha and 2498 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 10.8 dpm/100 cm^2 removable alpha and 53.5 dpm/100 cm^2 removable beta-gamma. See Table 6.3 for the summary of the survey results for all ESUs.

[14]Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof.

Table 6.3. Summary of contamination and dose rates for the K-1330 study area

Location	Alpha total		Alpha removable		Beta-gamma total		Beta-gamma removable		Dose equivalent rate (mrem/h)
	Min	Max	Min	Max	Min	Max	Min	Max	
					Interior survey units				
ISU 1	< 0	43.95	< 0	< 0	< -298.85	< 457.1	< -22.16	< 22.16	.003 – .005
ISU 2	< 0	53.6	< 0	< 0	< -293.85	< 359.15	< -36.01	< 22.16	.002 – .005
ISU 3	< 0	58.6	< -2.69	< 2.69	< -97.95	750.95	< -22.16	< 38.78	.003 – .005
ISU 4	< 0	117.2	< -2.69	< 2.67	< 293.85	1012.15	< -24.93	< 22.16	.002 – .003
ISU 5	< -14.65	53.6	< 0	5.38	< -195.9	522.4	< -60.94	< -16.62	.003 – .005
ISU 6	< -14.65	58.6	< 0	5.38	< -359.15	555.05	< -47.09	< 8.31	.002 – .004
ISU 7	< 0	53.6	< 0	5.38	< -424.45	979.5	< -160.66	< 19.39	.003 – .004
ISU 8	< 0	58.6	< 0	< 2.69	< -489.75	< 359.15	< -27.7	< 22.16	.003 – .004
ISU 9	< 0	43.95	< 0	5.38	< -457.1	< 163.25	< -38.78	58.17	.003 – .005
ISU 10	< 0	58.6	< -5.38	< 2.69	< -326.5	< 261.2	< -8.31	< 19.39	.004
ISU 11	< 0	43.95	< -5.38	< 2.69	< 0	< 457.1	< -5.54	< 30.47	.003 – .005
ISU 12	< 0	< 14.65	< -5.38	< 0	< -261.2	653	< -72.02	< 8.31	.003 – .005
ISU 13	< -14.65	< 14.65	< 0	< 2.69	< -457.1	750.95	< -36.01	< 38.78	.003 – .004
ISU 14	0	38.85	0	5.38	403.39	806.78	< -27.7	30.47	.003 – .004
ISU 15	< -15.54	15.54	0	5.38	< -279.27	124.12	< -13.85	63.71	.004 – .005
ISU 16	< -15.54	62.16	0	2.69	< -496.48	186.18	< -38.78	16.62	.003 – .005
ISU 17	0	31.08	0	5.38	< -155.15	341.33	< -60.94	2.77	.004 – .005
					Exterior survey units				
ESUs 1 and 4	< -42.3	42.3	< 0	7.71	1156	2399	< -29.7	< 44.55	NR
ESUs 2 and 3	< -28.2	< 42.3	< 0	7.71	1214	2399	< -29.7	53.46	NR
ESU 5	< -14.1	< 42.3	< 0	< 2.69	< -86.7	751.4	< -30.47	< 41.55	NR
ESU Roof	< 27.1	45.3	< 4.85	10.76	405.99	1748.88	< 48.72	< 48.72	NR
					Furnishings survey units – Class 3				
FSU 2	< -62.06	15.54	< -2.69	5.38	< -155.15	651.63	< -77.56	2.77	NR
FSU 3 – Unit 1	< 0	43.95	< 0	5.38	< -718.3	< 97.95	< -13.85	27.7	NR
FSU 3 – Unit 2	< 14.65	43.95	< 2.69	< 2.69	< -457.1	< 195.9	< -16.62	< 33.24	NR
FSU 3 – Unit 3	< 0	43.95	< -2.69	< 2.69	< 0	848.9	< -72.02	< 13.85	NR
FSU 3 – Unit 4	< -29.3	117.2	< -2.69	2.69	< -1991.65	-587.7	< -44.32	< 19.39	NR
FSU 3 – Unit 6	< 0	< 43.95	< 2.69	< 5.38	< -881.55	< -522.4	< -8.31	< 38.78	NR
FSU 3 – Unit 7	0	29.3	0	5.38	< -359.15	130.6	< -41.55	36.01	NR
FSU 3 – Unit 7	< 0	58.6	< 0	< 2.69	< 457.1	1240.7	< 0	< 44.32	NR
FSU 3 – Unit 8	< 0	58.6	< -2.69	18.83	< -293.85	587.7	< -13.85	94.18	NR
FSU 3 – Unit 9	< 0	73.25	< 0	< 5.38	< 97.95	< 326.5	< 0	< 41.55	NR
FSU 3 – Unit 10	< -14.65	< 14.65	< -5.38	< 2.69	< -326.5	620.35	< -2.77	< 19.39	NR

Table 6.3. Summary of contamination and dose rates for the K-1330 study area (continued)

Location	Alpha total		Alpha removable		Beta-gamma total		Beta-gamma removable		Dose equivalent rate (mrem/h)
	Min	Max	Min	Max	Min	Max	Min	Max	
FSU 3 – Unit 11	< -14.65	< 14.65	< -8.07	< 0	< -391.8	< 359.15	< -58.17	< 24.93	NR
FSU 3 – Unit 12	< 0	43.95	< 0	< 8.07	< -489.75	< 97.95	< -24.93	< 19.39	NR
FSU 3 – Unit 13	< -7.77	< 7.77	< -2.69	< 2.69	< -279.27	< 279.27	< -11.08	< 5.54	NR
FSU 3 – Unit 14	< -2.69	2.69	< -2.69	0	< -24.93	47.09	< -5.54	36.01	NR
FSU 15 – Unit 15	< -15.54	31.08	0	5.38	< -62.06	186.18	< -36.01	47.09	NR
FSU 3 – Unit 16	< -15.54	46.62	0	10.76	< -589.57	< 93.09	< -58.17	49.86	NR
FSU 3 – Unit 17	< -15.54	62.16	0	5.38	< -186.18	372.36	< -60.94	11.8	NR
FSU – Exterior	< -15.54	108.78	0	5.38	< -527.518	310.3	< -49.86	27.7	NR
DOE limits	5000		1000		5000		1000		20

Notes: All readings are in units of disintegrations per minute (dpm)/100 cm^2.
A "<" preceding a value indicates that the result cannot be distinguished from background at the 95% confidence level.
"NR" denotes that no reading was taken.

6.3.2.3 Furnishings survey units

The survey for the release of materials from the K-1001-A, -B, -C, and -D buildings prior to their demolition was the methodology used for the survey of equipment and furnishings in the study footprint. The specific methodology is discussed in the attached survey plan (Appendix D).[15]

All furnishings survey units (FSUs) were classified as either Class 3 or Class 2, based upon their as-found condition, process knowledge, and historical data, if available. Furnishings are defined as any item typical of an office, such as desks, chairs, tables, bookcases, or trash cans. In addition, an exterior FSU included an air conditioner, a transformer, a disconnect, and a covered bench (see Fig. 5.1 for the location of these units). Class 3 FSUs consist of the newer furnishings and were scanned over 10% of all accessible areas, with a maximum surface area not to exceed 5000 m^2. Class 2 FSUs consist of the older furnishings and were scan surveyed over 10% of their accessible surfaces, with a maximum FSU area of 1000 m^2. A minimum of 11 data points was collected from each FSU at the areas of the highest activity as determined during the scan survey.

No FSU had any result above 25% of the DCGL except for a sink top located in Room 231. The sink (in Room 231, which had a tile floor) is made of porcelain, contains NORM, and had a maximum total beta-gamma reading of 1469 dpm/100 cm^2 from the initial survey and 2247 dpm/100 cm^2 from the QA/QC verification survey. In previous surveys, activity levels of 700 to 2200 dpm/100 cm^2 have been measured in similar porcelain sinks; therefore, the result should be compared to the screening levels established for glazed clay tiles of 2800 dpm/100 cm^2. Since all results were less than the screening level for Class 3 units, no further statistical analysis was performed. Activities were less than 117.2 dpm/100 cm^2 total alpha and 1241 dpm/100 cm^2 total beta-gamma, with all removable contamination results less than 19 dpm/100 cm^2 removable alpha and 94.2 dpm/100 cm^2 removable beta-gamma. See Table 6.3 for the summary of the survey results for all FSUs.

6.3.2.4 Quality assurance/quality control surveys

A 5% verification survey of the data gathered from each survey unit was performed in each survey unit for QA/QC. All QA/QC survey data gathered were in agreement with the initial survey unit data.

6.3.3 Survey Data Review and Analysis

A health physicist (HP) reviewed all survey data prior to use in this report. All surveys were conducted in accordance with the survey plan per the HP (including the correct number of survey units, data points per survey unit, instrumentation data, and performance of QA/QC survey).

Results of the surveys performed in the study area and the statistical test performed on the data gathered in each survey unit indicate that the interior, exterior, and present furnishings are below the DOE surface contamination limits and within the acceptable dose equivalent rate range for building interiors. The null hypothesis was rejected for each survey unit. Therefore, the alternative hypothesis (H_a) was accepted, which states that the residual radioactivity in each of the survey units does not exceed the DCGL and, therefore, can be released without restrictions.

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[15] *Survey Protocol Unrestricted Release of Building Furnishings*, prepared by Safety and Ecology Corporation for Bechtel Jacobs Company LLC Radiation Control (RADCON), undated.

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APPENDIX A

REAL ESTATE LETTER

PROPOSED TRANSFER OF ETTP BUILDINGS
OAK RIDGE RESERVATION, TN

FILES RESEARCH FOR HAZARDOUS SUBSTANCE ACTIVITY

The following statement is provided in support of guidance promulgated under Section 120(h) of the Comprehensive Environmental Response, Liability, and Compensation Act, as amended (CERCLA) 42 U.S.C. 9620(h) and in support of regulations issued by the Environmental Protection Agency at 40 CFR part 373.

The undersigned has made a complete search of existing and available Department of Energy (DOE) records, documentation, and data within the real estate files relating to the property that is subject to the proposed fee transfer action of Buildings K-1007, K-1035, K-1036, K-1225, K-1330, K-1400 and K-1580 at the East Tennessee Technology Park within the Oak Ridge Reservation, Tennessee. The proposed action would result in transfer to the Community Reuse Organization of East Tennessee (CROET) under a 10 CFR 770 Proposal. The search conducted was considered reasonable with a good faith effort expended to identify whether any hazardous substances were stored for one year or more, released, or disposed of on the property. The available real estate records of this office do not reflect any determinable reference that hazardous substance activity as defined by Section 101(14) of CERCLA took place on or in the property during the time the property was owned by the United States of America.

Lands affected by this action are identified as portions of the following original acquisition tracts in which the United States of America acquired title, (having been acquired for the Atomic Energy Commission as a forerunner of the Department of Energy) by Civil Action No. 429 filed in the United States District Court for the Eastern District of Tennessee, Northern Division:

a. Buildings K-1035, K-1036, and K-1400 are located on a portion of **Tract H-719**. Title to this land was vested in the United States of America by Declaration of Taking No. 26 dated March 19, 1943. Judgment on Declaration of Taking was filed for public record on March 30, 1943 in Vol. Y-5, page 515 in the Roane County Register's Office, Tennessee.

b. Buildings K-1225, K-1330, and K-1580 are located on a portion of **Tract H-720**; and Building K-1007 is located on a portion of **Tract H-731**. Title to this land was vested in the United States of America by Declaration of Taking No. 19 dated February 8, 1943. Judgment on Declaration of Taking was filed for public record on February 23, 1943 in Vol. Y-5, page 136 in the Roane County Register's Office, Tennessee.

This record shall be made a part of the CERCLA report currently being prepared.

Katy Kates

Katy Kates, Realty Officer
Oak Ridge Operations Office
Department of Energy
August 8, 2003

Attachment-Plat Exhibit

APPENDIX B

STUDY AREA MAPS FROM RECORDS SEARCH

Location of Pre–World War II Structures and Cemeteries in or near the East Tennessee Technology Park

LEGEND

- Pre–World War II Structures
- Cemeteries
- Buildings
- Roads
- Water Bodies
- Streams

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0 500 1000 1500

DATA COMPLIED BY GRID IS NAD 83 FEET
ER REMOTE SENSING PROGRAM
ENVIRONMENTAL INFORMATION MANAGEMENT PROGRAM
GEOGRAPHIC INFORMATION SCIENCES AND TECHNOLOGY GROUP
ORIGINAL BY: BARGE, WAGGONER, SUMNER AND CANNON, INC.
REVISED BY: TETRA TECH, INC. 2/1001

KMAPS ORO HISTORIC MAP GSL

APPENDIX C

SAMPLING AND ANALYSIS PLAN FOR THE K-1330 BUILDING

Sampling and Analysis Plan for Collection of Groundwater, Air, and Soil Vapor Samples for the K-1330 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

This document is approved for public release per review by:

BJC ETTP Classification and Information Control Office — Date: 14 JAN 04

SCIENCE APPLICATIONS INTERNATIONAL CORPORATION

contributed to the preparation of this document and should not be considered an eligible contractor for its review.

BJC/OR-1714

Sampling and Analysis Plan for Collection of Groundwater, Air, and Soil Vapor Samples for the K-1330 Building at the East Tennessee Technology Park, Oak Ridge, Tennessee

Issued—January 2004

Prepared for the
U. S. Department of Energy
Assets Utilization

BECHTEL JACOBS COMPANY LLC
managing the
Environmental Management Activities at the
East Tennessee Technology Park
Y-12 National Security Complex Oak Ridge National Laboratory
Paducah Gaseous Diffusion Plant Portsmouth Gaseous Diffusion Plant
under contract DE-AC05-98OR22700
for the
U. S. DEPARTMENT OF ENERGY

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ACRONYMS

bgs	below ground surface
COPC	chemical of potential concern
DCA	dichloroethane
DCE	dichloroethene
DOE	U. S. Department of Energy
ELCR	Excess Lifetime Cancer Risk
EPA	U. S. Environmental Protection Agency
ETTP	East Tennessee Technology Park
FFA	Federal Facility Agreement
GC/MS	gas chromatography/mass spectrometry
PCE	tetrachloroethene
PRG	preliminary remediation goal
PSS	Park Shift Superintendent
RCRA	Resource Conservation and Recovery Act of 1976
RCW	recirculating cooling water
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
SSC	sampling subcontractor
TCA	trichloroethane
TCE	trichloroethene
TIC	tentatively identified compound
VOC	volatile organic compound

1. INTRODUCTION

This Sampling and Analysis Plan (SAP) describes sampling efforts to be undertaken to determine whether subsurface contamination from volatile organic compounds (VOCs) has resulted in organic vapors entering the K-1330 building. This plan was developed as part of an effort to address concerns raised by U. S. Environmental Protection Agency (EPA) Region 4 regarding the potential for vapor intrusion of VOCs from shallow groundwater into buildings at the East Tennessee Technology Park (ETTP) that are proposed for transfer.

The K-1330 building is located in the southeastern portion of the ETTP. Building K-1330 was constructed in 1990 to provide office space for the Environmental Restoration organization. It is a rectangular-shaped, slab-on-grade two-story masonry structure with 7200 ft^2 of space on each floor. The building exterior is red brick and the interior walls are cinderblock covered with dry wall. Building K-1330 does not have a basement. Building K-1330 has been used for office space by several site organizations since its construction. The K-1330 building is bounded by an asphalt parking area to its north and grass-covered areas to its south, west, and east. Site plans dating from construction of the Oak Ridge Gaseous Diffusion Plant in the 1940s until the late 1980s indicate that Bldg. K-1330 was constructed in an area that had not been formerly used for industrial activities.

This SAP presents the rationale and details of air sampling that will be conducted in Bldg. K-1330. These activities are being performed to determine the potential for vapor intrusion into the building by VOCs that may be present in the subsurface. The VOCs selected for analyses are those compounds present in the shallow bedrock groundwater plume located side gradient to Bldg. K-1330.

2. OPERATIONS CONDUCTED IN PROXIMITY OF THE K-1330 BUILDING

To the west of Bldg. K-1330 are K-1320 and K-1580. The K-1580 building was built in 1980 to provide office space. In 1982, the K-1320 building was constructed to provide additional office space. In 1984, an addition was added to K-1320 and designated K-1320-A.

There are no past or present facilities in the vicinity of K-1330 that are potential areas of contamination. The closest environmental restoration area is the Recirculating Cooling Water (RCW) Lines Leak Sites 500 ft to the northwest. The RCW lines, in conjunction with a cooling tower, served a process support building from the mid-1950s to 1984. The makeup water for the system contained a chromate/zinc/phosphate treatment until 1977, when it was replaced by a phosphate treatment system. The cooling tower was demolished in the 1990s (Energy Systems 1995). Potential leaks from the RCW lines are listed as a Solid Waste Management Unit under the Resource Conservation and Recovery Act of 1976 (RCRA) and Appendix C of the Federal Facility Agreement (FFA).[1] The FFA is an agreement between the U. S. Department of Energy (DOE), the EPA, and the state of Tennessee to integrate the requirements of RCRA corrective actions and Comprehensive Environmental Response, Compensation, and Liability Act of 1980 remedial investigations at specific sites within the Oak Ridge Reservation. The specific facilities to which the FFA applies are listed in Appendix C of the FFA.

[1]DOE 1992. *Federal Facility Agreement for the Oak Ridge Reservation*, DOE/OR-1014, EPA Region 4, DOE, and TDEC, Washington, D.C.

3. EXISTING/HISTORICAL DATA

Hydrogeologic characterization data for K-1330 are limited because, currently, no groundwater monitoring wells exist in its immediate vicinity. Much of the hydrogeologic characterization data have been interpolated from available ETTP-wide information. Depth to bedrock (interpolated) is expected to be from 2 to 20 ft below ground surface (bgs). The interpolated depth to groundwater, based on the ETTP-wide potentiometric map, indicates depths to water ranging from 12 to 20 ft bgs. The depth to groundwater is suspected to become shallower, moving from northeast to southwest in the vicinity of the building. Shallow groundwater flow is anticipated to be to the southwest in the area of K-1330.

Because a groundwater plume has not been identified beneath K-1330, there are data gaps regarding possible groundwater contamination beneath this building that may be from an upgradient source (K-1330 does not have any groundwater contamination sources; it is and always has been an office building). Groundwater flowpaths in bedrock at ETTP are an unknown due to the complex geology and geologic structure underlying ETTP. An identified groundwater plume exists within 500 ft to the northwest of K-1330. As shown in Fig. 3.1, this plume is located hydraulically side gradient rather than directly upgradient of the building. However, this plume occurs in bedrock and the possibility of transport through bedrock flowpaths toward the building cannot be completely discounted based on available data.

Contaminants that have been detected in this plume include 1,1,1-trichloroethane (TCA), tetrachloroethene (PCE), trichloroethene (TCE), 1,2-dichloroethene (DCE), vinyl chloride, methylene chloride and benzene. Although 1,1-DCE and 1,1-dichloroethane (DCA) were not detected, these degradation products of 1,1,1-TCA should be considered to be potentially present. Methylene chloride is a potential degradation product of carbon tetrachloride via chloroform. It is unknown if the methylene chloride results from biological degradation of these parent compounds or from its direct historic use. Accordingly, carbon tetrachloride, chloroform, methylene chloride and chloromethane are considered to have the potential to be present in the groundwater plume.

Monitoring well BRW-071, which is located approximately 500 ft northwest of K-1330 (Fig. 3.1), contained TCE at a maximum concentration of 10 micrograms per liter (µg/L) during sampling events conducted between 1994 and 1998. This well has not been sampled since 1998. Monitoring well BRW-053, located 500 ft side gradient from K-1330, represents the most contaminated well near K-1330. During the September 2002 sampling event at well BRW-053, TCE and 1,2-DCE were detected at concentrations of 87 µg/L and 130 µg/L, respectively. Concentrations of TCE found in the wells northwest of Bldg. K-1330 have declined since the initial monitoring event but have remained relatively constant over the past two years. Conversely, concentrations of 1,2-DCE increased an order of magnitude at well BRW-053 from 2001 to 2002. Concentrations of 1,2-DCE also increased an order of magnitude during the most recent sampling event at wells BRW-054, BRW-071 and BRW-073.

Although contemporaneous sampling of the wells indicated in Fig. 3.1 has not been performed, TCE and 1,2-DCE concentrations are significantly lower at wells BRW-054, BRW-071, BRW-072 and BRW-073 than at the upgradient well BRW-053. Average concentrations of TCE over the last four sampling events decline from 70 µg/l at well BRW-053 to 7 µg/l at well BRW-071. Over the past four sampling events, the average concentration of 1,2-DCE declined from 66 µg/l at well BRW-053 to 3 µg/l at well BRW-071. Given the observed concentrations in monitoring wells located nearest to K-1330, the age of original source releases, and natural attenuation effects, it appears unlikely that concentrations of TCE in groundwater at K-1330, if transported to this building, would exceed those observed at monitoring well BRW-071.

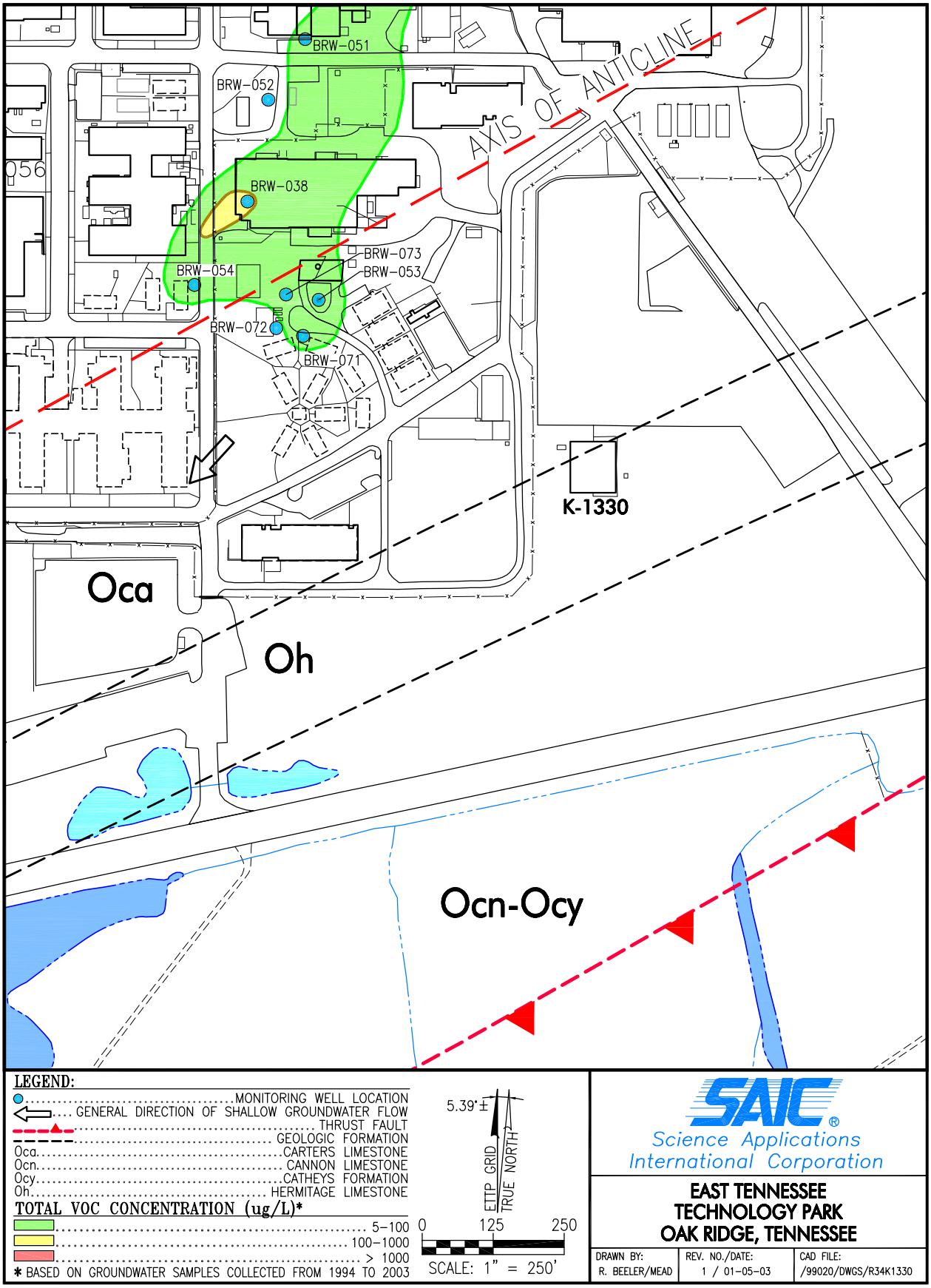

Fig. 3.1. Groundwater VOC concentrations in the vicinity of K-1330.

4. SCOPE

The overall scope of this SAP is to determine airborne VOC concentrations in the soil vapor directly beneath the K-1330 building slab and in the building indoor air at normal breathing zone heights in order to evaluate the vapor intrusion pathway. This overall objective will be met by sampling soil vapor directly beneath the slab of the lowest floor using EPA-approved methods with detection limits that are sufficient to meet the requirements of the risk assessment. If the average concentrations of any of the VOCs in the soil gas directly beneath the building slab exceed their respective site-specific trigger levels, indoor air sampling will be performed to determine exposure concentrations. Indoor air sampling will also be performed using EPA-approved methods with detection limits that are sufficient to meet the requirements of the risk assessment. In addition, to assess a potential change in site conditions, an upgradient groundwater monitoring well or soil gas well will be sampled.

5. OBJECTIVES AND RATIONALE

5.1 SAMPLING OBJECTIVES

EPA recently issued *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway From Groundwater and Soils* (EPA 2002).[2] The draft guidance provides a tiered approach to determine if the vapor intrusion pathway is complete and if any exposures that occur present unacceptable risks. The three tiers in the evaluation approach are:

- Tier 1 – Primary Screening, designed to be used with general knowledge of a site and the chemicals known or reasonably suspected to be present in the subsurface;
- Tier 2 – Secondary Screening, designed to be used with some limited site-specific information about the contamination source and subsurface conditions; and
- Tier 3 – Site-Specific Pathway Assessment, which involves collecting more detailed, site-specific information and conducting confirmatory sub-slab and/or indoor air sampling.

The first tier is intended to provide a rapid screening of whether the vapor intrusion pathway is potentially complete at the site. In the Tier 1 evaluation, the user determines whether chemicals of sufficient volatility and toxicity are present in the vadose zone or groundwater at the site and if receptor locations are sufficiently close (~100 ft from the source) to present an exposure potential. If these criteria are met, the user subsequently evaluates whether conditions exist that warrant immediate action to verify whether the pathway presents unacceptable risks and, if necessary, eliminates those risks. Conditions that may warrant immediate action to verify or eliminate risks from the vapor intrusion pathway include odors within buildings, wet basements where VOCs are present in shallow groundwater, and physiological effects reported by receptors.

The second tier provides generic screening criteria based on an excess lifetime cancer risk (ELCR) range of 10^{-6} to 10^{-4} and conservative attenuation factors. The Tier 2 evaluation is intended to allow the

[2]Available on the World Wide Web at http://www.epa.gov/epaoswer/hazwaste/ca/eis/vapor/complete.pdf.

user to eliminate the vapor intrusion pathway, if the generic screening criteria are not exceeded. Certain site conditions make the use of the generic screening criteria inappropriate. These conditions include:

- very shallow groundwater sources at depths of less than 5 ft below foundation level, or

- relatively shallow soil or groundwater sources (at depths of less than 15 ft below the foundation) and the presence of significant openings or preferential pathways in the building to the subsurface such as sumps, unlined crawl spaces, or utility corridors.

If the generic screening criteria are exceeded or the above conditions exist, a Tier 3 evaluation is required. In the Tier 3 evaluation, the draft guidance recommends sampling of sub-slab soil gas and, if indicated, indoor air measurements.

As previously stated, EPA Region 4 has raised concerns regarding the potential for vapor intrusion of VOCs from shallow groundwater into buildings at the ETTP that are proposed for transfer. Using the draft guidance provided by EPA Region 4 personnel, it has been determined that a few buildings at ETTP that are proposed for transfer, meet the Tier 1 criteria (presence of VOCs and proximity to source). In general, the Tier 2 screening criteria are not applicable to facilities being considered for transfer, because of the shallow depth to groundwater and limited depth to bedrock that exhibits karst features. Therefore, EPA has requested that soil gas samples be collected and/or that indoor air be monitored.

The draft guidance does not require the user to begin at Tier 1 and proceed stepwise through Tier 3. A site-specific Tier 3 assessment may be performed without previous evaluation. Additionally, the draft guidance allows the use of other technically sound approaches in evaluating the vapor intrusion pathway.

Based on the site-specific conditions and considerations from the guidance indicated above, DOE and EPA have agreed to the following strategy for evaluation of the vapor intrusion pathway:

- DOE will sample soil vapor directly beneath the slab of the lowest floor or basement within a subject building;

- DOE will concurrently sample the groundwater monitoring well in closest proximity to the subject building that exhibited the most elevated concentrations of VOCs during the most recent sampling event to establish current conditions;

- As an option to groundwater sampling to establish current conditions DOE will obtain an upgradient soil gas sample from a location in close proximity to the building;

- Soil vapor concentrations of VOCs beneath the building will be compared against site specific soil vapor trigger levels that have been agreed to by DOE and EPA Region 4;

- If the average concentrations of all VOCs in the soil vapor samples do not exceed their respective trigger levels, further evaluation of the vapor intrusion pathway will not be performed because the subslab concentrations are not considered to present any risk to potential receptors;

- If the average concentrations of any VOCs in the soil vapor samples exceed their respective trigger levels, indoor air samples will be collected at normal breathing zone height under normal working conditions from the basement or lowest floor of the subject building in order to determine if a pathway for exposure exists;

- An outdoor air sample will be obtained concurrent with the indoor air samples to identify any potential contribution of VOCs from external sources; and

- The data from the indoor air samples and outdoor air sample will be compared against 25-year industrial preliminary remediation goals (PRGs) to determine if any unacceptable risks are presented to potential receptors upon building transfer.

The overall objective of this SAP is to obtain data to assess the vapor intrusion pathway for Bldg. K-1330. In order to achieve this objective, sampling and analytical protocols followed under this Plan must ensure detection of volatile contaminants at levels at or below relevant risk screening criteria. For the groundwater sample (which is being collected to assess current conditions), the analytes that must be identified are those VOCs typically reported in the ETTP groundwater monitoring program. A preliminary set of analytes of interest for the vapor intrusion pathway for Bldg. K-1330 was identified as those VOCs historically detected in the nearby monitoring wells indicated in Fig. 3.1. This preliminary set of analytes of interest also includes the degradation (and parent) compounds of the detected VOCs. The preliminary list of analytes of interest for Bldg. K-1330 is provided in Table 5.1. Any VOCs that are currently analyzed by the groundwater program that are detected will also be reported.

For soil vapor samples, the sampling and analytical protocols must ensure that VOCs are quantified at levels at or below the levels that trigger indoor air sampling to further evaluate the potential risks associated with the vapor intrusion pathway. For ambient air (indoor and outdoor) samples, the sampling and analytical protocols must ensure that VOCs are quantified at or below the 25-year industrial PRGs. The 25-year industrial PRGs are the lower of the airborne concentrations corresponding to an ELCR of 10^{-5} or a hazard quotient of 0.1. Table 5.1 also provides the 25-year industrial PRGs for the preliminary set of analytes of interest.

Table 5.1. Preliminary analytes of interest and respective indoor or PRGs[a] for the vapor intrusion pathway at Bldg. K-1330

Chemical	Industrial PRGs[b], mg/m^3
Carbon tetrachloride	3.58E-04
Chloroform	1.78E-03
Chloromethane	1.31E-02
1,1-Dichloroethane	7.31E-02
1,1-Dichloroethene	8.18E-04
1,2-Dichloroethene	4.60E-03
cis – 1,2-Dichloroethene	5.11E-03
Methylene chloride	8.67E-02
1,1,1-Trichloroethane	3.21E-01
Tetrachloroethene	7.05E-02
Trichloroethene	5.83E-03
Vinyl chloride	4.65E-03
Benzene	4.38E-03
Acetone	4.6E-01
2-Butanane	7.31E-01

[a]PRG = Preliminary remediation goal.
[b]Industrial 25-year PRGs are the lower of the concentrations corresponding to an excess lifetime cancer risk of 10^{-5} or a hazard quotient of 0.1.

Soil vapor action or trigger levels will inherently be larger than risk screening criteria due to the attenuation within the foundation materials and dilution effects as the vapors migrate into the indoor air volume of the buildings lowest floor. Therefore, detection and reporting limits for indoor air samples are suitable to meet the established objectives for soil vapor samples. Detection and reporting limits for the VOCs to be reported in groundwater, soil vapor, and ambient air samples are further identified in Chap. 7 of this SAP.

5.2 SAMPLING DESIGN

To evaluate the potential for VOC intrusion into the ETTP buildings designated for transfer, the general sampling approach has been divided into two phases. The first phase involves collection of soil vapor samples from directly beneath the slab of the building's lowest floor. A groundwater sample will also be collected in the first phase of sampling from the upgradient monitoring well that has historically exhibited the most elevated concentrations of VOCs. As an option to groundwater sampling, a soil gas monitoring well may be installed in proximity to the building to collect upgradient soil gas samples. Data obtained from this groundwater monitoring well or soil gas well will be used to define current conditions and monitor for any future change in conditions. The second phase of sampling involves collection of indoor ambient air samples at the normal breathing zone height within the lowest floor of the subject building. An outdoor ambient air sample would also be collected in this second phase to identify any potential external sources that may contribute VOCs detected in the indoor air samples.

5.2.1 Phase 1 – Sub-Slab Soil Vapor and Upgradient Groundwater or Soil Gas Sampling

During the first phase, four soil vapor samples will be collected directly beneath the first floor or foundation slab of Bldg. K-1330. Building K-1330 does not have a basement and, therefore, the VOC concentrations measured in these sub-slab soil vapor samples reflect equilibrium conditions resulting from attenuation in the soil column beneath the building. Samples taken in this fashion eliminate the uncertainty associated with partitioning calculations in modeling.

The four sample stations for the sub-slab soil vapor samples will be located on the basis of best professional judgment. Sampling stations for Phase 2 indoor air samples will generally coincide with the locations selected for sub-slab soil vapor sampling. Therefore, the selection of sampling stations will attempt to avoid locations immediately adjacent to activities that may be fugitive VOC sources (such as lavatories or janitorial closets that may contribute VOCs from cleaners, floor stripping, indoor painting activities or industrial activities that use organic solvents). Additionally, the sampling stations will be located toward the building interior to avoid leakage of atmospheric air and the resulting dilution of soil vapor samples that may occur if sample stations are located near the building edge.

The soil vapor samples shall be collected by drilling a small (~ 9/16 in diameter) penetration through the first floor or foundation slab. If a vapor barrier is present beneath the floor slab, penetration of this barrier will be required. Otherwise, care shall be taken to avoid disturbance or penetration of the underlying soil or aggregate. Soil vapor samples shall be grab samples (sample collection duration of less than 60 seconds). Soil vapor samples shall be collected using 5L pre-evacuated SUMMA canisters. The preliminary analytes of interest for the soil vapor samples are identified in Table 5.1. Any VOCs that are currently analyzed by the groundwater program that are detected will also be reported.

A groundwater sample shall be collected concurrent with the soil vapor samples to determine current groundwater conditions. The groundwater sample shall be collected from the monitoring well in closest proximity to the subject building that exhibited the most elevated VOC concentrations in the most recent groundwater monitoring event. For Bldg. K-1330 the groundwater sample shall be collected from well

BRW-053. This well will be purged and sampled using micropurging techniques to produce samples of lower turbidity. To be consistent with the groundwater program, samples will be analyzed for those VOCs typically reported under the ETTP groundwater monitoring program.

As previously indicated, the groundwater monitoring wells in closest proximity to Bldg. K-1330 are ~ 500 ft northwest of the building. These monitoring wells are hydraulically side gradient rather than upgradient from the building. Therefore, as an option to groundwater sampling, upgradient soil gas samples may be collected to determine current conditions and monitor for any changes in soil gas composition that may occur in the future. To collect these samples, a permanent soil gas monitoring well (piezometer) will be installed at a location upgradient to and in relatively close proximity to the building. Soil gas samples collected from this piezometer will be analyzed for the suite of VOCs typically reported under the ETTP groundwater monitoring program.

5.2.2 Phase 2 – Ambient Air Sampling

Phase 2 ambient air sampling will be performed for buildings scheduled for transfer only if VOC concentrations in the Phase 1 soil vapor samples exceed the site-specific soil vapor trigger levels. Proposed site-specific soil vapor trigger levels are provided in Table 5.2.

Four indoor air samples will be taken at 2 to 5 ft above the floor within the building. To ensure the samples are indicative of VOC concentrations within the building during normal operating or working conditions, all sampling activities will be conducted with the building heating, ventilation, and air-conditioning systems turned on. The sample stations for the four indoor air samples will generally coincide with the locations selected for the sub-slab soil vapor samples. As indicated, the location of indoor air sampling stations will be selected to attempt to avoid locations immediately adjacent to activities that may introduce fugitive VOC emissions.

The indoor air samples will be collected using pre-evacuated (sub-atmospheric) pre-cleaned and certified 5L SUMMA canisters. Indoor air samples will be 8-h., time-weighted average samples. A minimum of one 8-h, time-weighted average ambient air sample will be collected outside of the building to exclude any potential contributions from external industrial sources. This outdoor sample station will be set up near the building at an upwind location. The location of the sampling station will be made by contacting the Park Shift Superintendent's (PSS) Office to acquire wind direction from the site meteorological station. The sampling station shall be located no more than 20 ft from the building at a location that will be minimally impacted by facility operations (i.e., high-traffic areas shall be avoided to the extent possible). The final location of this sampling station shall be determined in the field during sampling activities. Sample stations for the four indoor samples are discussed in Chap. 6.

6. FIELD SAMPLING PLAN

Soil vapor and ambient air sampling activities at K-1330 will be implemented in two separate mobilization events. Prior to each mobilization event the sampling subcontractor (SSC) will obtain evacuated 5L SUMMA canisters that have been cleaned, conditioned and certified in accordance with the requirements of Method TO-15. Other sampling system components shall be cleaned in accordance with Method TO-15 prior to assembly of the sampling system. Non-metallic parts shall be rinsed in deionized water and dried in a vacuum at 50° C. Stainless steel parts and fittings shall be cleaned in an ultrasonic bath using methanol followed by ultrasonic cleaning in hexane. These parts shall be subsequently rinsed in deionized water and baked in a vacuum over at 100° C for 12 to 24 h.

Table 5.2. Proposed site-specific soil vapor trigger levels indicating the need for indoor air sampling

Volatile organic compound	Proposed trigger level[a] (mg/m^3)	Concentration in building (ug/m^3)	Alpha[b]
1,1,1-Trichloroethane	3.01E+02	3.21E+02	1.07E-03
1,1,2,2-Tetrachloroethane	6.67E-01	7.05E-01	1.06E-03
1,1,2-Trichloroethane	1.91E+00	2.04E+00	1.07E-03
1.1.2-Trichloro-1,2,2-trifluoroethane	4.04E+03	4.38E+03	1.08E-03
1,1-Dichloroethane	6.88E+01	7.31E+01	1.06E-03
1,1-Dichloroethene	7.55E-01	8.18E-01	1.08E-03
1,2-Dichloroethane	1.43E+00	1.57E+00	1.10E-03
1,2-Dichloroethene	3.95E+00	4.60E+00	1.16E-03
1,2-Dichloropropane	5.45E-01	5.83E-01	1.07E-03
2-Butanone	6.84E+02	7.31E+02	1.07E-03
2-Hexanone	na[c]	na[c]	1.04E-03
4-Methyl-2-pentanone	4.06E+02	4.38E+02	1.08E-03
Acetone	4.13E+02	4.60E+02	1.11E-03
Benzene	4.05E+00	4.38E+00	1.08E-03
Bromodichloromethane	2.62E+00	2.38E+00	9.11E-04
Bromoform	1.39E+01	1.02E+01	7.38E-04
Bromomethane	6.89E-01	7.31E-01	1.06E-03
Carbon disulfide	9.31E+01	1.02E+02	1.10E-03
Carbon tetrachloride	3.35E-01	3.58E-01	1.07E-03
Chlorobenzene	2.75E+00	2.92E+00	1.06E-03
Chloroethane	1.38E+03	1.46E+03	1.06E-03
Chloroform	1.62E+00	1.78E+00	1.10E-03
Chloromethane	1.24E+01	1.31E+01	1.06E-03
cis-1,2-Dichloroethene	4.81E+00	5.11E+00	1.06E-03
cis-1,3-Dichloropropene	2.80E+00	2.92E+00	1.04E-03
Dibromochloromethane	1.26E+01	1.02E+01	8.11E-04
Ethylbenzene	3.49E+01	3.72E+01	1.06E-03
Methylene chloride	7.92E+01	8.67E+01	1.09E-03
Styrene	1.38E+02	1.46E+02	1.06E-03
Tetrachloroethene	6.66E+01	7.05E+01	1.06E-03
Toluene	5.39E+01	5.83E+01	1.08E-03
trans-1,2-Dichloroethene	9.67E+01	1.02E+02	1.06E-03
trans-1,3-Dichloropropene	4.91E+00	5.11E+00	1.04E-03
Trichloroethene	5.45E+00	5.83E+00	1.07E-03
Vinyl chloride	4.23E+00	4.65E+00	1.10E-03
Xylenes (total)	1.38E+01	1.46E+01	1.06E-03

[a]Proposed trigger level is the result of selecting a soil gas concentration that results in an indoor air concentration equal to the PRG. Note that these are still under negotiation with Region 4 EPA.

[b]Alpha is the infinite source indoor attenuation coefficient and directly correlates the soil gas concentration with the indoor air concentration.

[c]na = not available due to lack of toxicity data.

In the first phase of sampling, four soil vapor samples shall be collected from directly beneath the building foundation or first floor slab. An upgradient groundwater or soil gas sample will also be collected to assess current conditions.

The sampling systems for soil vapor shall be 5L subatmospheric SUMMA canisters. For collection of the soil vapor, flow restriction will be provided by a critical orifice set to charge the canisters to the desired end pressure over a 60 second sample collection period. The sampling systems shall be assembled in accordance with Fig. 1 of Method TO-15 prior to mobilization to the field.

Four sub-slab vapor samples shall be collected during the sampling event at locations shown in Fig. 6.1. A penetration permit may be required for installation of the sub-slab sample ports. Floor penetrations shown in Fig. 6.1 are approximate only and must be field located prior to installation based upon the requirements of the penetration permit. Prior to penetration of the floor slab, the sampling system shall be located at the stations indicated in Fig. 6.1. Once the sampling system has been set up at the designated locations, the SSC shall record temperature, humidity, and other parameters indicated by Method TO-15. The inlet tubing to the sampling system shall be as short as possible. Samples will be taken by drilling small (~9/16-in.-diam) holes through the slab taking care not to disturb the materials underlying the slab. If a vapor barrier is part of the design, penetration of this barrier will be required. Consistent with EPA guidance, a capped brass or stainless steel tube will be inserted into the penetration. Immediately upon completion of the penetration, it will be sealed using non-VOC-bearing caulk. After completion of the penetration the cap shall be removed from the stainless tube to attach the inlet tubing of the sampling system. The inlet line of the sample system shall be attached to the floor penetration tube and the flow valves opened.

Upon collection of the soil vapor samples, the SUMMA canisters shall be valved closed. The sampling line shall be disconnected from the canister and the canister removed from the sampling system. Upon collection of the samples, the final pressure shall be checked and recorded. The final system pressure should be ~ 88 Kpa (90-100 torr vacuum).

Upon collection of the SUMMA canister, it shall be labeled as required by the SSC's standard operating procedures (SOPs). The canisters shall be shipped to the laboratory in a canister shipping case as required by the manufacturer's specifications or the SSC's SOPs.

Decontamination of sampling equipment used for collection of air samples is not required. All equipment, including the sampling inlet line, used at each sampling station shall be dedicated.

Groundwater samples shall be collected from well BRW-053 using micropurging techniques. The SSC shall locate the sampling equipment at the indicated well and place sufficient plastic sheeting around the well to prevent cross contamination. The sampling pump should be of stainless steel construction fitted with Teflon bladders and Teflon-lined polyethylene tubing. The SSC should ensure that the Micropurge Water Analyzer and Flow Cell are calibrated in accordance with the manufacturer's instructions. In order to collect the groundwater sample, the well should be opened and the headspace monitored for organic vapors using a photoionization detector. Water levels in the well should be measured to using an electronic level indicator. After determination of the water level, the pump should be inserted to the midpoint of the water column or midpoint of the screen as required by the SSC SOPs. The water level indicator should subsequently be reinserted and purging should be initiated. The purge rate should be adjusted to maintain the static water level in the well. Purging should continue until the parameters of temperature, pH and specific conductance have stabilized and the turbidity has reached the desired end point (usually 5–10 nephelometric turbidity units). Sampling should be conducted immediately after the well has been purged by re-directing the flow through cell to the specified sample containers.

As indicated, none of the existing monitoring wells are located upgradient from Bldg. K-1330. Therefore, a permanent soil gas monitoring well may be installed upgradient from Bldg. K-1330 at the location indicated in Fig. 6.2. The borehole for installation of this soil gas well (piezometer) will be developed using a Geoprobe® track-mounted rig to remove the soil from a 4.0 in diameter borehole in a manner analogous to collecting sub-surface soil samples. The borehole shall be advanced to a depth of 8.0 ft bgs.

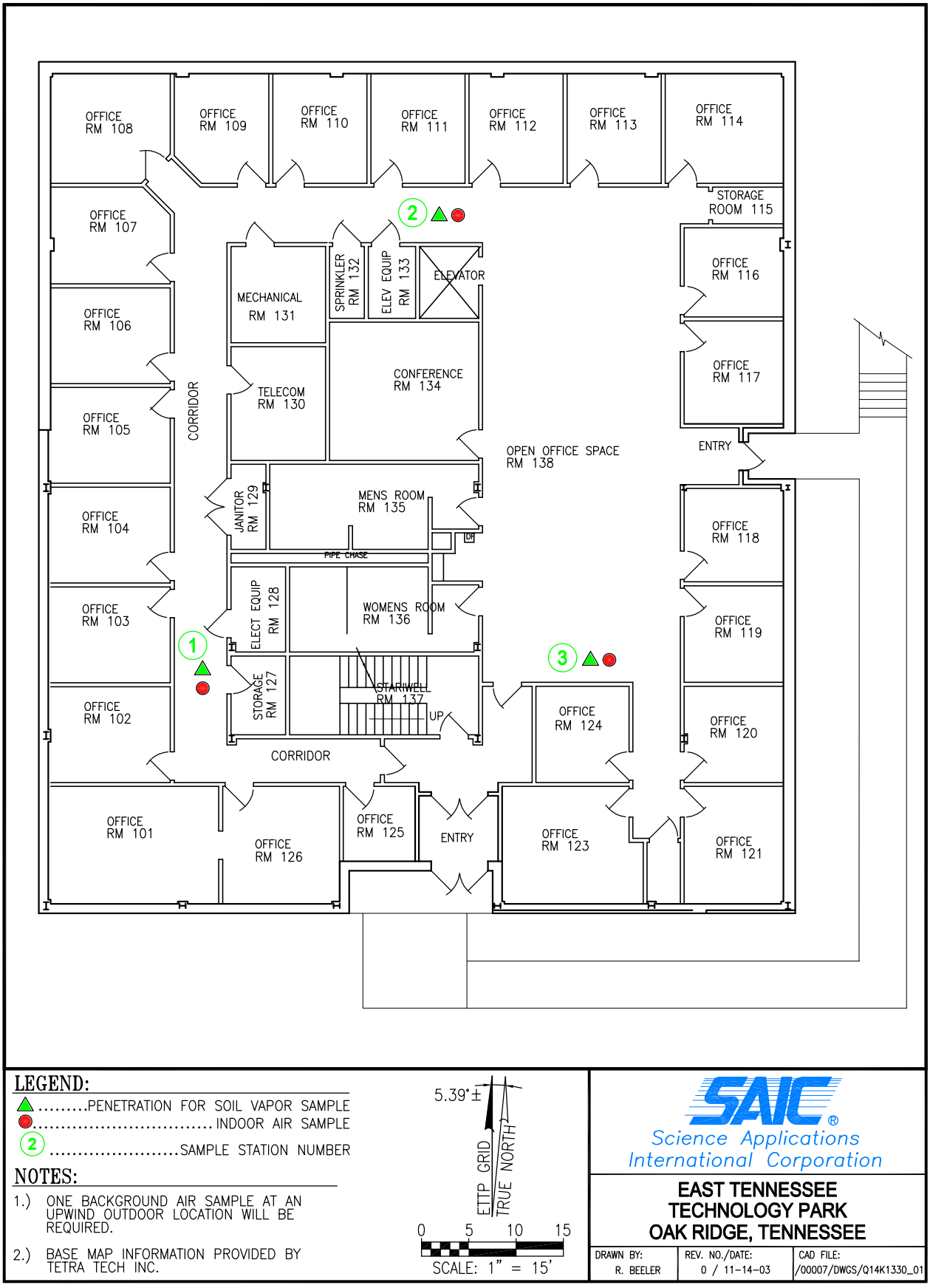

Fig. 6.1. Building K-1330 soil vapor and indoor air sampling locations.

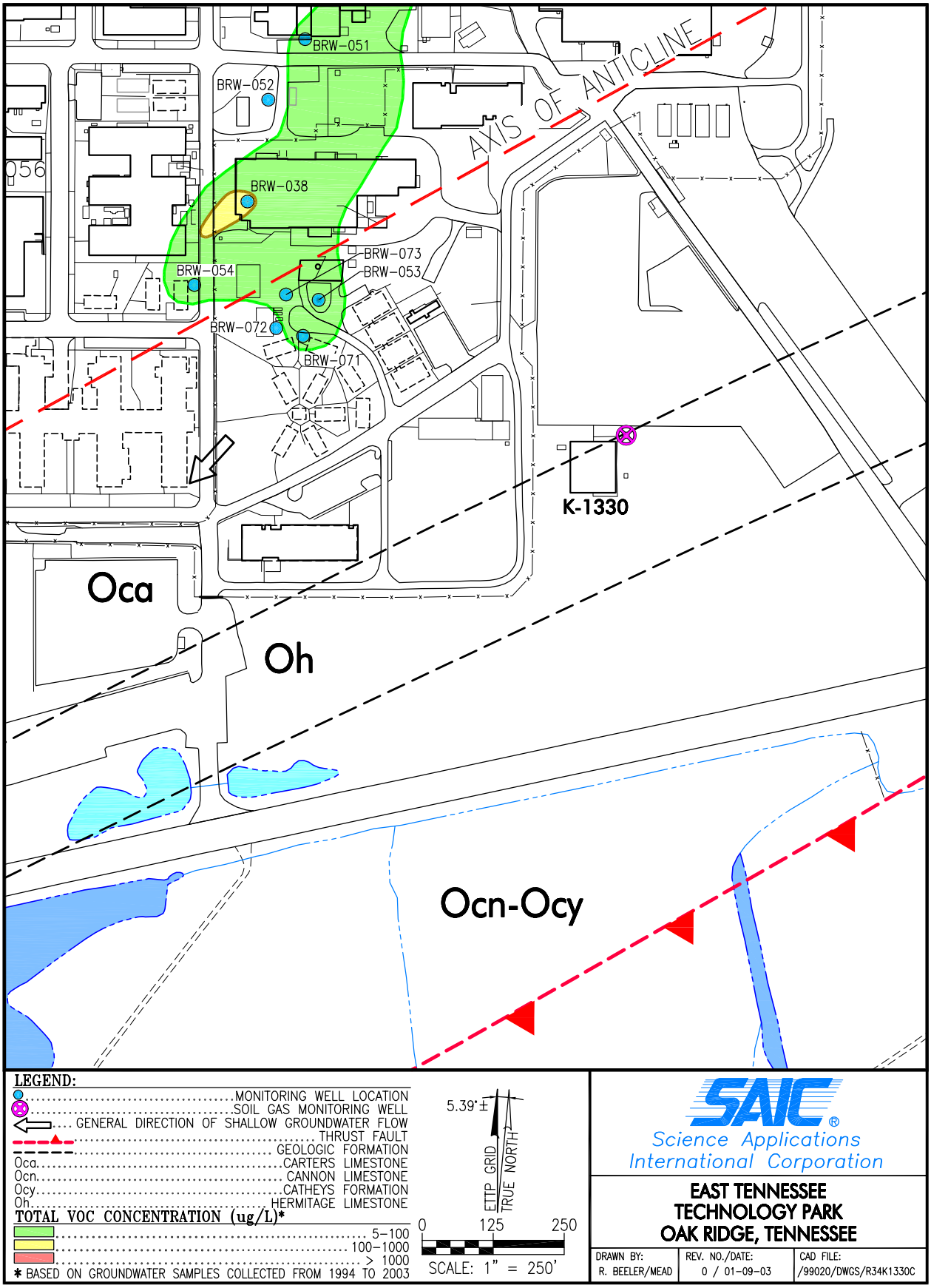

Fig. 6.2. Proposed location for K-1330 soil gas monitoring well.

After completion of the borehole, the soil gas well screen and casing shall be inserted in the boring so that ~ 1.0 ft of granular filter pack material is beneath the well plug. The casing, screen and fitting materials for construction of the soil gas well shall be 1.0 in diameter, Schedule 40 carbon steel. Screen sections will be commercially fabricated with slotted openings equal to 0.025 cm (0.010 in). The length of screen for the piezometer will be 2.0 ft. The casing will be of sufficient length for 2.5 ft of casing to extend above ground surface. The top of the casing will be provided with a threaded, airtight cap that is fitted with a sample port sized to join to the inlet line of a 5L SUMMA canister. After insertion of the piezometer screen and casing in the borehole, granular filter pack material will be placed within the annular space around the screen to a depth of 1.0 ft above the top of the screen using a tremie pipe. Granular filter pack material shall be 0.0188 in sand. Bentonite will be used to create an annular seal between the granular filter pack and an upper grout seal. Commercially available bentonite pellets will be added to the annular space above the filter pack using a tremie pipe. A sufficient quantity of bentonite pellets will be added to create a 2.0 ft thick seal. After placement of the bentonite pellets, a small volume of VOC-free potable water will be added to hydrate the seal material. Hydration time for the bentonite pellets shall be a minimum of 1.0 h.

After completion of the bentonite seal, the remaining annular space from the top of the bentonite seal will be grouted to ground surface. A 5.0-ft × 5.0-ft concrete collar will be poured around the soil gas well. This concrete collar will have a minimum thickness of 4.0 in.

The soil gas well shall be purged approximately 48 h after placement of the concrete collar to remove atmospheric air introduced during construction. Purging shall be accomplished by connection of a vacuum pump to the sampling port located on the piezometer's top cap using flexible stainless steel tubing. A flow totalizing indicator shall be attached to the discharge line of the vacuum pump. Purging shall be continued until three well volumes have been removed from the piezometer.

Sampling shall not be conducted for at least 72 h after initial purging of the piezometer. The upgradient soil gas sample shall be collected using 5L SUMMA canisters that have been cleaned, conditioned and certified in accordance with Method TO-15. All components of the sampling system will be pre-cleaned, conditioned in accordance with Method TO-15. The sampling system should be assembled prior to field mobilization as previously described. Once the sampling system has been located at the soil gas sampling station, connection to the sample port in the piezometer shall be made with stainless steel tubing fitted with a stainless steel vacuum valve. The SSC technicians shall record temperature, pressure and other relevant parameters specified by Method TO-15. After the sample system has been attached to the piezometer's sampling port, the connections shall be leak tested. The soil gas sample shall be collected by opening the system's valving for the specified sample collection period of 60 sec. Flow restriction shall be provided by a critical orifice set to charge the canister to the desired end pressure over this sample collection period. Once the soil gas sample has been obtained the sampling system shall be valved closed and the end pressure verified. The SUMMA canister shall be managed as previously described.

If the average concentrations of any VOCs detected in the Phase 1 soil vapor samples exceeds their respective trigger levels, indoor air samples will be collected in Phase 2. An outdoor air sample will also be collected in Phase 2.

Indoor air samples shall be collected at the same sample stations indicated for the soil vapor samples in Fig. 6.1. The sampling systems for the indoor air samples shall be cleaned, conditioned, and certified in accordance with Method TO-15 prior to mobilization. Sampling systems for indoor air samples should be assembled prior to field mobilization as previously described. To collect the indoor air samples, the sampling systems shall be located at the stations depicted in Fig. 6.1 with the inlet suspended 3 to 5 ft above the floor surface. Once the sampling system has been set up at the designated locations, the SSC shall record temperature, humidity, and other parameters indicated by Method TO-15. Flow restriction for the

indoor air samples shall be provided by an electronic mass flow controller as described by Method TO-15. A practice canister, as described in Method TO-15, shall be used to verify the system fill rate and absence of leakage prior to collecting the ambient air samples. The reading from the certified mass flow meter should be within ± 10% of the reading from the system's mass flow controller. If the values are in disagreement, the system should be checked for leakage, the mass flow controller recalibrated, or the sampling system replaced. After adjustment of the canister flow rate to the proper value, the sampler should be turned off and the practice canister disconnected from the system. A clean certified canister shall be attached to the system for sampling and the system valves opened. The system timer shall be set to start and stop the sampling period at the appropriate times.

Outdoor air samples shall be collected at a location determined in the field by the SSC. This location shall be recorded on a map in the SSC field logbook. Outdoor air samples will also be collected with subatmospheric 5L SUMMA canisters that have been cleaned, conditioned and certified in accordance with Method TO-15. To collect the outdoor air sample, the SSC shall set up the sampling system at the field determined location. The inlet for the outdoor air sample shall be suspended ~ 5 ft above ground surface. Flow restriction for the outdoor air samples shall also be provided by an electronic mass flow controller and magnelatch valve as described by Method TO-15. A practice canister, as described in Method TO-15, shall be used to verify the system fill rate and absence of leakage prior to collecting the outdoor air sample. Once the canister flow rate has been properly adjusted and the system verified as leak free, the practice canister shall be replaced with a new clean certified canister to collect the sample in the manner described above.

Upon collection of the air samples, the SUMMA canisters shall be valved closed. The sampling line shall be disconnected from the canister and the canister removed from the sampling system. Upon collection of the samples, the final pressure shall be checked and recorded. The final system pressure should be ~ 88 Kpa (~ 12.9 psi or 90-100 torr vacuum).

Upon collection of the SUMMA canister, it shall be labeled as required by the SSC's standard operating procedures (SOPs). The canisters shall be shipped to the laboratory in a canister shipping case as required by the manufacturer's specifications or the SSC's SOPs.

Decontamination of sampling equipment used for collection of air samples is not required. All equipment, including the sampling inlet line, used at each sampling station shall be dedicated.

The only field quality control samples required for the soil vapor and air samples are field equipment blanks and one duplicate. These QA samples are required only for the second phase of sampling. A field blank shall be required for groundwater sampling. All samples shall have the appropriate radiological analyses performed to comply with shipping protocols. Sample container, preservation and holding time requirements are provided in Table 6.1.

7. ANALYTICAL REQUIREMENTS

Air samples shall be quantitated for VOCs using gas chromatography/mass spectrometry (GC/MS) analyses as required by Method TO-15. Any of the VOCs indicated in Table 7.1 that are detected shall be reported. Additionally, the laboratory shall report up to twenty tentatively identified components (TICs). Quantitation of VOCs in air samples shall meet the reporting and detection limits specified in Table 7.1. Groundwater samples shall be quantified by GC/MS per Method OLM 03.1 VOA. Analyses of groundwater samples shall meet the reporting limits specified in Table 7.2. Additionally, the laboratory shall report up to twenty TICs in the groundwater sample.

Table 6.1. Sample container, preservation, and holding time requirements

Event	Sample station[a]	Sample type	Parameters of concern	Analytical protocols	Container type/volume	Preservation	Holding time
01	AU-01-41-1330-V	Soil vapor – grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
01	AU-02-41-1330-V	Soil vapor – grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
01	AU-03-41-1330-V	Soil vapor – grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
01	AU-04-41-1330-V	Soil vapor – grab	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
01	AU-00-41-1330-W	Groundwater[c]	Volatile organics[b]	OLM03.1VOA	3 × 40 ml VOA vials	HCl to pH<2; Cool 4° C	14 days
01	AU-93-41-1330-B	Field Blank	Volatile organics[b]	OLM03.1VOA	3 × 40 ml VOA vials	Prepreserved	14 days
01	AU-00-41-1330-G	Upgradient soil gas[c]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
02	AU-01-42-1330-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
02	AU-02-42-1330-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
02	AU-03-42-1330-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
02	AU-04-42-1330-I	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
02	AU-04-42-1330-D	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
02	AU-91-42-1330-B	Air Field Blank	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
02	AU-92-42-1330-B	Air Field Blank	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days
02	AU-05-42-1330-A	Indoor air: 8 h TWA[d]	Volatile organics[b]	TO-15	5L SUMMA Canister	None	14 days

[a]Sample station nomenclature is AU-AA-BC-DDDD-EE where the AA field is the station number 01-89. Sample station numbers 91 and 92 are dedicated for air field blanks. Station 93 is reserved for the groundwater field blank. The BC field designates the fiscal year and sampling event in that year. The DDDD field designates the building number. The EE field designates the sample type where V = soil vapor; I = indoor air; A = outdoor air; B = blank, D = duplicate, W = Groundwater, and G = Upgradient Soil Gas.

[b]Volatile organics of concern for air sampling at Bldg. K-1330 include tetrachloroethene; trichloroethene; 1,2-dichloroethene; vinyl chloride; 1,1,1-trichloroethane; 1,1-dichloroethene; 1,1-dichloroethane; carbon tetrachloride; chloroform; methylene chloride; chloromethane; benzene; acetone; and 2-butanone.

[c]Upgradient soil gas may be collected as an option to groundwater sampling.

[d]TWA = time-weighted average.

Table 7.1. VOCs and their respective quantitation and detection limits for soil vapor and air sampling

Analyte	Analytical method	Air quantitation level (mg/m^3)[c]	Air detection level (mg/m^3)[b]
1,1,1-Trichloroethane	TO-15	3.21E-01	3.21E-02
1,1,2,2-Tetrachloroethane	TO-15	7.05E-04	7.05E-05
1,1,2-Trichloroethane	TO-15	2.04E-03	2.04E-04
1,1,2-Trichloro-1,2,2-trifluoroethane		4.38E-00	4.38E-01
1,1-Dichloroethane	TO-15	7.31E-02	7.31E-03
1,1-Dichloroethene	TO-15	8.18E-04	8.18E-05
1,2-Dichloroethane	TO-15	1.57E-03	1.57E-04
1,2-Dichloroethene	TO-15	4.60E-03	4.6E-04
1,2-Dichloropropane	TO-15	5.83E-04	5.83E-05
2-Butanone	TO-15	7.31E-01	7.31E-02
3-Hexanone	TO-15	na[c]	
4-Methyl-2-pentanone	TO-15	4.38E-01	4.38E-02
Acetone	TO-15	4.60E-01	4.6E-02
Benzene	TO-15	4.38E-03	4.38E-04
Bromodichloromethane	TO-15	2.38E-03	2.38E-04
Bromoform	TO-15	1.02E-02	1.02E-03
Bromomethane	TO-15	7.31E-04	7.31E-05
Carbon disulfide	TO-15	1.02E-01	1.02E-02
Carbon tetrachloride	TO-15	3.58E-04	3.58E-05
Chlorobenzene	TO-15	2.92E-03	2.92E-04
Chloroethane	TO-15	1.46E+00	1.46E-01
Chloroform	TO-15	1.78E-03	1.78E-04
Chloromethane	TO-15	1.31E-02	1.31E-03
cis-1,2-Dichloroethene	TO-15	5.11E-03	5.11E-04
cis-1,3-Dichloropropene	TO-15	2.92E-03	2.92E-04
Dibromochloromethane	TO-15	1.02E-02	1.02E-03
Ethylbenzene	TO-15	3.72E-02	3.72E-03
Methylene chloride	TO-15	8.67E-02	8.67E-03
Styrene	TO-15	1.46E-01	1.46E-02
Tetrachloroethene	TO-15	7.05E-02	7.05E-03
Toluene	TO-15	5.83E-02	5.83E-03
trans-1,2-Dichloroethene	TO-15	1.02E-01	1.02E-02
trans-1,2-Dichloropropene	TO-15	5.11E-03	5.11E-04
Trichloroethene	TO-15	5.83E-03	5.83E-04
Vinyl chloride	TO-15	4.65E-03	4.65E-04
Xylenes (total)	TO-15	1.46E-02	1.46E-03

[a] mg/m^3 = milligram per cubic meter.
[b] $\mu g/m^3$ = microgram per cubic meter.
[c] na = no toxicity data available.

Table 7.2. VOCs to be reported and their respective quantitation limits for groundwater

Analyte	Analytical method	Groundwater quantitation level (µg/L)[a]
1,1,1-Trichloroethane	OLM03.1VOA	5
1,1,2,2-Tetrachloroethane	OLM03.1VOA	5
1,1,2-Trichloroethane	OLM03.1VOA	5
1,1-Dichloroethane	OLM03.1VOA	5
1,1-Dichloroethene	OLM03.1VOA	5
1,2-Dichloroethane	OLM03.1VOA	5
1,2-Dichloroethene	OLM03.1VOA	5
1,2-Dichloropropane	OLM03.1VOA	5
2-Butanone	OLM03.1VOA	10
3-Hexanone	OLM03.1VOA	10
4-Methyl-2-pentanone	OLM03.1VOA	10
Acetone	OLM03.1VOA	10
Benzene	OLM03.1VOA	5
Bromodichloromethane	OLM03.1VOA	5
Bromoform	OLM03.1VOA	5
Bromomethane	OLM03.1VOA	10
Carbon disulfide	OLM03.1VOA	5
Carbon tetrachloride	OLM03.1VOA	5
Chlorobenzene	OLM03.1VOA	5
Chloroethane	OLM03.1VOA	10
Chloroform	OLM03.1VOA	5
Chloromethane	OLM03.1VOA	10
cis-1,2-Dichloroethene	OLM03.1VOA	5
cis-1,3-Dichloropropene	OLM03.1VOA	5
Cibromochloromethane	OLM03.1VOA	5
Ethylbenzene	OLM03.1VOA	5
Methylene chloride	OLM03.1VOA	5
Styrene	OLM03.1VOA	5
Tetrachloroethene	OLM03.1VOA	5
Toluene	OLM03.1VOA	5
trans-1,2-Dichloroethene	OLM03.1VOA	5
trans-1,2-Dichloropropene	OLM03.1VOA	5
Trichloroethene	OLM03.1VOA	5
Vinyl chloride	OLM03.1VOA	2
Xylenes (total)	OLM03.1VOA	5

[a]µg/L = microgram per liter.
OLM = organic laboratory method, EPA Contract Laboratory Program.
VOA = Volatile organic analysis.

8. DATA MANAGEMENT AND REPORTING

Data obtained from this sampling event shall be managed in accordance with the requirements of the *Data Management Implementation Plan for the Reindustrialization Program, Oak Ridge, Tennessee* (BJC/OR-865). Results will be provided to EPA Region 4 and to the Tennessee Department of Environment and Conservation DOE-Oversight Office.

9. REFERENCES

Energy Systems (Lockheed Martin Energy Systems, Inc.) 1995. *Site Descriptions of Environmental Restoration Units at the Oak Ridge K-25 Site*, K/ER-47/R1, Lockheed Martin Energy Systems, Inc., Environmental Restoration Division, Oak Ridge, TN, November.

EPA (U. S. Environmental Protection Agency) 1999. *Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air, Second Edition, Compendium Method TO-15, Determination Of Volatile Organic Compounds (VOCs) In Air Collected In Specially-Prepared Canisters And Analyzed By Gas Chromatography/Mass Spectrometry (GC/MS)*, Center for Environmental Research Information, Office of Research and Development, Cincinnati, OH, January.

EPA (U. S. Environmental Protection Agency) 2002. *Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils*, EAP530-F-052, November.

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APPENDIX D

RADIOLOGICAL SURVEY PLAN FOR THE K-1330 BUILDING

1. AREA TO BE SURVEYED

The area to be surveyed is the K-1330 building (both interior and exterior surfaces), the building contents, the exterior sidewalk, the covered bench on the eastern side of the building, and the electrical equipment to the east and west of the building, all of which are to be transferred to the Community Reuse Organization of East Tennessee (CROET). No exterior laydown, parking, or soil areas are associated with this footprint. The K-1330 building has been primarily used for office space for different groups and has two floors (7200 ft^2 on each of the 1st and 2nd floors for a total of 14,400 ft^2). The building exterior is red clay brick, the interior is cinderblock with drywall covering it, and the facility is primarily carpeted throughout. See Fig. 1 in this appendix for the survey area.

2. HISTORY OF THE AREA

The area where the K-1330 Environmental Restoration Offices are located was farmland prior to the construction of the Oak Ridge Gaseous Diffusion Plant (ORGDP), later known as the K-25 Site, in the early 1940s. During the construction of the ORGDP, the area was an undeveloped field and remained as such until Bldg. K-1330 was constructed, in 1990, as the Environmental Restoration Offices. Environmental Restoration moved from the building in the 1990s, and it has since been occupied by other organizations, such as Human Resources and Public Relations. The building has always been outside the control fence of the plant.

Radiological contamination, if present, is expected to be a small percentage of the applicable U. S. Department of Energy (DOE) surface contamination limits due to the results of the prior surveys performed in the area discussed below, but mainly due to the historical usage of the facility. In general, no contamination was found within the area that exceeded the DOE limits.

3. EXISTING SURVEY DATA SUMMARY

A search of the Bechtel Jacobs Company LLC (BJC) Radiation Control (RADCON) electronic survey data collected since 1996 revealed that three surveys were performed in, or near, the building. A review of these surveys provided some information for the survey classification of the individual survey units; however, the majority of the input to the survey unit classifications is from the building's historical use.

Two equipment surveys were conducted in October and December 1997 of pneumatic piston vibrators and a pallet of material. No elevated activity above background levels was detected for the direct and removable contamination readings.

4. DATA QUALITY OBJECTIVES/PURPOSE

The purpose of this survey plan is to obtain radiological survey data to determine the presence of residual contamination in the area. The data gathered will be used to make a decision regarding the release of the K-1330 building and contents to CROET.

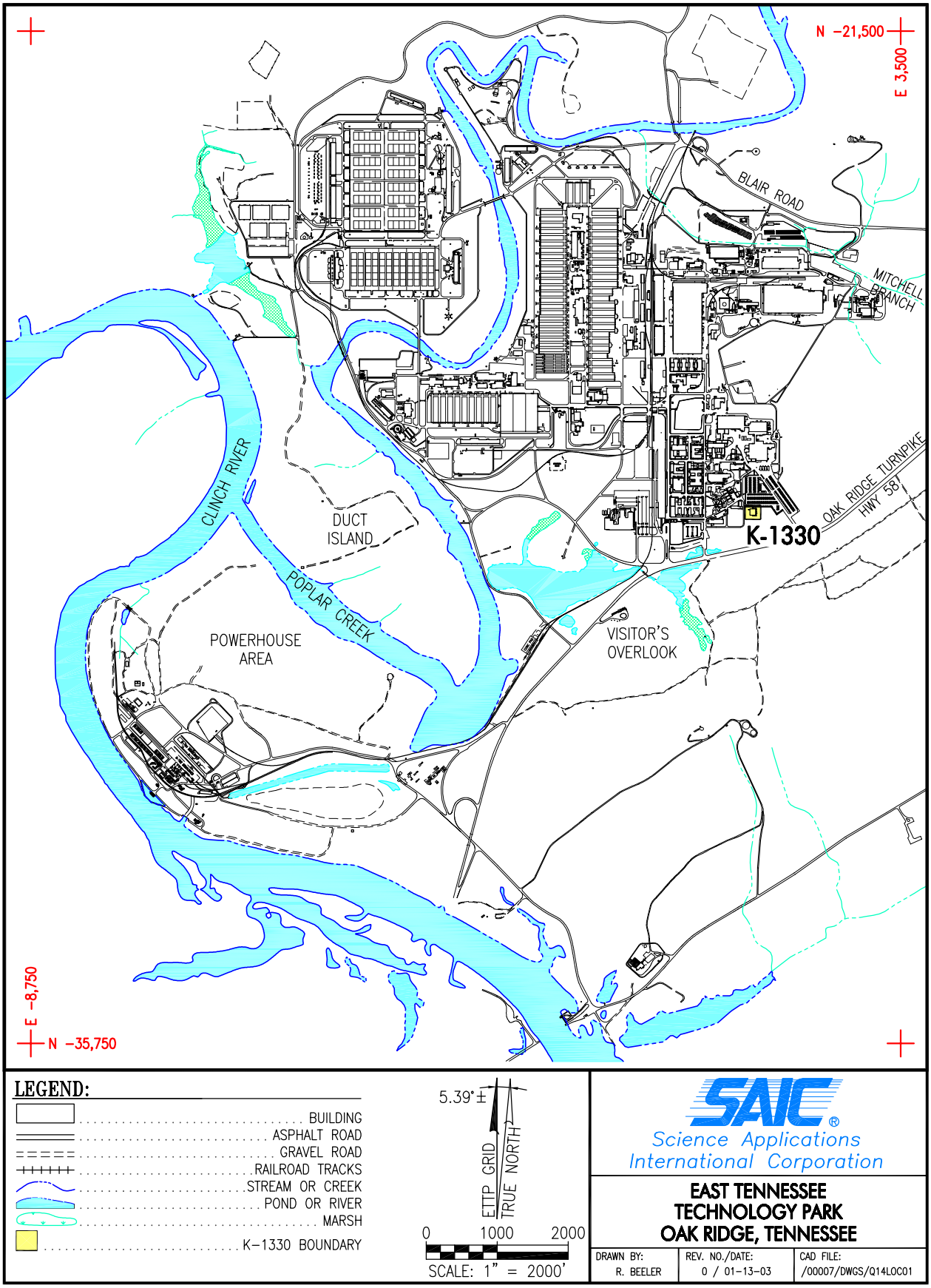

Fig. 1. K-1330 survey area.

5. MEASUREMENT TECHNIQUES/SURVEY APPROACH

5.1 RADIONUCLIDES OF CONCERN

Process history of the East Tennessee Technology Park (ETTP) site indicates that uranium (natural, depleted, and/or enriched uranium) would be the most prominent radiological contaminant potentially present in the K-1330 building due to tracking of contamination from other on-site buildings. Uranium-235 enrichment levels expected from operations since the early 1960s would be anticipated to be between 0.2 to 5.0%. Most facilities would be potentially contaminated via tracking from enrichments of less than 3%.[16] However, as this has been an administrative building throughout its history, it is assumed that the uranium would be from natural sources and the enrichment is approximately that of natural uranium, 0.72%.

Other radionuclides (^{60}Co, ^{137}Cs, $^{89/90}$Sr, ^{237}Np, ^{99}Tc, and $^{238/239/240}$Pu) have also been detected on-site at ETTP. These other radionuclides originated from the introduction of contaminated materials from Oak Ridge National Laboratory and/or from the Hanford and Savannah River reactor returns uranium reprocessing program; however, these radionuclides are expected to be found in much lower quantities than uranium and undetectable in this area, based upon its operational history as an administrative facility. If they were present, it is assumed that they would be present at ratios of 1140:1 for uranium to transuranic (U:TRU) and 350:1 for uranium to technetium-99 (U:^{99}Tc)[17] [both ratios are process buildings weighted averages].[18]

5.2 DETERMINATION OF THE RESIDUAL RADIOACTIVITY LIMITS

The overall goal of this survey is to show that residual contamination exceeding the release criteria is not present in each of the survey units. As shown by modeling, the dose and risk obtained from exposure to radioactivity at the DOE surface contamination limits, as set forth in Title 10 *Code of Federal Regulations* (*CFR*) 835[19] and also in DOE Order 5400.5,[20] is less than that from the dose and risk criteria, as explained in the Design of Radiological Surveys document[21] (hereafter referred to as the "design document"; also see Appendix A). As a result of this modeling, the derived concentration guideline levels (DCGLs) for this survey will be set at the DOE contamination limits for uranium (see Table 1 in this appendix), which is the dominant contaminant present on-site. A separate limit for the maximum allowable contamination that is concentrated in a smaller area, the derived concentration guideline level$_{\text{elevated measurement comparison}}$ ($DCGL_{EMC}$), is normally calculated based upon modeling the dose obtained from an area determined by the number of samples taken in the survey unit and the spacing between them. However,

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[16]Contracted Health Physics Technician Training handouts, K-25, 1993.

[17]The average transuranic (TRU) composite for ETTP is 47% ^{237}Np, 10% ^{238}Pu, 20% $^{239/240}$Pu, and 23% ^{241}Am. The uranium to TRU (U:TRU) ratio ranged from 43.2:1 to 62,500:1 for ETTP, with the vast majority > 50:1. A ratio of 50:1 indicates that uranium radiological protective measures for surface contamination would be sufficient for the TRU content. The uranium to technetium (U:Tc) ratios for ETTP range from 0.00258:1 to 1640:1, with the ratios less than 1:1 coming from the posted Tc areas within the process and main support buildings (K-25 East, K-27, K-29, K-31, K-1231, and K-1420). With a ratio greater than or equal to 1:1, the implication is that the uranium radiological protective measures would be sufficient for the Tc content.

[18]*Isotopic Distribution of Contamination Found at the U. S. Department of Energy Gaseous Diffusion Plants*, Science Applications International Corporation (SAIC) report delivered to Bechtel-Jacobs, SAIC document number 143.19991103.002, October 1999.

[19]*CFR* 1999. 10 *Code of Federal Regulations*, entitled *Occupational Radiation Protection*; the values are taken from Appendix D, "Surface Radioactivity Values."

[20]DOE Order 5400.5 is entitled *Radiation Protection of the Public and the Environment*; the values are taken from Fig. IV-1, "Surface Contamination Guidelines."

[21]BJC 2000. *Design of Radiological Surveys of Potential Lease Space at East Tennessee Technology Park, Oak Ridge, Tennessee*, BJC/OR-554, Bechtel Jacobs Company LLC, Oak Ridge, TN, March.

the $DCGL_{EMC}$ will be set to three times the appropriate contamination limit, which equates to the contamination averaging criteria as set forth by DOE in 5400.5 for an elevated reading within a 1 m^2 maximum size area.

Table 1. Contamination limits (DCGLs) for all survey units

	DCGL (dpm/100 cm^2)	$DCGL_{EMC}$ (dpm/area)
Total alpha	5000	15,000
Removable alpha	1000	N/A
Total beta-gamma	5000	15,000
Removable beta-gamma	1000	N/A

DCGL = derived concentration guideline level.
$DCGL_{EMC}$ = derived concentration guideline $level_{elevated\ measurement\ comparison}$
N/A = not applicable.

If activity is detected at levels exceeding 80% of the DCGL (i.e., 4000 dpm/100 cm^2), but less than 100%, the data will be reviewed and approved by the RADCON site project Health Physicist prior to release of the material(s)/area(s).

5.3 IDENTIFICATION OF SURVEY UNITS AND CLASSIFICATIONS

Areas are classified as either Class 3, 2, or 1 based upon historical data and process knowledge.

Survey units must be of the same or similar material type—that is, a survey unit cannot contain both asphalt and soil, for example. It would be divided into a survey unit of asphalt and another survey unit of soil. Refer to the design document for complete descriptions of the different classifications of survey units. In general, a Class 3 survey unit is not expected to have residual radioactivity levels above 25% of the DCGL prior to any historical remediation (1250 dpm/100 cm^2 total activity or 250 dpm/100 cm^2 removable activity). A Class 2 survey unit is expected to have residual radioactivity levels less than the DCGL prior to any historical remediation. A Class 1 survey unit is expected to have residual radioactivity levels above the DCGL prior to any historical remediation. Based upon the historical usage and process knowledge for the facility, all areas are initially classified as Class 3 areas. The K-1330 building will be composed of a total of 23 Class 3 survey units, as shown in Table 2 in this appendix. See Figs. 2 and 3 in this appendix for the locations of the 1st and 2nd floor interior survey units (ISUs) and Fig. 4 in this appendix for the exterior survey units (ESUs).

5.4 INSTRUMENTATION SELECTION AND SURVEY TECHNIQUES

Refer to the design document appendix for details on instrumentation selection. In general, alpha scintillation and beta-gamma Geiger-Müeller (GM) detectors used for static measurements will be attached to scalar rate meters and will have minimum detectable activities less than 25% of the DCGL. Gas-proportional floor monitors or floor monitors with the probe detached from the monitor cart for usage as a hand-held probe, calibrated and operated to detect both alpha and beta-gamma radiations, will be used for as much of the scan surveys as possible, including the primary work surfaces, walls, and ceilings. Sodium iodide (NaI) meters and Bicron MicroRem® meters[22] will also be used, as specified in this survey plan. Removable contamination surveys (i.e., smear surveys) will be conducted at all locations where a

[22]Reference herein to any specific commercial product, process or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof.

fixed/total measurement is taken. All removable contamination survey smears will be counted on a gas-proportional counter, or equivalent, calibrated to detect both alpha and beta-gamma radiations.

Table 2. Survey units classification

Area	Class	
	Interior areas	Exterior areas
K-1330, 1st floor, northeast corner (ISU 1)	Class 3	N/A
K-1330, 1st floor, southeast corner (ISU 2)	Class 3	N/A
K-1330, 1st floor, east open office space (ISU 3)	Class 3	N/A
K-1330, 1st floor, restrooms (ISU 4)	Class 3	N/A
K-1330, stairwell from 1st to 2nd floor (ISU 5)	Class 3	N/A
K-1330, 1st floor, corridor from south entrance to northern office area (ISU 6)	Class 3	N/A
K-1330, 1st floor, maintenance/mechanical/elevator rooms (ISU 7)	Class 3	N/A
K-1330, 1st floor, southwest corner (ISU 8)	Class 3	N/A
K-1330, 1st floor, northwest corner (ISU 9)	Class 3	N/A
K-1330, 2nd floor, northeast corner (ISU 10)	Class 3	N/A
K-1330, 2nd floor, southeast corner (ISU 11)	Class 3	N/A
K-1330, 2nd floor, east open office space and conference room (ISU 12)	Class 3	N/A
K-1330, 2nd floor, maintenance/storage/copier/elevator rooms (ISU 13)	Class 3	N/A
K-1330, 2nd floor, restrooms (ISU 14)	Class 3	N/A
K-1330, 2nd floor, corridor form south to main entrance (ISU 15)	Class 3	N/A
K-1330, 2nd floor, southwest corner (ISU 16)	Class 3	N/A
K-1330, 2nd floor, northwest corner (ISU 17)	Class 3	N/A
K-1330 building exterior walls (entire wall) [ESUs 1 through 4]	N/A	Class 3
K-1330 building sidewalk (entire walk) [ESU 5]	N/A	Class 3
K-1330 covered bench on eastern side (ESU 6 – not pictured)	N/A	Class 3
K-1330 building electrical equipment cabinets (eastern and western sides of building) [ESU 7 – not pictured]	N/A	Class 3
K-1330 building roof (ESU 8 – not pictured)	N/A	Class 3

ESU = exterior survey area.
ISU = interior survey area.
N/A = not applicable.

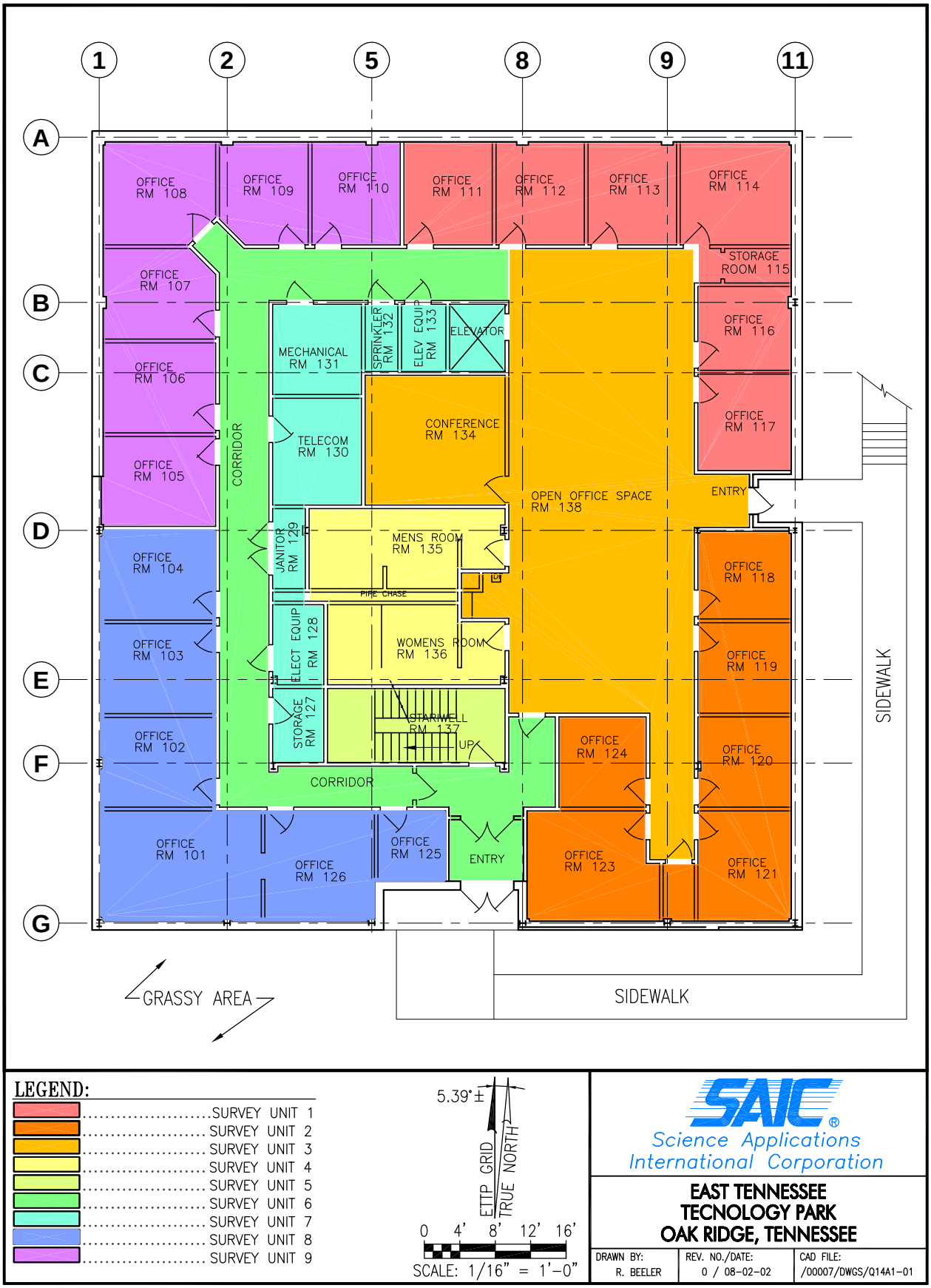

Fig. 2. K-1330 first floor survey units.

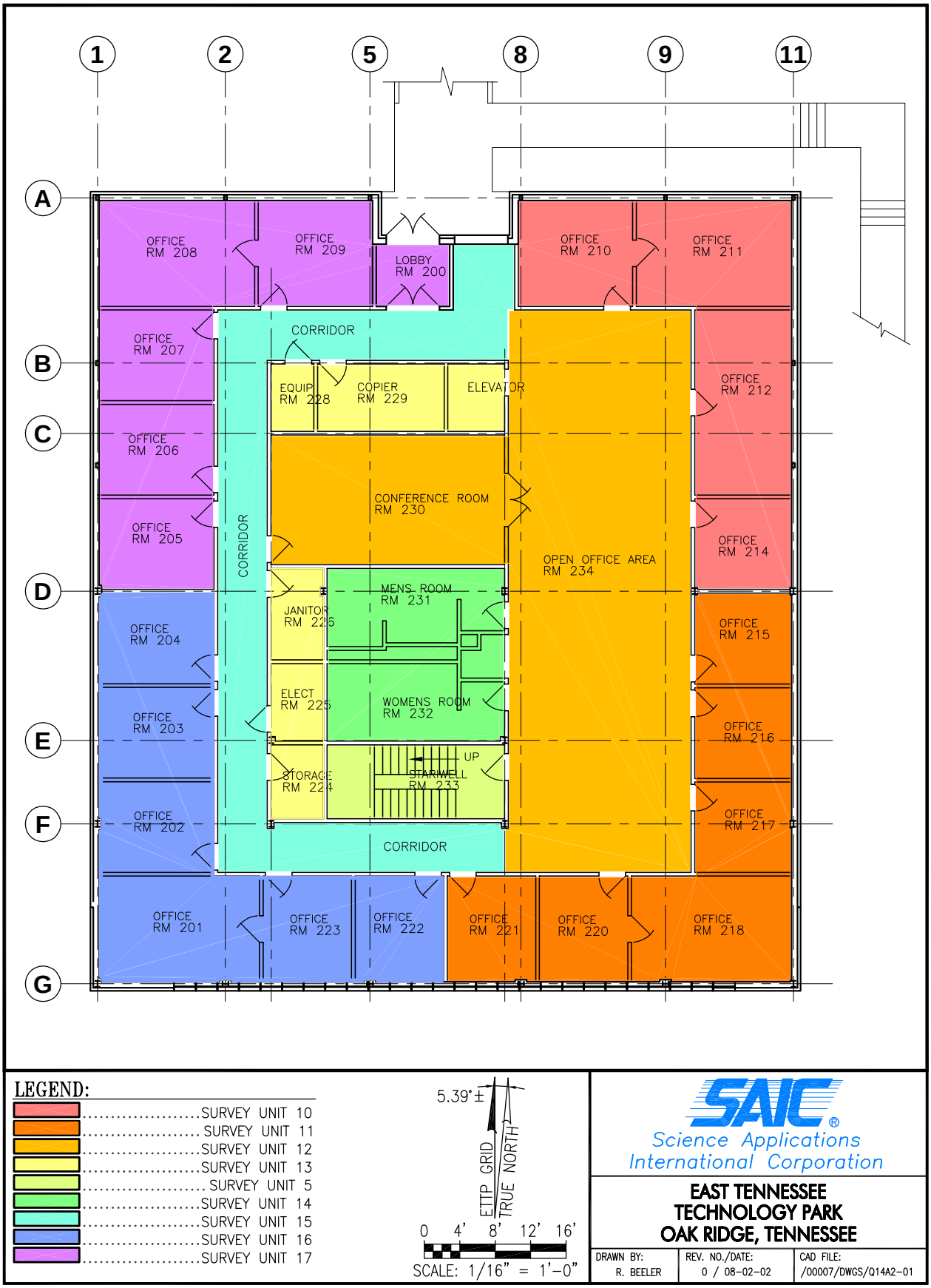

Fig. 3. K-1330 second floor survey units.

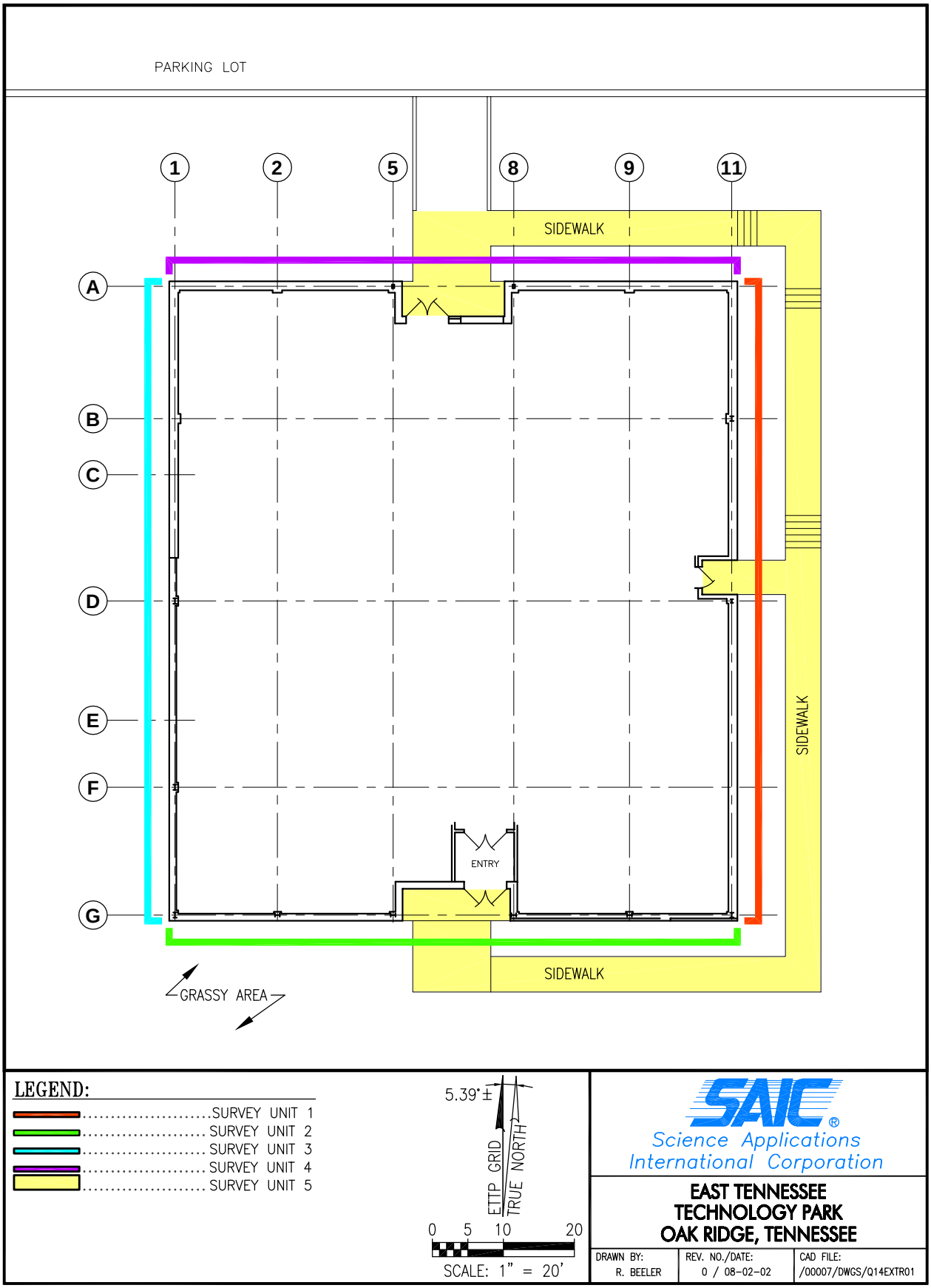

Fig. 4. K-1330 exterior survey units.

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